A BILINGUAL/L2 HYBRID INTERVENTION MODEL: COMBINING HUMAN AND MACHINE INTELLIGENCES

BY

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DISSERTATION

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ABSTRACT

Most Taiwanese English language learners have been exposed to traditional approaches to acquiring English as a second or foreign language. Studies demonstrate current/traditional teaching practices are not the most effective for struggling English language learners, and the rate of improvement has been limited. Therefore, this study explores current hybrid environments that integrate a combination of advanced computer-assisted technologies that are operated with artificial intelligence technologies to deliver more effective English language teaching, as well as using translanguaging, a current bilingual teaching method, to support the language acquisition process.

To push English language teaching and learning to a more effective and efficient level, artificial intelligence-powered tools providing interventional support have been identified as the integral technological innovations to be leveraged with other tools (reading platforms, formative platforms, on-screen share tools, etc.). Specifically, the use of machine translation tools operating with artificial intelligence technologies have been identified in the literature as a vital computer-assisted tool in supporting learners with their English or second language development via translingualism. However, due to the limitations of artificial intelligence in which causality is lacking, machine translation tools operated on artificial intelligence continue to make errors in translation. Therefore, human intervention is needed in facilitating the teaching and learning process by leveraging other intelligent computer-assisted tools, namely writing assistant software and voice recognition/evaluation software, to make the intervention model more effective in the overall language learning process.

Hence, combining machine and human intelligences in deploying machine translation tools, as well as other artificial intelligence-operated tools, serves as an integral approach to
addressing learning progression limitations and moving the teaching and learning process into a more innovative hybrid zone based on extending the transtheoretical model for hybrid learning in assisting struggling English language learners. This research will explore how humans can interact with machines by training image-bilingual text translation models via Google's Teachable Machine, as well as utilizing other artificial intelligence-powered tools, namely a writing assistant and a voice recognition or evaluation software, to fill the gaps in current literature regarding integrating intelligent computer-assisted tools for English language learning amongst struggling nonnative English speakers in a hybrid learning environment.
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CHAPTER 1: INTRODUCTION

The topic of improving English language learning support in the K-12 setting has been widely studied. This review explores issues related to learning English as a second or foreign language in the Taiwanese international school teaching setting. Prior studies have demonstrated different instructional designs of blended teaching and learning in an effort to improve bilingual proficiency and/or learning English as a second or foreign language. Hence, this literature review focuses on the theories, debates, and evidence related to hybrid pedagogy as a form of blended learning, the current advantages and disadvantages of hybrid learning with the integration of online technologies to establish a mixed-mode learning environment, and the benefits and limitations of hybrid pedagogy in English language teaching and learning. Furthermore, this literature delves specifically into machine translation with human intervention as a starter artificial intelligence tool to activate the translingual space of training learners’ minds to use their first language to support their second language in hybrid learning contexts. Studies about automated writing assistants and voice recognition software programmed with similar artificial intelligence algorithms as machine translators are included to discover further advancements and effects in language instruction with these powerful tools that may revolutionize the arena of language pedagogy.

This review aims to discover both the strengths and the shortcomings of hybrid language learning contexts, specifically in the context of bilingual learning, English as a second or foreign language, and other foreign language learning.

Background of Study

Taiwanese English language learners in the international K-12 academic setting may face delayed improvement in their English language learning. Most learners acquire English as a
second language. This issue stems from the reliance on traditional, didactic instruction rather than the authentic and/or transformative pedagogies that account for 21st century new learning affordances. Traditional, didactic pedagogy is confined to the boundaries of the classroom walls, and instruction is mainly teacher-centered, rote learning-based and test-based, while authentic and/or transformative pedagogies inherit student-centered, active learning, knowledge-creating qualities. These move beyond the boundaries of the traditional classroom (Kalantzis & Cope, 2012). Kung (2017) discusses the issues of Taiwanese students accustomed to the mindset of teacher-fronted traditional classrooms and modesty. Both factors lead to reticence due to fear of losing face when raising questions in class. Unlike western societies that are shifting away from teacher-centered classrooms, most students in Asia are still immersed in the traditional teacher-centered approaches, which Ho (2007) defines as the “meaningless [(Initiate-Response-Feedback)] pattern of talk” (p. 19). Many Asian students have grown accustomed to teachers initiating classroom instructions, becoming passive learners with this teaching approach. These Chinese cultural variables, which are also relevant to the Taiwanese setting, have adversely influenced English language acquisition pedagogy, resulting in reduced learning motivation because of low standardized test results. Moreover, Su (2018) posits that English as a second or foreign language programs in international schools do little to bolster students’ English language learning skills. Kung (2017) emphasizes the need for teachers to increase students’ communicative competence by being aware of cultural factors, namely learners’ reticence and face-saving concerns, and to develop creative curricular modifications to boost students’ motivation to learn a second language. Wu (2011) also argues the importance of shifting from achieving high grades to focusing on the teaching of using English in daily communication by increasing the use of interactive technologies to motivate students to learn English naturally in a
stress-free environment. Furthermore, Chou (2019), in a study that examined remedial English instruction via internet-assisted multimedia, asserts the effectiveness of supporting the learning motivation of struggling learners using computer-assisted technologies but also presents pedagogical limitations in the areas of effective implementation of online resources, clear teacher instructions for home usage of online resources and tools, and lack of interaction in the classroom. This brings attention to the need for developing remedial programs with instructional interventions tailored for struggling learners to close the learning gap between low and high achievers (Chen, 2007; Chou, 2019). These issues have inspired research that investigates whether an improved mode of hybrid teaching and learning that focuses on the bilingual method of translation and translanguaging and other English language learning strategies with the integration of appropriate technologies in English language learning contexts is a solution.

**Problem Statement**

Designing an optimal hybrid mode for deploying bilingual or English language learning methods effectively and efficiently to assist struggling Taiwanese English language learners is a challenge. These learners’ cultural background and traditional learning habits, as discussed earlier, are potential hindrances to their effective engagement in a hybrid learning environment that induces more active, communicative, and independent learning. Adding to this dilemma is the availability of a wide range of hybrid approaches to appropriately structure instructional design for a given context (Ducate, Lomika, & Lord, 2012; Horn, 2012). The body of research presented in the literature review allows for the need to critically reflect on how to better assess learners’ progress with the possibility of tactful usage of technologies that may allow both teachers and students to engage in more meaningful and precise evaluation of English language learning.
Whether related to English teaching or not, the main issue mostly pertains to designing instructional methods that work seamlessly between online and offline channels of teaching and learning, both inside the classroom and outside of the classroom. Effective instructor facilitation of the online component is another area that needs improvement. Therefore, this literature attempts to specifically identify and investigate the effects of revolutionary online translation tools, programmed with machine and deep learning algorithms, as a primary catalyst in activating improved translation/translanguaging pedagogy implemented in hybrid zones of English as a second or foreign language teaching and learning.

In recent years, technological advancements in translation tools have brought new light to using translation and translanguaging to teach and learn English as a second language or foreign language more effectively. In the past, translation has not been a popular method for teaching English as a second or foreign language, as it may hinder the language learning process (Zhou & Zou, 2017; Priya & Jayasridevi, 2018). Often, English language learners encounter difficulties when translating from one language to another without proper support. However, Zhou and Zou (2017) claim that identifying the problems and training teachers to instruct learners to improve their translation competence in English language learning is a way to transform it into an effective approach. The authors further indicate that using digital tools in appropriate ways makes translation more meaningful and instructive but do not state exact methods of implementation. More recently, the translation method has been garnering more interest amongst English as a second language practitioners (Priya & Jayasridevi, 2018; Shipman, 2019). High-speed online or mobile app translation tools have become so prevalent that language teachers are beginning to utilize them in practical and more effective ways of teaching and learning (“How Will Machine Translators,” 2016). However, as machine-generated translations
are still imperfect, there is room to investigate more possibilities in advancing new methods and systems for better translation method practices in English language teaching and learning via hybrid instructional designs.

Furthermore, as machine translation software alone will not fully deliver the effects of a bilingual or English language learning hybrid mode of teaching and learning, other combinations of intelligent digital tools will be added in this study as leverage to extend the effects of translanguaging and other second language teaching strategies.

**Rationale of Study**

The current research aims to investigate the pedagogical implications of hybrid learning and teaching to identify the existing challenges in hybrid pedagogy and address the importance of advancing this area of study in this bilingual and English as a second language domain. The research aims are as follows:

- To investigate the various modes of hybrid teaching and learning in different language and non-language learning contexts
- To examine the benefits and challenges of hybrid teaching and learning
- To identify the technologies used in a hybrid learning environment
- To identify the effects of hybrid learning in English language learning
- To examine the theories associated with hybrid learning in the following context: bilingual learning as a support to develop English as a second language
- To define the artificial intelligence, machine learning, and deep learning used in neural machine translation
- To identify pathways between artificial intelligence machine/deep learning and hybrid bilingual and English as a second or foreign language learning contexts
• To identify, examine, and evaluate the effects of bilingual/English as a second language hybrid models that deploy neural machine translation in translation/translanguaging pedagogy

• To identify the benefits and limitations of deploying neural machine translation in translation/translanguaging in hybrid bilingual and English as a second language contexts

• To hypothesize innovative zones of machine learning in translation/translanguaging pedagogy via hybrid language learning environments

• To identify the benefits of adding other intelligent tools, such as an automated writing assistant and a speech evaluation tool, in this learning environment

Theoretical Framework

• To extend the transtheoretical model for hybrid learning that encapsulates traditional learning theories, the affordance theory, and bilingual and second language teaching strategies via a combination of technologies with artificial intelligence-powered machine translation tools at its core to activate a more expanded space for translingualism

• To further support the transtheoretical model with other artificial intelligence-powered tools in addressing shortcomings of machine translation tools

Overview of Methodology—an explanatory sequential mixed methods design

• Quantitative methods - a causal-comparative design to test the effectiveness of the bilingual or second language learning hybrid intervention model; a computation method to measure students' translinguaging learning processes (output - writing and speaking) at a more granular level

• Qualitative methods – documentation of teacher and student perceptions about the implementation of the hybrid mode
Research Questions and Hypotheses

Research questions

What bilingual and English as a second language hybrid intervention model that integrates a combination of artificial intelligence technologies with machine translation as the integral starter tool, and other computer assistive tools lead to improved English language performances among struggling English language learners?

What is the rate and quality of improvement of struggling English language learners who received instruction via the bilingual and English as a second language hybrid intervention model compared to those who received traditional instruction?

What are teachers' and students' perceptions about teaching and learning via the implementation of a bilingual and English as a second language hybrid intervention model?

Hypotheses

The research questions are answered using an explanatory sequential research design.

Though there are no perfect intervention models for a given context, a set of digital instructional designs can be written to pinpoint a particular hybrid landscape for English language learners to navigate and acquire the information more efficiently and effectively. In this hybrid landscape for English language learning, struggling learners are expected to improve at a greater rate and quality compared to a traditional learning environment, as both human instructors and a combination of intelligent digital tools are deployed. As this intervention model immerses both teachers and struggling English language learners in a highly digital learning environment with numerous deployments of basic to advanced computer tools, the perceptions from both teachers and students may yield positive and negative reactions due to its complexity in design.
CHAPTER 2: LITERATURE REVIEW

Traditional Hybrid Learning Landscapes for Bilingual and English as a Second Language Pedagogy and Related Theories/Concepts

Hybrid Learning Defined, Its Components, Benefits, Best Practices, and Challenges

Hybrid learning is a form of blended learning integrating the best of online learning and the ingredients of traditional classroom learning (Garnham & Kaleta, 2002; Christensen, Horn, & Staker, 2013; Ducate et al., 2012; Linder, 2017). Christensen et al. (2013) identify various types of blended learning models, both hybrid and nonhybrid: the Rotation model (3 hybrid variations—station rotation, lab rotation, and flipped classroom) and four nonhybrid models—the Individual Rotation model, the Flex model, the A La Carte model, and the Enriched Virtual model (See Figure 2.1). Generally, hybrid models combine traditional classroom instruction and new technologies for online learning. For the purpose of this study, the focus will be placed on hybrid learning in which learners are involved in a switch between different offline and online learning modalities based on a teaching schedule or at the teacher’s discretion. Offline instruction may include classroom-directed teaching, pair/group work/projects, one-to-one tutoring, and even traditional paper-and-pencil activities. Online work may include in-class or outside-of-class activities supported with various computer-assisted tools. Moreover, Ducate et al. (2012) further define hybrid learning, with respect to language learning, as “a learning space where instruction takes place in a traditional classroom setting and is enhanced or supplemented—sometimes even replaced—by computer-based or online activities” (p. 68).
Christensen et al. (2013) present four features for identifying a hybrid learning environment. First, it promotes a sustainable learning environment that bridges old technologies implemented in a traditional classroom with newer, disruptive technologies such as online learning to create alternative solutions that integrate the best of both worlds. Second, it targets individuals who need new forms of learning. Third, it strives to execute the job of existing technologies as well as integrate more powerful and newer features to make learning more seamless. Last, hybrid learning is modest in a sense as it retains crucial traditional instructional methods and material design, making its operation more feasible than a fully online learning model.

Linder (2017) further discusses the benefits offered in a hybrid learning environment. Differentiated instruction offered through customization of resources based on students’ learning needs and interests, collaborative learning in both online and offline spaces, and the flexibility of self-paced learning are some of the advantages of designing and implementing a hybrid course.
Furthermore, Linder (2017) asserts the need for teachers to engage in best practices for hybrid learning to generate the best possible learning outcomes. Transforming the learning environment from a teacher-centered to a learner-centered focus and instilling student autonomy in their studies are important features of hybrid learning. Establishing a connection between online and offline activities is vital as well. Also, every piece of technology used must be purposeful to the course design. Both teachers and students must be well-trained to use these tools to produce the best technology-mediated pedagogical results. Last, Linder (2017) mentions the changing roles of teachers and students in which teachers become facilitators while students learn to take a more active role as learners by assuming more responsibility for their own learning in a hybrid learning environment.

Oliver and Stallings (2014) also highlight three features—context, instruction, and technology—that teachers must have in order to deliver a successful blended learning environment that supports learners on a more personalized level. Context refers to the learners, the content, and the learning environment. Instruction refers to the skill of intentionally redesigning instruction and learning that is more student-centered. Last, technology is a key vehicle in blended learning which calls for equipping oneself with new technology skills to support the pedagogical needs of today’s learners.

The main challenges are designing a blended environment using effective technologies to promote positive learning results and the issues teachers may encounter. These may include the use of technology in teaching and facilitating students’ collaboration, self-autonomy, learning engagement both in the classroom and outside of the classroom, ability to accomplish learning goals and objectives, time management skills in completing assignments punctually, and tailoring instruction to fit different learner needs (Albiladi & Alshareef, 2019; Oliver & Stallings,
Teachers also need to be aware of careful alignment and making explicit the relation between online and offline coursework (Linder, 2017). Based on Albiladi et al.’s (2019) and Linder’s (2017) claims, it can be argued that improving hybrid teaching and learning requires careful planning and structured organization of a hybrid course design as students may not initially have the academic skills and independent skills to move into a student-centered learning environment. To further support this notion, Arispe and Blake (2012), in their hybrid second language learning study, conclude online learning may not work for every type of language learner and will require a great amount of learner conscientiousness to perform well via carefully planned instructions for classroom activities, online collaborative chat meetings with the teacher as a mediator, and independent online work. McNeil (2016) also claims that today’s teachers, who were not hybrid or online language learners themselves, may not be prepared to teach effectively using advanced educational technologies. Hybrid pedagogy is further challenged by Kenney and Newcombe (2011), who discuss the instructional design obstacles encountered in a pilot study conducted with features of a hybrid learning environment. These include the time needed to transform a course to a hybrid format, the time for teacher and student training in both technologies and the pedagogical methods used, redesigning instructional units to fit different learning groups, and the increased time needed to facilitate the online portion of a hybrid learning format. Though challenges persist, Watson (2008) highlights that the blended approach of hybrid learning, which “combines the best elements of online and face-to-face learning...is likely to emerge as the predominant model of the future...” (p. 3). Christensen et al. (2013) contend that since online learning is not in full consumption in the K-12 setting, as the majority have access to government-funded schools, establishing hybrid learning may possibly be a better alternative to online learning. This notion is further supported by Horn’s
(2010) discussion about the rapid growth and funding invested in hybrid learning. Nevertheless, identifying, understanding, and re-evaluating the benefits and limitations of a hybrid language learning environment is vital to improving this learning model's effective and efficient implementation.

**Figure 2.2**

*Benefits and Challenges of Hybrid Learning*

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Differentiated instruction</td>
<td>• Curriculum and instruction with the integration of relevant technologies</td>
</tr>
<tr>
<td>Collaborative learning</td>
<td>• Teachers’ need to develop more knowledge in using a variety of technologies as pedagogical tools</td>
</tr>
<tr>
<td>• Self-paced learning</td>
<td>• Clear alignment of online and offline work</td>
</tr>
<tr>
<td>• Student-centered learning</td>
<td></td>
</tr>
<tr>
<td>• Teachers as facilitators</td>
<td></td>
</tr>
<tr>
<td>• Students as active learners</td>
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In sum, as the popularity of hybrid learning models continues to grow with the increased availability of new technologies, further examining the overall benefits and challenges for improved implementation is needed, as delineated in Figure 2.2. Though the review on hybrid learning, in general, identifies salient benefits of preparing young learners to become more independent and active learners via channels of differentiated instruction, collaborative learning, self-paced learning, student-centered learning, and facilitative instruction, the challenges presented here call for a new approach to curriculum and instructional design in any discipline, not only language learning.

**Online Technologies Used in Various Hybrid Learning Studies (English Language Learning Related and Non-related)**

Online technologies include learning management systems, computer-assisted tools, mobile app learning, and, more recently, robot-mediated communication devices. Prior studies
have revealed the positive effects and shortcomings of utilizing online technologies to mediate hybrid learning environments. This section will examine the orchestration of such technologies to determine their viability for teaching and learning in a landscape that delivers the best of both worlds.

**Learning Management Systems**

Various studies have examined the learning effects of using learning management systems in hybrid language learning. Davies (2019) presents the online e-portfolio learning management system Moxtra as a mobile technology tool used in a blended learning environment that involves a hybrid mode of mixing traditional classroom teaching and online learning in a Japanese university-level English as a foreign language class. Moxtra offers social networking features as well as functions for uploading, sharing, annotating, recording voice threads, creating audio posts, and initiating video chats. Findings indicate that this hybrid learning approach of using Moxtra offers a user-friendly digital learning space for social networking as well as improved teacher-student interaction and student organization and management of their assessments. The system also keeps a record of grades and digital feedback for students to access anytime. However, since most collaborative activities are completed in class, there has been no significant improvement in utilizing the tool to establish peer-to-peer relationships. Davies (2019) concludes that Moxtra’s communicative features are not utilized effectively as an online learning affordance to improve student-to-student interaction. Therefore, the study addresses the need to maximize the learning affordances in both classroom and online learning environments to execute the best of both worlds in hybrid learning. BookWidgets is another learning management system implemented in a hybrid blended language learning environment (Menon, 2019). Through analyzing and reviewing the strengths of the apps, particularly test and review functions
(e.g., quizzes and flashcards), game-design features, and planner/evaluation (e.g., planners, surveys, and forms), programmed within BookWidgets, Menon (2019) justifies the effectiveness of using BookWidgets for interactive learning and confirms the importance of today’s teachers to acquire the basic skills in designing instructional material that are technology-enhanced. Solihati and Mulyono (2017), who identify a disconnection between face-to-face classroom instruction and the online component of hybrid language learning, also support the ongoing need to understand the pedagogy behind hybrid learning using Google Classroom as the core management system. Hence, the use of this tool has created new learning modes that aim to embrace the best of both worlds for language learning, but there is still a need to explore further effective teaching and learning methods in this learning environment.

**A Combination of Technologies**

Several studies also examine hybrid learning via a combination of technologies. Foomani and Hedayati (2016) investigate the use of mobile and computer devices (mobile/computer-assisted language learning) to teach idioms to a class of 24 Iranian learners in an English as a foreign language environment that mixes non-virtual and virtual spaces in a seamless learning design subdivided into four different phases of teaching and learning. Non-virtual spaces include classroom teaching of idioms and final group presentations of photo artifacts. Virtual spaces include online collaborative learning in sharing and discussing student-created photo artifacts that reflect students’ understanding of idioms with teacher facilitation. Descriptive statistics were used to categorize the photo artifacts into different genres to understand students’ thinking processes better. Student and teacher interviews were also conducted to understand their perceptions of this learning context. Results indicated a strong interest in this learning environment which offers the building of learner autonomy. For instance, students’ motivation
increased in a collaborative environment that offers the affordances of commenting on/reviewing and peer-assessing each other’s works. Similar to the challenges in a hybrid learning environment that utilizes a learning management system, Foomani and Hedayati (2016) also discovered challenges that include the need for more teacher facilitation to monitor the appropriateness of online comments and training students in the photo artifact creation process and engaging them in more meaningful peer assessment. An additional study presents the same issue is Hosseinpour, Biria, and Rezvani’s (2019) research on using Edmodo, a mobile app, to facilitate collaborative writing in an English as a foreign language setting. This quasi-experimental mixed-methods study, using one class assigned as the experimental group and the other as the control group, examined whether students learned better in a hybrid blended environment or a traditional classroom setting. Both classes received offline instruction in writing and took pre- and post-writing tests to analyze the effects of using Edmodo for collaborative writing. Although quantitative results indicate positive student learning outcomes in all writing components, Hosseinpour et al. (2019) contend that there is still a need for more strategic designing of the online portion of the hybrid blended models, especially in promoting more student-student and teacher-student interactions. In a similar study that employs both computers and mobile devices in an English for Specific Purpose college accounting course, Hoven and Palalas (2011) propose a hybrid learning model subdivided into three parts: in-class, online, and mobile-assisted activities. The in-class learning space offered mostly interactive oral language practice. The online component was divided into computer-based WebCT platform reading and writing activities and mobile learning-based listening activities (e.g., audio/video podcasts and blogging). The learning design included both mandatory and optional assignments, which gives flexibility for students to decide on more practice of their own choice. The authors
discovered that most students found the affordance of using mobile devices to access listening material anytime and anywhere convenient; however, the cost of the device and experiencing technical difficulties, such as wireless connectivity and typing on small screens, were identified as physical barriers. From a teaching and learning perspective, they also identify the issue of students needing guidance on how to access the material for the online portion. The mobile activities also lack interaction features and require more transparent facilitation of peer-to-peer and/or teacher-student interaction in a relevant learning context. In another hybrid study that combines the use of the Blackboard learning system, instructor-created websites, and video conferencing, learners at the university level who studied under the hybrid format, partly online and partly face-to-face, recognized the flexibility of completing some work online but found spending extra time figuring out questions on their own through emails and discussion boards when immediate feedback was not available inconvenient. Likewise, Senn (2008) also contends the need for instructors to spend more time and effort to provide instructional support online than in traditional face-to-face settings. Hence, this study also suggests a gap in limited student and teacher interactions. Also echoing a similar limitation, Wichadee (2014) discovered satisfactory learning achievement in a university hybrid English language course, as well as moderate satisfaction learning with the hybrid course and comfort with the use of technology. Some appreciated the flexibility and convenience a hybrid learning environment offered, while others encountered difficulty or felt discomfort using the required digital tools. Nevertheless, students’ participation level seems to be the main concern in increasing their motivation to learn in both online and offline channels. Through examining these hybrid studies that integrate a combination of technologies, the different modalities offer more learning flexibility on the part of the learner. Still, they have not advanced hybrid learning to its full potential due to the difficulty of designing
instructional methods for teachers to seamlessly facilitate and balance the offline and online components.

**Robot-Mediated Communication Devices**

On the contrary, Gleason, and Greenhow (2017), in their hybrid learning model of using robot-mediated communication devices, claim improvement in student interaction, though with limitations. They identify a major gap in establishing “social presence” in the online synchronous part of hybrid learning in a university course that enrolls both online and on-campus students. Hence, they suggest using robot-mediated communication devices for off-campus students to remotely control their individual presence in class using social robotic telepresence systems (SRTS) to establish a more authentic and social interactive presence in class. That is, some students learning online will appear on screens mounted on an apparatus compared to other video conference technologies, such as Zoom, which projects multiple users simultaneously on one screen. Data collection using a survey, focus groups, and students’ written reflections revealed a stronger social connection with peers and instructors due to the affordance of mobility and co-location with their both on-campus and off-campus peers. However, challenges include the malfunctioning of the robots, poor audio quality, limitations in zoom-in/zoom-out functions, and the interruption of the teaching flow when adjusting the location of the robots. Another challenge is the question of the feasibility of using such technologies in all types of learning settings. Although this study may not be directly related to English as a second/foreign language learning, it offers insight into tackling the issue of “social presence” to allow students to feel more connected with each other in any learning context.
In sum, regardless of what types of online tools are used to facilitate a hybrid learning environment, there is a need to focus on better teacher execution and facilitation of a combination of online technologies to bring forth effective and efficient instruction. All the aforementioned hybrid learning studies suggest the need for more teacher facilitation in online activities, particularly in communication features (Davies, 2019; Foomani & Hedayati, 2016; Hosseinpour et al., 2019; Senn, 2008). Despite several studies indicating a similar gap, Suwantarathip’s (2019) quantitative study on predicting students’ satisfaction in a hybrid university English course, which was operated using three learning platforms with three instructional channels—face-to-face, online, and chat center, had students expressing satisfaction with the instructor mainly because the instructor offered support both online and offline. Another study that seems to reinforce the need for improvement in the area of teacher facilitation in a hybrid learning environment is Mohsen and Alshahrani’s (2019) study which confirmed better writing performance when students were engaged in a hybrid mode of receiving feedback from both the machine and the instructor.
Figure 2.3 is an overview of all the hybrid studies:

**Figure 2.3**

*An Overview of Hybrid Studies*

<table>
<thead>
<tr>
<th>Hybrid Studies</th>
<th>Combination of technologies used in hybrid study</th>
<th>Learning context, goals, limitations</th>
</tr>
</thead>
</table>
- Examined student and teacher perceptions  
- No analysis about language learning |
| Focmani and Hedeni (2016)       | - CALL, MALL  
- Mobile devices  
- App - Padlet                                                        | - Iranian intermediate EFL context/higher education  
- Student and teacher perceptions  
- No analysis about language learning |
| Hosseinpour, Biria, and Rezvani (2015) | Edmodo mobile application                                                                                         | - Iranian intermediate EFL context/higher education  
- Writing aspects  
- Experimental group outperformed the control group in organization, vocabulary, mechanics (no differences in content and grammar) |
| Hoven and Palas (2011)          | - In-class  
- online  
- computers  
- mobile-assisted (iPod Touch)                                        | - ESP Accounting course  
- Speaking and listening improved although learners indicated the need for written language support and vocabulary to help them with listening tasks; questions whether synchronous/asynchronous activities would improve oral language development |
| Suwantarat (2019)               | - Face-to-face  
- online  
- chat center                                                          | - Postsecondary intermediate English course in Thailand  
- Student and teacher perceptions  
- No analysis about language learning |
| Wichadae (2014)                 | - Multiple web-based tools  
- Face-to-face meeting using WebEx video conference  
- Self-study material via LMS  
- Student-teacher small group meetings                                | - Fundamental English at the postsecondary level in Thailand  
- Examined student perceptions  
- Test analysis indicating the mean score was higher than the set criteria at a significant level of 0.05  
- Increased participation leading to higher learning achievement |
| Mohsen and Alshahrani (2019)    | - Automated writing  
- Evaluation program MY Access  
- Hybrid mode: AWE feedback and instructor feedback                    | - Saudi intermediate postsecondary EFL context  
- Examined student perceptions  
- Improvement in students' writing via the hybrid mode with both AWE feedback and teacher's feedback  
- More support in the areas of writing content and organization |
Effects of Hybrid Learning on English Language Learning

Many hybrid studies reviewed thus far place more emphasis on student and teacher perceptions about their English language development (Davies, 2019; Foomani & Hedayati, 2016; Hosseinpour et al., 2019; Hoven & Palalas, 2011; Suwantarathip, 2019; Wichadee, 2014; Mohsen & Alshahrani, 2019). Generally, students and teachers indicated satisfaction with the hybrid learning mode and expressed that they learn better via technology-enhanced learning spaces; however, the limited transparency in student achievement levels in all English language domains is another area that needs to be further explored to gain deeper insight into the quality of learning hybridization can deliver. The studies in this review that have examined student achievement levels indicated improvement in writing (Hosseinpour et al., 2019; Wichadee, 2014; Mohsen & Alshahrani, 2019) and oral language development (Hoven & Palalas, 2011). In supporting the notion of the need to examine student learning performances in a technology-enhanced learning environment, Ware and Hellmich (2014) argue that more studies should focus on “a learning outcomes perspective” (p. 151) to assist educators in determining the appropriate online tools to suit particular pedagogical methods to meet curricular goals for the targeted population. Hence, this review will further explore a combination of bilingual and English as a second language teaching methods aimed at targeting all language learning domains via improved teacher facilitation of online technologies and selected pedagogical/theoretical frameworks. Proposed teaching methods based on prior bilingual and English as a second language practices will be discussed in the next section.

Bilingual and Second Language Acquisition Pedagogical Methods in Hybrid Learning

To address the shortcomings of the hybrid learning environment that the above literature has revealed, especially in student-student interaction and teacher facilitation to promote learning
motivation, relevant second/foreign and bilingual language learning methods have been identified to inform a technology-enhanced environment. This section explores the literature on language learning methods to provide a pedagogical framework for acquiring English as a second or foreign language. Consequently, second language acquisition methods, the Communicative Approach and the Natural Approach, and the bilingual method of translanguaging as well as the use of machine translation in translanguaging, will be discussed.

**The Communicative Approach**

The essence of the Communicative Approach is “the negotiation of meaning between learners and learners, learners and teachers, and learners and text” (Richard-Amato, 1996, p.18). Successful acquisition of the target language will require the interdependence of the teachers and students to develop a flexible learning environment. Kavanagh (2012) further explains that this approach to second language learning also encourages students to engage in meaningful and authentic language use, especially in conversational practice in the target language. Though correct language use is imperative, teachers who execute meaningful, authentic communicative language teaching, as Kavanagh posits (2012), act as facilitators in focusing more on fluency and intelligibility than on accuracy and monitor learning by providing ongoing feedback. Illustrating a meaningful and authentic language learning environment relevant to this hybrid study is Meskill and Anthony’s (2005) discussion of the value of communicative language teaching in a computer-mediated communication hybrid foreign language teaching environment, where such a learning medium enabled learners “time to notice, use resources, reflect, and compose” (p. 102) via teacher facilitation, feedback, and scaffolding of salient language learning features. Such instructional online conversations afforded by the digital communicative tools put forth by Meskill and Anthony (2005) have given language learners opportunities to learn better via an
online channel with teacher guidance as well as reinforce their learning in live classroom sessions. Hence, the Communicative Approach is a promising second or foreign language teaching method in the context of a digital learning environment.

**The Natural Approach**

Closely related to the Communicative Approach is the Natural Approach, which focuses on reading and listening comprehensible input, production of language via a series of stages (early speech production, speech emergence, and full production), communicative goals, and the establishment of a teaching environment with low affective filter (Richard-Amato, 1996; Terrell, 1982). This practice requires the teacher to take an active role in facilitating a combination of teaching strategies as learners are at the beginning stages of producing language. This approach to literacy development has evolved to include academic content, peer work, grammar teaching, and more complex/broader instructional units. Though limitations include the method’s orientation in beginning to low-intermediate oral language development, less emphasis on formal grammar teaching, and basic content and tasks, the goals of the Natural Approach can be adapted to fit the needs of the struggling learners in this study.

**Traditional Grammar Translation, Translation as a ‘Fifth Skill’, Translanguaging, and Machine Translation in Translanguaging**

Even with the two aforementioned approaches that mainly focus on the communication process of second language learning, translation is still needed one way or another (Priya & Jayasridevi, 2018). Traditionally, the Grammar Translation method used in teaching English as a second language was criticized for stressing teaching different aspects of English as separate components using the mother tongue and excessive drill practice but with minimal use of the English language and little focus on textual content and pronunciation (Priya & Jayasridevi, 2018; Richard-Amato, 1996). However, Priya and Jayasridevi (2018) argue that the Grammar
Translation method still has its value if effectively implemented. They conclude that translation requires meaningful interpretation which can be accomplished through first language processing to develop effective second language assimilation skills, bilingual immersion/bilingual text usage methods, and making distinctions between the similarities and differences between the first language and the second language.

Furthermore, Ross (2000) further posits the pedagogical perspective of translation as a fifth skill alongside the four main language domains (listening, speaking, reading, and writing), and in order to utilize this skill effectively in language learning, the linguistic features of both the target language and second language must be exploited carefully through a concept known as contrastive analysis. Contrastive analysis is defined as comparing and contrasting students’ mother tongue with their target language of study to build metalinguistic awareness in both languages (Beeman & Urow, 2013). This systematic bridging of both languages brings forth the notion of the bilingual method of translanguaging.

Translanguaging, a term coined by Cen Williams, is a bilingual approach that activates the learning of two languages by alternating instruction between both linguistic modes flexibly. Baker (2011) asserts that in order to use two languages to make meaning, understanding, and knowledge, “there needs to be strategic classroom languaging planning” (p. 287). However, in recent times, there has been a shift in the meaning of translanguaging, where students’ linguistic repertoires are not seen as separate entities but rather as a single repertoire, which students use to maximize learning in both content and language development (García, Johnson, & Seltzer, 2017; Wei, 2018). Bilingual learners in this learning context are allowed to deploy their entire linguistic repertoire without setting any linguistic boundaries in order to understand the full meaning of texts. An example of translanguaging in this bilingual space occurs when learners
engage in a creative language learning space in which they utilize their first language knowledge to create or invent new words or phrases in the second language to assist them with their understanding (Wei, 2018). Often times, a challenge persists when native speakers of the second language experience difficulty understanding these new utterances as they cannot grasp the “creative and critical dimensions of these expressions” (p. 13). García et al. (2017) identify this notion as the translinguaging corriente, where language use breaks free from accepted rules, allowing for the generation of novel and creative ways of using languages from speakers of more than one language. It is also a critical and creative space for setting in motion the learning and teaching in the translinguaging classroom. The notion of translinguaging has also further evolved with the application of machine translation in bi/multilingual teaching. Vogel, Ascenzi-Moreno, and García (2018), in their case study of leveraging the teaching of writing using machine translation, contend that translinguaging pedagogy requires explicit technology instructions to support “…students’ social actions with machine translation and the biliteracy instances…” (p. 102) that emerge. In order to further expand understanding of this learner-machine assemblage, there will be a need to understand how students’ linguistic repertoire will affect the way they use machine translation and vice versa.

In the next section, a selection of learning theories will be explored regarding hybrid language learning environments.

**Theories Associated with Hybrid Learning**

*Learning Theories and Related Concepts to Support a Bilingual and English as a Second Language Hybrid Landscape*

Hybrid learning is a promising mode of instruction as technology-enhanced learning continues to play an integral role in today’s classrooms (Horn, 2010; Picciano, 2017). This learning mode, which mixes both classroom and online learning, has been linked to many
traditional learning theories such as Constructivism and the Motivation Theory (Jin, 2009). Jin (2009) contends that these two theories alone cannot truly encapsulate a hybrid instructional design. Also associated with hybrid learning is the Affordance Theory, which is defined as the action possibility offered by a given environment or an object to an agent in a given environment, yielding positive or negative results (Gibson, 1979). For the purpose of this review, we refer to the word ‘affordance’ in terms of what complementary technological support a hybrid learning environment can offer. This theory emerges from Kalantzis and Cope’s (2015) seven learning affordances (multimodality, recursive feedback, collaborative intelligence, metacognition, differentiated learning, ubiquitous learning, and active knowledge making) to push forth new boundaries for a hybrid learning environment tailored for the specific learning needs of English language learners. For the purpose of this review, these three related theories will be explored to discern how they might support a bilingual and English as a second language hybrid learning model with the purposeful facilitation of appropriate online technologies to guide struggling English language learners with more effective language learning strategies.

Constructivism, a learning theory proposed by well-known theorists such as Jean Piaget, Lev Vygotsky, and Jerome Bruner, is about engaging learners in cognitive development and deep learning that is both complex and nonlinear; that is, it steps away from procedural pedagogy (Fosnot, 2005). A fundamental principle in constructivism is that “learners construct their knowledge through their interaction with the physical world, collaboratively in social settings, and in a cultural and linguistic environment” (Sjoberg, 2007, p. 486). Similarly, Picciano (2017) defines collaboration and community as the “interaction among students, teachers, and content” (p. 176), a feature often cited in the constructivist theory of education. Furthermore, collaboration and communication are two vital aspects of hybrid learning (Ducate, Lomicka, &
Lord, 2012). Supporting a hybrid learning mode, this theoretical model promotes interaction between students-to-students and teachers-to-students as a critical feature, and such community-based learning spaces can be made available through technologies that enable communication and collaborative functions for sharing, reflection, and debate within a learning community. These may include blogs, wikis, social media, and other tools with similar functions (Ducate et al., 2012). Fosnot (2005) also advocates for the need for dialogue within a community to engage learners in further thinking. Learners engaged in a community of discourse are responsible for the skills of “...defending, proving, justifying, and communicating their ideas…” (p. 34). To apply this theory in constructing knowledge via communication and collaboration, the Communicative Approach discussed earlier will serve as the vehicle in setting the learning and teaching of language in motion in a hybrid learning mode that engages learners in meaningful community dialogue.

Motivation is an essential factor affecting learning in a hybrid environment (Delialioglu, 2005). Generally, motivation comprises two features: extrinsic and intrinsic. Extrinsic motivation results from grades, time, and other external rewards, while the intrinsic desire to learn grows from an internal will to acquire knowledge and solve problems, which leads to the development of higher-level learning and critical thinking skills. Delialioglu’s hybrid computer course reveals that both types of motivation are necessary for successful learning in a hybrid environment. Intrinsic motivation has a stronger effect on instilling the “joy” of learning in students and understanding what they learned. From a second language learning perspective, Gardner and Lambert describe two types of motivation: integrative motivation and instrumental motivation (as cited in Richard-Amato, 1996; as cited in Ducate et al., 2012). Integrative motivation is the desire to learn a new language due to self-interest in the language and culture. Instrumental
motivation involves the learners’ goal to acquire a language for functional purposes. Whether learners’ will to learn is extrinsic, intrinsic, integrative, or instrumental, the aforementioned technologies that promote interaction can serve as channels for language learners to develop the motivation to acquire a new language more meaningfully. Ducate et al. (2012) also point to studies in which learners have shown more interest in an online learning environment that allows for more collaborative and autonomous learning. In Chen and Jang’s (2010) study which tests a model of self-determination theory to discover students’ will to learn online, they found that although the theory fails to predict learning outcomes, online instructors should understand students’ reasons for learning and provide “customized facilitation that helps individual students reduce uncertainty and anxiety, become more assured and self-determined, and begin to enjoy their learning online” (p. 750). Complementing the Natural Approach, features of the Motivation Theory will serve as a driving force in creating a stress-free and enjoyable hybrid learning environment.

The availability of online tools to support a hybrid learning environment has created new learning spaces for digital affordances to assist learners of a second or foreign language. The term “affordance” is associated with computer-assisted language learning, as technologies offer various affordances in language learning (Blin, 2016). There is also potential and possibilities for the concept of affordance in human-computer interaction and design, which may suggest “ways to improve the usability of new artifacts” (Gaver, 1991, p. 83). These artifacts help the instructional designer to analyze and understand the actions technologies may offer. Kalantzis and Cope (2015) describe seven learning affordances found in online learning environments as defined below:
Ubiquitous learning: The notion of ubiquitous learning (u-learning) offers learning anytime, anywhere through the use of appropriate technologies, such as learning management systems and assistive technologies.

Recursive feedback: Recursive feedback brings forth the idea of real-time response to formative assessments so that learners can rectify any shortcomings in the learning process at a quicker rate (Kalantzis & Cope, 2012). Recursive feedback technologies provide instantaneous feedback that can help both teachers and learners immediately identify any learning areas that need further development and/or improvement.

Multimodal meaning: Multimodality incorporates the usage of digital texts, images, sounds, and data to enhance the learning experience in the classroom and virtual spaces.

Active knowledge making: E-learning offers more spaces for learners to become more actively involved in knowledge-making using available digital tools and assistive technologies.

Collaborative intelligence: The idea of collaborative intelligence involves learners interacting with one another and the instructor using digital tools that allow for transparency amongst all individuals in the teaching and learning process.

Metacognition: Metacognition involves learners to think about the learning of any given task or discipline. This cognitive process may involve learners to become peer assessors using digital feedback tools, which involves them in thinking metacognitively about the nature of any given task.

Differentiated learning: This component allows instructors to utilize assistive technologies to personalize instruction. Learners can move at their own pace, while instructors utilize data to tailor instruction to individual learning needs.
Supporting the definition of affordance, which refers to the action possibility given by an environment or an object to another agent, the seven learning affordances that Kalantzis and Cope (2015) present all include this quality and offer many new methods of teaching and learning a second or foreign language, made possible by online technologies. Prior studies have examined these affordances offered in a hybrid language second or foreign language learning environment. Arispe and Blake (2012) find that low-performing language learners learned more comfortably in a hybrid environment that affords self-pacing, digital texts, online chat features, and the convenience of accessing resources online anytime. Furthermore, high-performing students in this study also expressed similar preferences for the online component of hybrid learning and less inclination for class sessions. Gedik et al. (2012) identify several affordances in hybrid English language learning. These include spaces for ease of access to all course content, interactive activities for students to reinforce their learning, motivation to learn, instructor monitoring and facilitation, and time efficiency. These affordances can be attributed to several learning affordances Kalantzis and Cope (2015) outline, namely collaborative intelligence via online interaction, multimodal meaning via digital resources, active knowledge-making via motivation to learn, and differentiated learning via self-paced, reinforcement learning. However, Gedik et al. (2012) also argue that there are learning barriers even with the availability of affordances, which include “...workload, course design, cultural aspects, technology support, and the inter-dependence of the two environments” (p. 111). They further contend that overcoming these obstacles will require more research in the pedagogical approach to course design which will ensure appropriate usage of technologies in both online and offline components of hybrid learning. Hence, since the seven affordances have opened up new learning spaces to support language learning both inside and outside of the classroom, they are integral components to the
systematic and cogent development of a bilingual and English as a second language hybrid
learning environment in which a combination of online technologies will be utilized to activate
these learning affordances.

Overview of Modern Theories Encapsulating Hybrid Teaching and Learning

Previously, the learning theories of constructivism, motivation, and affordance have been
identified as the groundwork of hybrid teaching and learning to support struggling English
language learners. However, these distinct theories do not fully capture a hybrid environment as
a unified whole. This section will discuss more modern and integrated models theorizing how
hybrid learning may be translated into practice.

Picciano (2017) and Tashior, Hung, and Martin (2011) realize the need for more coherent
theoretical models to illustrate hybrid teaching and learning. Picciano (2017) proposes a common
integrated theory for online learning known as “Multimodal Model for Online Education” after
exploring several traditional learning theories (e.g., behaviorism, connectivism, social
constructivism, and cognitivism). Figure 2.4 delineates the key components of this integrated
model for online learning. Key concepts emphasized in this integrated model include learning
community, interaction, autonomy, and social/emotional development.
By examining relevant and traditional online learning theories, Picciano (2017) indicates that online education has evolved from traditional learning rather than distance learning. Furthermore, the author asserts that the proposed integrated model should be based on blended learning, as this instructional approach is becoming a more prevalent and prominent learning mode, combining both face-to-face and online learning. However, the author cautions that the acceptance level of the integrated model is still unclear despite its attempt to encapsulate the perspectives of several traditional theories. Hence, theorists from different disciplines may argue for more compelling theoretical connections regarding how it pertains to online learning.

Similar to Picciano’s (2017) stance on hybrid learning, Tashior et al. (2011) discuss the lack of theoretical coherence in hybrid learning as instructional designs and delivery modes vary and evolve. That is, despite the popularity of hybrid learning in recent times, evidence-based frameworks for this type of learning in terms of pedagogy and training grounded with strong
research to optimize learning for a diverse body of learners are inadequate. In promoting a theoretical framework for hybrid learning, Tashior et al. (2011) identify drawbacks and posit implications of hybrid learning to propose a Transtheoretical Model, encompassing evidence-based pedagogies as a means to ensure its efficacy and efficiency. The barriers identified include knowledge gaps (measuring learning outcome, knowledge transfer, teacher-student/student-student interaction, etc.); limited understanding of the distinctive response from each learner in a learning space that combines both face-to-face and online interactions; the different learning patterns related to cognition, motivation, and behaviorism similar to the ones set forth by Picciano (2017), illustrating a multivariate teaching-learning-assessment environment; the disconnection of current pedagogies/materials and students’ conceptual and performance abilities; inadequate information about what students learn, retain, and transfer into the real-world experiences; and the lack of agreement among faculty/trainers about a singular theory resulting in a wide variety of instructional designs that fail to accommodate flexibility for all learners. The six deficiencies are obstacles to gathering robust data on the efficacies of instructional methods and materials, which calls for the need to move in the direction of evidence-based learning to provide appropriate pedagogical interventions.

Tashior et al. (2011) discuss various ratios of face-to-face and online pieces of learning, all of which incorporate the components of hybrid learning, and add three distinct proportions of face-to-face and online course components in terms of organization, as well as make an effort to revise course structure (Complete Release of all course materials for the duration of the course; Time Hierarchy Release of course materials based on a time schedule that does not require mastery of content as learners progress from one activity to the next; Topic Hierarchy without Mastery with course materials released by topic without requiring mastery of prior content;
Topic Hierarchy mastery with course materials released with mastery of prior content). For each course structure, the extent of scaffolding is categorized as “Guided” (high degree) and “Unguided” (little to no support). The following table (Figure 2.5), a 6 x 8 matrix of cells, delineates this revised taxonomy that focuses on the three themes of organization, communication, and course structure with each cell representing a hybrid learning landscape that encompasses different proportions of face-to-face/online learning, as well as the availability of complementarities of classroom and online elements. Letters A, B, and C represent the course types that the authors found in their research. They conclude that courses with no complementarities and lack of scaffolding were poor examples of course design and instructional design, respectively.

**Figure 2.5**

*Hybrid Course Taxonomy Derived from the Rudak-Sidor Taxonomy*

<table>
<thead>
<tr>
<th>Face-to-Face</th>
<th>Complete Release</th>
<th>Time Hierarchy</th>
<th>Topic Hierarchy</th>
<th>Topic Hierarchy with Mastery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low (&lt;35%)</td>
<td>C</td>
<td>U</td>
<td>G</td>
<td>U</td>
</tr>
<tr>
<td>Medium (36-70%)</td>
<td>C</td>
<td>NC</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>High (&gt;70%)</td>
<td>C</td>
<td>NC</td>
<td>C</td>
<td></td>
</tr>
</tbody>
</table>

(Tashior et al., 2011, p. 58).

With these hybrid learning implications in mind, Tashior et al. (2011) argue for empirical bases to support the viability of hybrid course designs as few instructors have engaged in rigorous research to discover what really works. According to their findings of what makes hybrid learning work, instructional design for hybrid learning is shaped by theories of cognition and
behavioral change. However, they argue that, based on their research, there is no consensus for both theories in the literature. Therefore, they investigated a transtheoretical model for hybrid learning based on the previously designed 6x8 taxonomy hybrid courses. Seeking to encapsulate all the different combinations of hybrid learning, they adapted Holly and Gunderson’s Panarchy Theoretical Framework which reflects an adaptive cycle examining three dimensions “that shape dynamics within ecosystems, social agencies, and people” (Tashior et al., 2011, p. 62)—potential, connectedness, and resilience. Potential is defined as a system’s ability to accomplish goals, connectedness refers to the measure of collaborating entities in a system, and resilience aims to measure a system’s ability to recover from setbacks and manage intricate transformations within the system. Within these three dimensions in the adaptive cycle are sectors represented by the variables K, Ω, α, and r that have specific qualities in representing different combinations of the three dimensions, as illustrated in the following diagram. For instance, K refers to more Potential Connectedness but less Resiliency, which means increased efficiency, organized operations, and better collaboration. In other words, there would be more productivity in the K region. The Ω region would lend itself to inflexible Connectedness so that organization may be difficult, which may lead to periods of collapse. The α region may pose uncertainty as Connectedness is low though Resilience and Potential are high, which calls for reorganization. Lastly, r may encounter external factors to the system as Potential and Connectedness are low. Hybrid learning would move through the adaptive cycle Ω to α, α to r, r to K, and K to Ω. Variability of each dimension (increases and decreases) would change along this cycle.
Translating this model, as shown in Figure 2.6, into a hybrid learning environment, or what they refer to as a transtheoretical model for hybrid learning, Tashior et al. (2011) apply the definitions of each dimension to a hybrid learning context. That is, Potential refers to the ability of a hybrid learning environment to reach its desired learning outcomes, Connectedness would refer to the collaboration of all stakeholders in the implementation process (e.g., faculty, IT, context experts, and instructional designers), and Resilience would refer to the types of setbacks the technologies used may encounter (e.g., server crashes, the viability of learning management systems, IT issues, etc.). After analyzing the most optimal region for hybrid learning accounting for scalability, Tashior et al. (2011) identify the K region as the most viable due to “high Potential, high Connectivity, and relatively high Resilience” (p. 64). However, they argue that there may be insufficient data to prove that hybrid learning is certain in this area. Therefore, though this adaptive cycle may advance hybrid learning via a transtheoretical approach, the data...
collection process and the designing of an analysis framework to explain and verify the application of the three dimensions proposed in this theory in hybrid learning remain a challenge.

**Expanded Hybrid Landscapes Combining Human and Machine Intelligences**

The research examining the effects and results of blended learning environments, such as hybrid learning, is limited (Ducate et al., 2012). This review explores pedagogical solutions to address the gaps related to bilingual and English as a second language in hybrid learning contexts.

Prior studies have demonstrated different instructional designs of hybrid teaching and learning to improve English as a second or foreign language pedagogy. These studies have described various modes of hybrid learning. To narrow the context of hybrid teaching and learning and for the purpose of this study, the definition of hybridity refers to online and offline components of instruction both in the classroom and beyond the classroom walls. As the literature in this area is lacking, most selected studies will be identified as a hybrid learning environment based on the aforementioned definition.

The subsequent literature will delve into related concepts and evidence related to the effectiveness of hybrid pedagogy and assessment in a bilingual, second, and/or foreign language learning environment, which may open a new channel for the transtheoretical model for hybrid learning. Specifically, the focus will be investigating a pathway between human and machine intelligences using machine learning in translation and translanguaging as a bilingual method to support struggling English language learners. In discussing machine learning, the literature will also tap into artificial intelligence used in online translation tools to investigate how such a revolutionary technology can support English as a second or foreign language pedagogy to a
greater and more effective extent. The strengths and weaknesses of this form of pedagogy will also be discussed.

**Conceptualizing Artificial Intelligence, Machine Learning, and Deep Learning for Language Learning**

This section discusses the concepts of artificial intelligence, machine learning, and deep learning to establish a deeper insight into the mechanism of today’s online translation software, automated writing assistants, and speech evaluation tools used for hybrid learning in bilingual and English as a second language contexts.

**Artificial Intelligence**

Artificial Intelligence is an umbrella term for various areas of technology. Patrick and Williams (2020) and Togelius (2019) describe two main categories of artificial intelligence: artificial general intelligence and narrow artificial intelligence. Though not existent in the real world yet, general artificial intelligence enables a machine to think like a human and perform numerous tasks without human input. It also has the capability to adapt and evolve independently. On the other hand, narrow artificial intelligence is a machine that requires human input and can only handle a specific task or a limited number of tasks. Its automated functions may also perform tasks beyond a human’s ability, such as computing algorithms almost instantaneously. Subcategories of narrow artificial intelligence include machine learning, deep learning, speech recognition, natural language processing, image recognition, and robotics. Machine learning utilizes structured data points accumulated via a database to predict specific outcomes logically and consistently. A subset of machine learning, deep learning, involves algorithms that serve the purpose of “[emulating] human neural networks” (p. 2). In other words, deep learning can structure data that are otherwise scattered with minimal human input. Such machines can “process, learn, and draw conclusions” (p. 2) from both structured and unstructured data and
generate a wide range of desired outputs. Speech recognition is the ability of a machine to “hear” and “capture” a human voice from a device and translate it into digital text. Natural language processing furthers the function of speech recognition by appropriately responding to the processed text. Such technologies, known as virtual assistants, include Google’s Home, Apple’s Siri, Amazon’s Alexa, and Microsoft’s Cortana. Image recognition is the ability of artificial intelligence to detect an object and categorize it into a specific domain. Lastly, robotics involves using artificial intelligence sensors to detect the environment to respond appropriately to a given surrounding. These innovations involving artificial intelligence have impacted the way we interact with our surroundings. As these technologies continue to make further advancements, we can predict their more significant effects on many facets of society. This study will focus on artificial intelligence in machine learning and deep learning, as illustrated in Figure 2.7.

**Figure 2.7**

![Diagram](Babu, 2019).

Togelius (2019) discusses the elusive nature of defining intelligence and/or artificial intelligence. Alan Turing’s intelligence test has often been used to determine whether a machine can think like humans. The test is administrated in a traditional text-only format with a human
communicating with two other entities, a human and a machine, for the purpose of determining whether a human can distinguish between a human and a machine; if not, then the machine is considered intelligent. However, Togelius (2019) presents arguments against computers as not intelligent, and that intelligence can only be applied to humans. He refutes this notion by comparing the computer’s ability to perform large numerical computations at a much greater speed than the human brain. Arguing from a human’s perspective, some contend Togelius’ claim is absurd, as humans create computers, and any intelligence from a computer should be credited to human intelligence. This idea that intelligence is only applicable to humans is further opposed by the argument that any human intelligence does not belong to the human but to the evolution of natural selection. A universal definition for artificial intelligence is challenging to pinpoint.

Despite the complexities of defining artificial intelligence, Togelius (2019) refers to artificial intelligence as “…the quest to make computers be able to do things that humans currently do better” (p. 36) and highlights three components of intelligence: (1) ability to solve problems, (2) ability to measure intelligence in any given situation, and (3) valuing the ability to describe and solve simpler issues. The goal of artificial intelligence is to invent a piece of software to understand human speech better than actual humans can. The author contends that for a piece of technology to achieve the quality of artificial intelligence, it needs to perform actions humans do better “consciously” (p. 37). He uses the absence of consciousness in the language learning process to illustrate his stance. This infers that artificial intelligence needs to be able to do something that humans do with awareness.

**Machine Learning and Deep Learning Used in Translation Software**

Alpaydin (2014) further defines machine learning as part of artificial intelligence, with intelligence referring to a system’s ability to learn in a changing environment. A system is
programmed to perform tasks based on data or past experience. Data are trained to formulate predictive or descriptive models. Predictive models are used to make predictions about a given phenomenon, while descriptive models are used to determine information from data. There are various applications of machine learning, such as learning associations, classification, regression, unsupervised learning, and reinforced learning. Learning associations refer to discovering interesting relations between two variables, x and y, to conclude user needs. Classification refers to categorizing a given set of data into different classes. Regression is a linear model (\( y = w_x + w_0 \)) with a given input that is used to make a prediction known as the output. While classification and regression undergo supervised learning in which an input \( x \) is mapped with an output \( y \), unsupervised learning is mainly concerned with input data and the patterns associated with clusters of data sets. Reinforcement learning in machine learning recognizes and learns correct sequences after trial runs to produce the desired goal.

The concept of deep learning and how it relates to machine translation will assist with the pedagogical aspect of hybrid teaching and learning, specifically for the bilingual method of translanguaging. Monroe (2017) discusses how machine-learning techniques are making advances in the written text between languages. Google, for example, has transformed its previous method of using a phrase-based system to neural machine translation (Figure 2.8). As of 2016, data reveal that Google’s translation software can perform human translations effectively for European languages. Essential features associated with machine learning include neural networks and deep learning. Neural networks refer to a rough simulation of how the human brain works. Functions are internalized to match the input and output, which creates the neurons or the neural network. Then, the machine is trained to learn as variables are constantly changed until the input matches the output. The term “deep learning” is a terminology used to describe neural
networks. “Deep learning” performs much more complex functions than traditional “neurons”. Hardware and graphical processing units, such as the tensor processing units, recently developed by Google can perform calculations at higher speeds and handle vast amounts of data. In other words, deep learning encompasses algorithmic improvements (including nonlinear functions), which allow the training of large and deep networks to normalize input data and aid the networks in identifying the desired data’s outputs. In sum, the process of machine translation involves two neural networks: (1) encoder – which processes the input process of text translation in a fixed-length vector representation that is subject to change; (2) decoder – which produces text in a different language.

Figure 2.8

A Demonstration of the Improvement in Google Translate Thanks to the Use of Neural Machine Translation

(Old translation)

(NEW TRANSLATION)

(Monroe, 2017, p. 12).

However, Monroe (2017) also evaluates the ongoing challenge of machine translation in terms of measuring the quality of a translation. Human evaluators of translation are still needed for “the ultimate validation” (p. 13), even though humans may also have weaknesses in making
biased judgments of what translation sounds more natural when it could be inaccurate. Monroe (2017) further contends that even though machine translation outputs have shown significant improvement for translation between European languages, which share similar linguistic features, there are loopholes in the machine translation process for languages from different families. For instance, in Arabic, the word endings play a significant role in conveying meaning, but the concept may not be the same when translated to English. Another example is Chinese, with the non-spacing of words being the most distinct difference between the two languages. What confuses the machine even more is lexical variations between dialects (e.g., Mandarin and Cantonese). These limitations put forth by Monroe (2017) call for the need to improve mapping between the two languages when training the translation model in deep learning. What machines can do is still far from perfect, suggesting that the human component in cooperating with machine learning is still essential. This proposition is further supported by Mohammed, Samad, and Mahdi’s (2018) argument for the necessity of training humans as translators to amend the limitations of current translation machines. Therefore, a negotiation between humans and machines will be necessary to make the best use of both agents.

Debates about the Limitations of Artificial Intelligence in Current Machine Translation Software and its Current/Future Potential

Before moving forward with the review of the effects of machine translation pedagogy in a hybrid learning environment, a deeper understanding of the potential of current artificial intelligence in current machine translation software and its future will offer more insight into the current limitations of such technologies and how human intelligence can improve its power and performance, as well as of the potential for effective, efficient, and appropriate facilitation of these tools in a hybrid language learning environment. Pearl (2018) presents three layers of causality and seven salient tasks that current machine learning cannot completely achieve. Yet,
filling these gaps can push artificial intelligence to another stronger level of establishing cause and effect relationships with human intervention as well as with robust algorithms. The three-layer causal hierarchy serves as the basis for discussing the obstacles facing machine learning. Figure 2.9 outlines these three layers as association, interventions, and counterfactuals. Association refers to making observations of the environment, interventions entail humans’ mediations of observations, and counterfactuals further explore whether human interventions have answered queries based upon observations or other possible alternatives that may also explain the same observations. In delineating these three layers, Pearl (2018) argues that if the current statistical-based machine learning systems continue to operate based on observed data without incorporating other phenomena outside the data, then moving beyond layer one of the hierarchy will be difficult.

**Figure 2.9**

*The Ladder of Causation*

(Pearl & Mackenzie, 2018, p. 28).
Hence, Pearl (2018) proposes seven pillars needed to overcome this obstacle:

- Ability to transparently integrate causal assumptions
- Increase in observations of causal variables to make causal inference from data despite the limitation of the current “back door” do-calculus method to make predictions of possible effects of interventions
- Development of algorithms for counterfactuals to enhance machine learning
- Deeper analysis involving interventions, as well as their direct and indirect effects
- Accounting for external validity and sample selection bias (humans testing the viability of a machine learning system to work in multiple environments with different conditions to assess the extent of its adaptability, transferability, learning lifespan, and explicability via artificial intelligence)
- Ability to utilize stronger causal models to recover missing data induced from a weaker statistical-based paradigm
- Utilization of causal models to make more accurate inferences via data

Achieving these pillars may push the boundaries of current machine learning systems and enable stronger artificial intelligence in software encoded with such algorithms. Hence, through these scenarios, deriving a mathematical equation to explain a natural phenomenon, such as “rain causing mud”, for the last few decades has not been possible. Fortunately, Pearl (2018) further notes that such equations are becoming more of a reality. However, critics have argued that Pearl’s framework of what constitutes better artificial intelligence is mostly theoretical and lacks practical application of its working in practice to generate evidence or observations to support his assertions (Pearl & Mackenzie, 2018, p. 53). More recently, Bengio, Deleu, Rahaman, Ke, Lachapelle, Bilaniuk, Goyal, and Pal (2019) have advanced Pearl’s work by deriving bivariate
algorithms to capture the causal variables to make inferences about the environment surrounding a learner. They describe this as meta-learning to support encoders in figuring out the cause-and-effect relationship between variables which enables them to make an initial step toward establishing a more optimized causal structure “…based on the speed of adaptation to modified distributions” (p. 11). In other words, there are various causal representations depending on the parameters and variations in causal graphs to consider improved machine learning systems. Though interpreting the mathematical models that illustrate these causal relationships may not be central to this review, understanding their current limits in Pearl’s (2018) work and Bengio et al.’s (2019) recent advancement in algorithms that encapsulate causal inferences of artificial intelligence in machine learning systems can assist with making deeper insights into why machine learning continues to produce errors and the likeliness of humans to execute interventions to induce and train the missing causal connections in current statistical-based machine learning systems that cannot be considered strong artificial intelligence. Henceforth, this may guide the innovation of more novel pedagogical approaches to integrating these powerful systems, particularly machine translation software, into a hybrid language teaching and learning environment.

**Pathways between Artificial Intelligence Machine/Deep Learning and Hybrid Teaching and Learning**

As there is a wide array of hybrid teaching and learning contexts, this study specifically focuses on discovering expanded spaces of translation/translanguaging pedagogy with the use of current translation software that deploy artificial intelligence machine/deep learning in hybrid teaching and learning tailored for bilingual/English as a second or foreign language learning. Therefore, this section seeks to identify two similar pathways—the theory of human-machine
assemblages and the theory of hybrid intelligence— as to how artificial intelligence machine/deep learning and hybrid teaching and learning are related.

**The Theory of “Human-Machine Assemblages”**

Dant (2004) explores the theory of human-machine assemblage in the context of the driver and the car and the range of social actions the combination affords. Each component alone cannot achieve the desired actions; the assemblage is needed to generate greater effects that neither component can accomplish alone. The concept of affordance is also introduced to explain how this assemblage offers unique actions that can only be accomplished with the integration of both features. Dant (2004) posits that the driver-car assemblage is “neither a thing nor a person” (p. 23). Both components are needed to activate their properties to act as a social being. The machine component is dependent on the cognitive capacities of humans to operate its affordances. Once this assemblage generates a form of action, it enters the stage of routine habitual and ubiquitous practice. Gradually, this will transform into a form of ordinary social action. This notion can be generalized as the “extension of the human body and an extension of technology and society into the human” (Dant, 2004, p. 24). Kamar (2016) deepens this notion by arguing that humans simply acting as helpers to machines powered by artificial intelligence systems is insufficient to understanding the theory of machine-learner assemblage. For instance, the driver of a hybrid car does not merely provide support to the car upon request but also proactively participates in the act of driving, which suggests “a paradigm shift from hybrid systems to hybrid teamwork” (Kamar, 2016, p. 4). In conclusion, this theory can be extended into other assemblages that may serve as intermediaries between humans and objects produced by societies. The theory of human-machine assemblage discussed in the context of the driver-car can be applied to hybrid language learning, with tactful usage of intelligent translation software.
for translingual development and other intelligent tools as the online pedagogical component and the human (both teacher and student) learners as the offline factor, together forming the assemblage of collaborative learning. As Savat (2012) endorses the notion of human-machine interaction, the technologies available cannot be treated as separate external entities. Instead, whether they be simple online computer-assisted tools or powerful artificial intelligence tools that operate like a combustion engine, they all need to be activated by humans in order “to make possible specific forms of action” (p. 71), which simply infers affordances made available via current technologies.

**Hybrid Intelligence**

Hybrid intelligence offers an analogous perspective of the theory of machine-learner assemblage but with a deeper insight into how both machine intelligence and human intelligence would work together to facilitate a hybrid learning environment. Dellerman, Ebel, Söllner, and Leimeister (2019) and Kamar (2016) define the combination of human intelligence and artificial intelligence as hybrid intelligence. In a broader sense, human intelligence refers to the human ability to utilize acquired knowledge to learn, reason, and adapt to any given environment with the ultimate move to achieve goals. Artificial intelligence involves creating and applying machine learning techniques with systems that can achieve complex tasks via analysis and adaptation to new situations. In essence, artificial intelligence can assist humans in making better decisions by formulating predictions. Conversely, humans can use their intelligence to train machine learning models to meet learning needs or targeted goals. Dellerman et al. (2019) assess the positive complementary effects of hybrid intelligence between humans and machines as well as the drawbacks of artificial intelligence in machine learning. Each component of hybrid intelligence can serve to assist each other to achieve targeted goals more efficaciously. Figure
2.10 outlines the distinct capacities of human and machine intelligences. Generally, humans possess the intuitive quality that machines lack, and machine intelligence can engage in analytics that may supersede the human’s ability to calculate mentally.

**Figure 2.10**

*Complementary Strengths of Humans and Machines*

(Dellermann et al., 2019, p. 640).

While artificial intelligence may perform automated tasks in the workplace, there are fears machines may take over certain jobs, placing humans in the vulnerable position of becoming obsolete. Even so, Dellerman et al. (2019) argue that artificial intelligence can make powerful predictions for humans to make better decisions. Likewise, humans can provide support to tasks that machines cannot perform on their own. That is, humans will need to be the ones to produce algorithms in order to train the machine to analyze the data. In other words, machines can also learn from humans who would act as the teachers to the model being trained. Figure 2.11 encapsulates the different roles in Hybrid Intelligence.
Furthermore, Dellerman et al. (2019) highlight three noteworthy core concepts of Hybrid Intelligence: collectively, superior results, and continuous learning. Hybrid Intelligence requires tasks to be performed collectively for both the learner and the teacher. With both human and machine intelligences interplaying with one another, outcomes based on artificial intelligence-powered predictions would be superior in effectiveness and efficiency. Over time, both agents, machines and humans, will learn and evolve together to make this “socio-technological system” (Dellerman et al., 2019, p. 640) better. Dellerman et al. (2019) outline major advantages of artificial intelligence: (1) understanding implicit knowledge generated by artificial intelligence is more accessible to novice learners; (2) humans assume more control in the teaching process as artificial intelligence can provide more robust data for interpretation; (3) human learning preferences via interaction allows for programming artificial intelligence to fit learners’ needs; (4) collaboration between humans and intelligence may increase more trust. Nevertheless, even with both intelligences working together, applying this combination in real-world settings continue to be a challenge. Despite limited research in this area, Kamar (2016) posits the potential of human and computer collaboration via a subdivision of labor between these two agents can offer more...
novel hybrid zones and further asserts that “there is a need for generalizable models, algorithms and workflows to move away from hand-crafted hybrid systems to optimized access to human input” (p. 4). In other words, more work is needed in the area of developing detailed instructional designs that specify how humans (e.g., teachers) can act as facilitators to make decisions based on human input (e.g., students) integrated inside artificial intelligence systems, such as machine translation. Doing so enables more innovative and practical applications in human and machine learning. Applying and activating the online learning component of a hybrid learning context leveraged on and powered by the hybrid intelligence theory could offer solutions in improved teaching and learning of the online aspect of a hybrid learning environment.

**The Benefits and Challenges of Leveraging Artificial Intelligence-Powered Tools in a Hybrid Learning Environment**

The digital affordances offered by current artificial intelligence technologies have pushed forth innovative pedagogical approaches in the landscape of bilingual/second or foreign language instruction. In this section, machine translators will be examined in depth to support the notion of a hybrid learning environment that activates the teaching and learning interactions between human and machine intelligences. As machine translators have limitations in the language acquisition pedagogical process and technical abilities, automated writing assistants and voice recognition software operating on similar machine learning/deep learning algorithms will also be discussed to draw further implications of how to fully operate and leverage a tactful amalgamation of these tools to generate new zones for learning a second language more effectively and efficiently.

Generally, machine translation in language learning and teaching can be classified as a mode of the proposed hybrid learning context of mixing online and offline pedagogical components, seeking the most optimal and seamless combination of instructional methods to
support bilingual/English as a second or foreign language learners. The evolution of translation methods in English language teaching and/or bilingual teaching has been explored earlier. They include traditional grammar translation, translation as a ‘Fifth Skill’, translanguaging, and machine translation in translanguaging. Previous literature shows all of these methods have their benefits and shortcomings in English language teaching and/or bilingual teaching, with translanguaging and the possibility of expanding machine learning in this area being the latest trend in bilingual/English as a second or foreign language pedagogy. As Vogel et al. (2018) posit, explicit technology instructions delivered by human instructors are essential to discovering how learners socially interact with machine translation that induces biliteracy learning. In order to broaden understanding of this machine-learner assemblage and/or the hybrid intelligence that may emerge in a hybrid learning environment, there will be a need to understand how students’ linguistic repertoire will affect the way they use machine translation and vice versa for their language learning development. For the purpose of this review, models of hybrid machine translation/translanguaging pedagogy in bilingual/English as a second language/English as a foreign language/foreign language teaching and learning are identified (as most studies regarding this topic do not make direct connections to hybridity) to examine and evaluate the effects of this learning model in language instruction.

Machine translation has benefits and drawbacks in the language learning process (Niño, 2009; Clifford, Merschel, & Munne, 2013; Case, 2015; Briggs, 2018). Niño (2009) recognizes machine translation’s ease of accessibility, multilingual feature, ability to conduct acceptable lexical translations, and ability to translate accurate simple-structured texts. In contrast, Niño (2009) also points out machine translation’s tendency to generate erroneous literal translations, numerous grammatical errors, discursive inaccuracies, spelling errors, unnatural writing, and
translations that lack cultural references. Case (2015), therefore, addresses machine translation as having “the potential to introduce disturbances, conflicts, and innovative changes in the ways that languages are taught and learned” (p. 8). Hence, both the positive and negative effects of teaching and learning will be examined in light of perceptions of teachers and students, current methods of language instruction with machine translation, and the technological capabilities of current machine translation to assist bilingual/English as a second or foreign language pedagogy.

Other artificial intelligence-powered tools, such as automated writing assistants and voice recognition/evaluation software, also deploy similar machine learning algorithms to machine translation. The use of automated writing assistants and voice recognition software/evaluation in English as a second or foreign language pedagogy also mirrors the same concept of how a learner interacts with the machine in the language learning process. Although these tools can also be used alongside machine translators and operated in a similar hybrid fashion, limitations due to errors produced by machine learning algorithms persist. Inherently, as Ali (2018) asserts, these tools are also imperfect, yet they are also leveraged as computer assistive tools in English as a second/foreign language teaching and learning. Automated writing assistants, such as Grammarly, have been popular tools for computer-mediated writing instruction. Several studies conducted at the tertiary level unveil different approaches, mixed reactions of users, and the potential/limitations of such tools (Dembsey, 2017; Ghuftron & Rosyida, 2018; Koltovskaia, 2020; Nova, 2018; Parra & Calero, 2019). The application of voice recognition software that deploys text-to-speech/speech-to-text functions in the educational setting is also on the rise. However, there is a dearth of research about deploying voice recognition software in language instruction, as artificial intelligence technologies have only recently made more advancements in producing more precise responses and automated feedback (Yong, 2020). Regardless, some
studies have shown promising results in oral language development (Ahmed Ali, 2020; Underwood, 2017; Yong, 2020). In the following subsections, the user experience of these cutting-edge technologies in the English language learning field, expanded bilingual and English as a second language methods in a hybrid learning landscape, and an assessment of the technological affordances on English language teaching and learning are examined.

**Teacher and Student Perceptions of Artificial Intelligence-Powered Tools in Language Teaching and Learning**

The technological capabilities of machine translators have led to different perceptions from learners and instructors regarding the effectiveness of machine translation tools in language teaching and learning (Niño, 2009; Clifford et al., 2013; Moorkens, 2018; Lee, 2020). In Niño’s (2009), Moorkens’ (2018), and Lee’s (2020) qualitative findings, they concur that learners consider machine translation useful for their language learning experience as they can develop the skill of detecting and correcting errors and become aware of the practical usage and limitations of machine translation. Similarly, Clifford et al. (2013) discovered that most of the students find machine translation sometimes helpful to their language learning, especially in vocabulary development, double-checking their work, dictionary usage, reading comprehension, and the different stages of the writing process. Niño (2009) and Case (2015) contradict students’ positive perceptions by expressing the instructors’ concern about the low-quality translation output that may further confuse lower-level students, the training needed in the target language, translation skills, and machine translation knowledge to make language learning with machine translation more feasible, and the lack of focus on the communicative approach to language learning. These limitations of machine translation may produce detrimental effects on the learning process if not appropriately taught and used in the language learning process.
Clifford et al. (2013) add to this discussion by identifying academic honesty as another concern from the instructors’ standpoint for second and foreign language teaching. Teachers of beginning to intermediate levels also reveal machine translation as not useful/somewhat not useful for language learning. Furthermore, a little over half of the teachers of advanced level regarded machine translation as useful/somewhat useful, as they realized that more advanced learners have adequate knowledge to perceive the limitations of machine translation and could engage in critical language learning when evaluating bilingual texts. These results suggest that most instructors doubt the efficacy of using machine translation in the language learning process. On the contrary, Case (2015) contends Clifford et al.’s stance (2013) regarding academic honesty by arguing that even though the challenges of perceiving using machine translation as cheating or plagiarizing persists, students use them anyway. Based on the results of teachers’ perceptions toward using machine translation, Case (2015) posits the need for future studies to examine teacher and student roles in a learning context where the skills a person needs to acquire now rely on the interaction of foreign language learning complemented with the outsourcing of laptops and smartphones. In other words, pedagogy needs to focus on the types of skills students can develop via machine translation. Instructional designs and assessments will be needed for learners to practice and assess these skills. In a more recent study, Briggs (2018) finds that a small percentage of students with weak written English skills find translation tools helpful to their learning and expresses the concern of students’ heavy reliance on web-based machine translation tools and a decrease in engagement in the cognitive aspect of language learning, which may result in laziness.

Due to these limitations regarding machine translation in the language learning process and in order to understand more deeply how machine translation tools may be useful for learners,
both Case (2015) and Briggs (2018) conclude the need for more qualitative data to examine why learners rely on web-based machine translation tools. This examination may fill the loopholes of using machine translation tools in language teaching and learning to discover more potential pedagogical benefits. Learning about students’ attitudes towards instructors’ role in integrating such tools into teaching more seamlessly is also essential (e.g., to decrease the human effort in the translation process or to expedite the language learning process to assist learners of lower English levels to keep pace with more fluent speakers of English). Despite the powerful aspects of machine translation tools, teachers’ and students’ mixed perceptions toward machine translation tools call for the need to critically examine the effectiveness of instructional methods using these tools in the language learning process in order to reach a consensus of what constitutes best practices in utilizing machine translation tools for learning.

**Automated Writing Assistants**

Automated writing assistants have been well-received by students despite the way they interact with the software not being optimal for effective learning. Consequently, teacher reactions toward this software are mixed. Nova (2018), Parra and Calero (2019), O’Neill and Russell (2019a), and Koltovskaia (2020) discuss that students exhibited positive attitudes and high satisfaction in autonomous learning and increased motivation with the usage of Grammarly. Koltovskaia (2020) investigates deeper student perceptions by examining the behavioral, cognitive, and affective aspects of Grammarly. Behaviorally, students did not effectively engage in making the corrections provided by the automated feedback. The students’ activation of metacognitive and cognitive processes in operating the tool to develop autonomous learning was moderate. Emotionally, there were questions about each automated feedback, but it was only understood to a certain extent with limited second language knowledge and intuition. Over-
reliance on automated feedback due to a lack of knowledge of target grammatical forms was also a concern. Furthermore, the software's limitations also require teachers to check students' works for high-order writing skills regarding content and organization (Ghufron & Rosyida, 2018; Nova, 2018; Parra & Calero, 2019). Although O'Neill and Russell (2019b) claim positive perceptions from instructors in second language development in terms of saving time in providing detailed lower-order grammar feedback, automated writing assistants continue to raise concerns about higher-order writing skills amongst teachers, suggesting that human intervention is still needed. Similar to machine translation software, writing assistants can only be leveraged as assistive tools to activate human and machine intelligences in bilingual and English language learning.

**Voice Recognition and Evaluation Software**

Student reactions to the integration of voice recognition software in language instruction are positive, but teachers' responses are limited. Ahmed Ali (2020) and Underwood (2017) confirm that students at the primary level demonstrated high engagement, joy, and increased motivation to practice the target language with a robot assistant such as Amazon's Alexa, Apple's Siri, Google voice search, and Google Assistant, in a stress-free environment. Ahmed Ali (2020) further stresses that such tools stimulated learners' natural curiosity about the technology's capabilities and limitations, such as cultivating their ability to make meaningful inquiries and commands as well as their attentiveness to listening to machine-generated responses. Learners also developed more perseverance to practice the language with the Google Assistant. However, there will be a need to investigate further teachers' perceptions regarding the use of these tools, as the studies conducted by Ahmed Ali (2020) and Underwood (2017) were restricted to the researchers themselves regarding tactful usage of these tools as helpful to language learning.
Feedback from other teacher participants and more insightful student feedback were also limited or absent from these studies.

**Current Methods of Bilingual/English as a Second or Foreign Language Instruction with Artificial Intelligence-Powered Tools**

As machine translation tools can perform tasks at near-human ability, instructional methods of utilizing and facilitating such technologies effectively in identified hybrid language learning environments have been examined. Niño (2009) identifies four different roles of machine translation in foreign language teaching and learning from previous studies. These roles include machine translation as a bad model, a good model, a vocational training tool, and a computer-assisted language learning tool. Machine translation as a bad model refers to increasing students’ awareness of translation errors when translating into the first language but is problematic when students are exposed to erroneous text in the second language. Machine translation as a good model refers to using translation memory database software, online dictionaries, or other corpus-based tools to improve the learners’ writing and translation skills in the second language. Machine translation as a vocational training tool involves learners in pre-editing of a text until the most appropriate machine translation output is generated and then post-editing machine translation output for further errors. Lastly, machines as computer-assisted language learning tools also engage learners in various areas of linguistic development. In presenting these four models, Niño (2009) asserts the struggle of language learners in determining how to use machine translation tools effectively in their language acquisition process. Niño (2009) and Clifford et al. (2013) posit that good teaching practices center around engaging learners to be linguistically and critically aware of the types of translation errors as well as assessing the erroneous outputs machine translation tools may generate, and becoming conscientious of the quality of outputs different machine translations generate. Clifford et al.
(2013) further advocate that acquiring the ability to perform such tasks is an important skill to foster in the language learning process. In contrast, Niño (2009) identify unwelcoming practices of machine translation by pointing out the issues of not providing learners background and objectives for using machine translation in language learning, introducing machine translations that generate a high degree of inaccuracies to low-level learners, and engaging learners in the challenging aspect of learning a new language that has extreme lexico-semantic and structural differences. Even so, Clifford et al. (2013) and Case (2015) argue that if calculators can be leveraged for effective math learning, then so could translation tools be used for second language acquisition. Furthermore, in Clifford et al.’s (2013) study, one-third of the students decreased the amount of machine translation used as their language skills increased. Whether this finding is due to language knowledge or error detection in machine translation, it could inform better language teaching practices. Hence, there will also be a need to examine more effective pedagogical practices with machine translation at different language learning levels (Clifford et al., 2013).

**Pre-editing, Post-editing, and Contrastive Analysis Tasks Using Machine Translation**

The shortcomings of machine translation tools have yielded machine-learner instructional strategies. The most common types of instruction with machine translation are pre-editing of text, post-editing of text, and contrastive analysis (Niño, 2009; Case, 2015; Briggs, 2018). Pre-editing of text engages the learners in modifying input texts until the machine translation generates the most appropriate output, and post-editing has learners make further corrections if machine-translation output produces more errors. Contrastive analysis, a concept that requires learners to skillfully apply translation as a fifth skill (Ross, 2000) in carefully exploiting the linguistic features of both the target language and a second language, involves comparing and contrasting
the kinds of translated errors generated from machine translation with the native language for the purpose of developing learners’ metalinguistic awareness in both languages regarding language structure, idioms, and collocations (as cited in Case, 2015; Beeman & Urow, 2013). Also, as noted earlier, Niño (2009) asserts that the third role of machine translation in having learners engage in pre-editing and post-editing of texts poses the issue of machine translation’s limitations in capturing grammatical and semantic features. This offers insight into the need for investigating more instructional techniques in these two linguistic features.

**Metacognitive Process of Evaluating Translation Results**

Briggs (2018) expounds on the possibility of using web-based machine translation in language learning at a university-level English language learning setting in Korea by having learners engage in the metacognitive process of evaluating translation results generated by two translation tools – Google Translate and Naver Translate. Google Translate, since 2016, has used an artificial neural network to predict the likelihood of a sequence of words on a sentential level (Briggs, 2018; Ducar & Schocket, 2018). Naver Translate is a web-based machine translation tool that integrates an electronic dictionary for users to translate from English to Korean, or vice versa, on a word level. Sample sentences are also provided for users to examine collocation and contextual use. For the research design, students assessed the translated output as acceptable, unacceptable, or uncertain. Since the ratings may be subjective, expert raters, who are either professors or assistant professors of English, also participated in providing translation ratings to which students’ ratings could be compared to engage in a deeper, comparative process of translation evaluation across more than one machine translation software with multiple human raters of different levels of language expertise.
Results reveal that most students showed low trust in the accuracy of the translated results as well as different responses of their reliance on and perspectives of valuing machine translators, which may insinuate the need to assess whether they are engaging in critical thinking when using such tools. As for recognizing web-based machine-translation output errors, students’ assessments of translated outputs were relatively near the ratings of experts. However, due to high subjectivity, students’ quality of assessments may not be as reliable because they gave high scores even when web-based machine translation outputs produced errors. Adding to the concern is students’ lack of critical analytic skills in improving sentence structures based on the original web-based machine translation outputs. Supporting Niño (2009), Clifford et al. (2013) and Case’s (2015) propose the need to devise pedagogical approaches in developing critical awareness of translated results for effective language learning, Briggs (2018) emphasizes learners’ struggles in critically analyzing the translated results though most have found machine translation tools useful for the language learning process. Nevertheless, Briggs (2018) posits that struggling learners could benefit from web-based machine translation in which they could “quickly transfer their focus to oral production, providing them with a beginning ‘script,’ which can afford them the opportunity to participate actively and potentially recognize existing errors if or when they interfere with communication” (Briggs, 2018, p. 17). Hence, instead of focusing on banning the use of web-based machine translation tools in the classroom, Briggs (2018) concludes that more effort will be required to support learners to use these tools “critically and analytically” (p. 17). Briggs (2018) further addresses the need to investigate different language learning domains with the use of web-based machine translation tools, as different student responses may vary. Teachers need to acknowledge the fact that web-based machine translation is improving, and its capability in generating accurate outputs could be better than translations
generated by learners themselves. Hence, lessons tailored around effective and appropriate usage of web-based machine translation tools are vital for teachers to consider enhancing the language learning experience, especially for struggling learners.

**Further Expanded Writing Task Models and Analysis of their Effects in Machine Translation Instruction**

Writing is a common task type in the implementation of machine translation in English as a second or foreign language learning (Garcia & Pena, 2011; Groves & Mundt, 2015; Giannetti, 2016; Ducar, 2018; Moorkens, 2018; Vogel et al., 2018). Positive effects of writing using machine translation have been identified, but different challenges emerged in various studies. In Garcia and Pena’s (2011) study focused on determining whether the use of machine translation is a successful mediator in improving writing performance amongst beginner and early intermediate second language learners, they discuss successes and limitations. The research design had learners produce a writing sample in the second language for an assigned topic (control group) and in the first language with pre-editing and then in the second language using the machine translation software Tradukka interface (experimental group). Data analysis consisted of two stages. First, students’ works were evaluated for the extent of communication via the number of words generated with the assistance of machine translation and the quality of communication via blind marking. Secondly, editing interventions were captured via screen recordings to evaluate students’ engagement with the writing task. Findings revealed that beginner English learners who used machine translation were able to communicate more effectively in writing; however, machine translation decreased the level of learner engagement during editing interventions as the machine enables learners to write more without putting too much effort into the thinking process. As a result, learners were more successful in editing interventions when writing directly in the second language without machine translation,
suggesting that the use of machine translation does not mean more learning will happen. Another shortcoming Garcia and Pena (2011) note is that their study only addresses writing. Reading with or without the support of machine translation and interactive oral chat to engage learners in fixing errors in machine-generated translations could make this research more comprehensive. This limitation is also noted by Giannetti (2016), who questions whether learners would exhibit the same language learning struggles for reading comprehension when using Google Translate. Nevertheless, machine translation may help a learner communicate more effortlessly. However, it does not train learners in the process of how to take one language and convert it to another language autonomously.

Groves and Mundt (2015) also assess the effectiveness of machine translation in language learning in an English-for-academic-purpose context, specifically in examining grammatical accuracy in writing after translation output. They posit that Google Translate (statistical-based, as neural translation was not introduced until 2016) can translate Malay or Chinese into English to a certain extent, but the output was far from producing accurate results. Therefore, this translating tool may not serve as a substitute for professional translation or language proficiency as the error level is much too high. Another issue with this tool is its different levels of accuracy in Malay and Chinese, which may also be present in other language pairs. Other problems include basic organization, avoidance of fallacy, hedging, and accounting for effective academic writing in different subject areas. Hence, they conclude that all of these issues call for the need for post-editing as a technique to generate higher quality translations, which is later confirmed in Giannetti’s (2016) work despite Google’s upgrade in utilizing artificial neural networks as a part of its machine translation software. Despite focusing on English for academic purposes for this study, machine translation in English for academic purposes also has overlapping concerns.
related to English language teaching. Groves and Mundt (2015) assert that the approach to translating and bilingual teaching is not common in English for academic purposes, as learners come from various cultural and linguistic backgrounds. Therefore, this might threaten more innovative approaches to integrating machine translation in teaching English for academic purposes. Another argument against this tool is that it may undermine the purpose of going through the language acquisition process or even learning a target language.

Furthermore, Giannetti’s (2016) examination of the effects of machine translation in foreign language learning also has implications regarding the improvement of using machine translation for bilingual/second or foreign language pedagogy. To counter Garcia and Pena’s (2011) and Groves and Mundt’s (2015) discussion of shortcomings of machine translation tools in language teaching and the potential threats of machine translation, Giannetti (2016) suggests training teachers to effectively use online translators by leveraging them as tools for instruction after discovering the need for tailoring instruction in proper and strategic usage of translators and the struggle of low-level language learners to properly monitor their usage of translators. In this mixed-methods study of collecting student work samples, engaging in classroom observations, and conducting questionnaires to examine the usefulness of Google Translate as a classroom support for writing, students discovered the value of Google Translate as it served as a support for beginner level students. Their writing not only improved, but they also produced fewer errors and increased vocabulary usage with the use of machine translation. Furthermore, their confidence increased when they discovered their ability to write more. Post-editing in student works increased students’ awareness of mistakes in their writing and their understanding of the language instantly. Hence, this opens the space for using more authentic cultural texts rather than solely relying on what students remember. However, issues arose when Giannetti (2016) found
that one instructional point is not enough for all learners to develop necessary learning strategies as well as learners’ limited exposure to Google Translate and the Spanish language (the target foreign language) which slowed down progress. Therefore, these two factors suggest the importance for both teachers and students to understand differentiated instructions in using Google Translate as well as the effects of translators on vocabulary acquisition in the target language to improve writing length. This notion is also supported by Moorkens’ (2018) study of comparing the effects of statistical-based translation to neural-based translation, with the improved neural model in both Google Translate and Microsoft Translate yielding more effective results. Moorkens (2018) identifies neural machine translation as the better option among most learners. Neural machine translation produced fewer word order errors compared to statistical machine translation, fewer morphological errors, and fewer segments requiring editing. However, there is also no improvement of omission or mistranslation when using neural machine translation. Despite the strengths discussed, another limitation exists in lacking artificial neural machine translation training data for bilingual texts; hence, errors persist even when using the neural paradigm. Therefore, human post-editing is still needed. As Moorkens (2018) and Ducar and Schocket (2018) highlight the fact that the current translators such as Google Translate and Microsoft Translate operated with artificial intelligence elements remain unreliable, machine translators alone cannot be the only facilitator of communication. Human teachers are still needed to activate further both the theories of machine-learner assemblage and hybrid intelligence in this bilingual and English as a second language context.

**Expanded Hybrid Bilingual and English Language Learning Hybrid Instructional Designs with Various Intelligent Technologies**

As previous studies highlight the need for human facilitation in utilizing machine translation in the language teaching and learning process, Vogel et al. (2018), Chen, Tsai, and
Tsou (2019), and Lee (2020) present more promising instructional hybrid bilingual and English language learning designs centering around the notion of machine-learner assemblage and hybrid intelligence. Vogel et al.’s (2018) case study of a sixth-grade emergent bilingual student leveraging the use of a machine translation software, Google Translate, during writing activities for the purpose of expanding more possibilities of translanguaging pedagogy in a digital environment confirms the claim that human teachers are needed to facilitate bilingual and English language learning instances. The focal student observed is an immigrant from China studying at a non-bilingual school with teachers utilizing the practice of translanguaging to support English language development. Specifically, Vogel et al. (2018) examine how Dant’s “human-machine assemblage” theory would apply to translanguaging to discover the learning effects of learner interaction with a machine and hoping to discover new biliteracy pedagogies. Despite noting similar challenges of plagiarizing, dependence on the technology, and the replacement of the role of human interpretation identified previously by Clifford et al. (2013), Case (2015), Briggs (2018), and Groves and Mundt (2015), Vogel et al. (2018) see the use of translation software as an “opportunity for learning, rather than as a threat” (p. 93). Nevertheless, in the process of collecting data, the learner was engaged in responding to questions in the first language, translating his responses into English in his own words, and then comparing the translated responses with Google Translate’s translations. During the process, the instructor discovered a “teaching into” moment in which the instructor found an opportunity to engage in meaningful discussion of both student-generated and machine translation outputs. Hence, this discovery shifted the teacher’s perspective of translanguaging to include machine translation as part of the learners’ semiotic repertoire for biliteracy development. The learner’s active use of Google Translate to make tactful choices in choosing words, phrases, or whole sentences for
translation based on his prior knowledge of Chinese and English revealed the learner’s ability to construct meaning via machine translation. This shows the potential of using machine translation as becoming part of the learner’s semiotic repertoire. Furthermore, data also show that the learner sought the opportunity to evaluate, analyze, and integrate translations for intelligibility, accuracy, and improving his own language practices, respectively. As the instructional approach satisfies the proposed definition of hybrid teaching and learning, this study offers potential in advancing bilingual and English language learning pedagogy via the underpinnings of the machine-learner and/or hybrid intelligence theories.

In another similar study conducted at the university level in an English for specific purposes Taiwanese setting, Chen et al. (2019) discuss the positive and negative effects of translanguaging with the integration of online translation tools. Students of both high and low English proficiencies engaged in four writing tasks in response to a prompt: (1) Write a draft in Chinese within 30 minutes; (2) Write a draft in English within 30 minutes; (3) Use Google Translate to generate an online translation from Chinese to English; (4) Revise the English draft using the translations generated from Google Translation within 10 minutes. Students’ works were evaluated using the CLASS evaluation chart for business communication with the following criteria: content, literacy, and style. The results of both groups were compared with the more proficient group producing longer essays and more revisions than the less proficient group. After comparing students’ drafts, Google translations, and revisions, Chen et al. (2019) observed an improvement in all three criteria, specifically in content improvement with clear evidence of students leveraging prior knowledge in the first language to show more understanding in the revisions, improved literacy with better sentential construction, and advancement in using more professional academic vocabulary. However, one of the main issues that occurred with the low
group is a direct borrowing of the Google translations without making any corrections, which suggests the need for “explicit instruction to help students compare different language systems and edit different versions of the text” (Chen et al., 2019, p. 82). Although both the machine and the learner have interacted with each other to generate more meaningful text via translanguaging, the learning process may not be as effective without training on editing the translations. Also executing a similar hybrid pedagogical design and examining the positive effects of machine translation in language teaching and learning, Lee (2020) acknowledges the reality of increased usage of machine translation both inside and outside of the classroom but claims that effective pedagogical use of machine translation as a tool for second language learning in English as a foreign language classroom is lacking. Noting that previous studies on machine translation mainly focused on postediting texts generated by machine translation and advancing Chen et al.’s (2019) study, Lee (2020) redesigns the pedagogical use of machine translation by having learners produce text in their first language followed by their own translation into the target language. Then, learners compared their own translations to machine translation translated texts to correct their errors. Figure 2.12 delineates the data collection and analysis. Students’ works were analyzed to generate quantitative results while interviews and reflection papers were collected from students for qualitative analysis.
For the quantitative text analysis, students’ works were analyzed for the changes learners made to their final revision while comparing their second language version to machine translation’s second language version of the text. Most changes occurred at the lexical, phrasal, and clausal/sentential level; no changes were found at the paragraph level. This reveals that the learners did not simply use machine-translated text in their own works. For statistical analysis, t-tests also verified significant differences in writing scores and the quantity of lexical and grammatical errors in the first version of the student-translated text and the final revised text.

Qualitatively, most students mentioned improvement in their writing with the support of machine translation. Some were at first doubtful of using machine translation due to previous notions of inaccuracies; surprisingly, after experiencing using machine translation, a student remarked on the tool’s impressive, translated results. Similar to the findings of Clifford et al. (2013) and Giannetti (2018) regarding vocabulary development, Lee (2020) also confirms improved vocabulary development in which learners find machine translation helpful in choosing more...
precise words and selecting more authentic ways of expressing ideas. They also prefer using machine translation to search for vocabulary, as the use of the dictionary exposes them to a plethora of words, and they often do not know which words to use for the most suitable context. Also supporting similar claims of the limitations of machine translation presented in Niño’s (2009) and Ducar and Schocket’s (2018) studies, Lee (2020) argues that machine translation continues to show instances of ungrammatical expressions, awkward literal translations, run-on sentences leading to more grammatical errors, lack of cultural transfer, inaccurate translations with elusive words, or words with multiple meanings. Surprisingly, the limitation of ongoing grammatical errors has assisted students to become more grammatically aware as they have become more cognizant of grammatical usage when examining and comparing machine translation-generated sentence structures to their own translations, which ultimately encouraged them to correct their errors. In evaluating the performances of low- and high-level students, Lee (2020) further identifies that students with lower writing ability found machine translation useful, helpful, and effective in improving their grammar and vocabulary in writing, while high-level students had more negative perceptions of machine translation. This reveals that students with a stronger command of the target language are more cognizant of the limited capabilities of current machine translation, which may suggest that machine translation in language teaching is more beneficial for lower-level learners or struggling language learners.

In essence, machine translation in second language writing has decreased lexicogrammatical errors and improved student revisions. It has also positively influenced student writing strategies and helped learners to think metacognitively about the writing process. As machine translation is becoming ubiquitously available to learners, instructors must learn to embrace this computer-assisted technology in language learning, seek task designs for various
learning contexts to integrate it into the pedagogical process, and become cognizant about its limitations to properly guide and engage learners with appropriate usage of machine translation in a hybrid language learning environment. Also, the limitations presented in these studies of machine translation in language learning, whether in a bilingual, English as a second or foreign language, or foreign language setting, offer deeper insights into further research about the appropriate application of machine translation software in hybrid teaching methods to make the machine-learner assemblage more interactive and to elicit more learner engagement.

Current methods that integrate automated writing assistants, specifically Grammarly, entail having the software detect lower-order writing errors (Ghufron & Rosyida, 2018; Parra & Calera, 2019; Koltovskaia, 2020). Students mainly copy and upload text onto the platform to independently check for grammatical features, such as punctuation, mechanics, and style, while the instructor serves as the facilitator (Ghufron & Rosyida, 2018; Parra & Calera, 2019; O’Neill & Russell, 2019a). In Koltovskaia's (2020) study, learners engaged in an initial submission for teacher feedback for higher-order content. After making the necessary revisions, they input the text into the system to check for lower-order writing errors. Although the results are mixed, with some studies suggesting writing improvement (Ghufron & Rosyida, 2018; O’Neill & Russell, 2019b), and others claiming the software has limitations in improving students' writing (Dembsey, 2017; Nova, 2018; Ghufron & Rosyida, 2018), most of these studies suggest the need for teacher monitoring and guidance as well as training in developing appropriate methods conducive to learning (Koltovskaia, 2020).

development guidebook that had students engage in interactive conversations and intensive practice with Google Assistant; thereafter, they practiced the same dialogues with their peers. During the process, students could also provide peer feedback based on what they had learned from the machine. Underwood (2017) discusses methods that focused on "free-style" student use of asking the voice assistant about information for projects, teacher-directed demonstration of how to have the voice assistant generate pictures of words that are difficult to distinguish and other higher-level challenging tasks, such as getting the voice assistant to answer the most complex questions. Gradually, teacher-designed tasks shifted to student-designed tasks. Ahmed Ali (2020) and Underwood (2017) both observed students' metacognitive skills in self-evaluating their own pronunciation after interacting with the machine. Furthermore, Yong (2020) presents more revolutionary breakthroughs of how current voice recognition software are machine-trained, with the capability to act as intelligent listening oral assessors, to evaluate spoken language in the following areas: phoneme accuracy, word accuracy, fluency, and stress position. The tools developed by Chiseng and Zhiling can be ubiquitously used for pre-class, after-class, presentation assessment, simulation test, and oral competition. The affordances offered by voice recognition software can foster more innovative methods and a more targeted, efficient, and precise evaluation of learners' oral language development of the target language.

**Assessing the Technological Capabilities of Current Artificial Intelligence-Powered Tools**

The examination of the benefits and drawbacks of machine translation tools in language teaching and learning may lead to questions about how machine translation can be effectively adapted in a bilingual or English as a second or foreign language learning environment. Ducar and Schocket (2018), in considering academic honesty, conclude that even with academic policies in place, regulating students’ use of machine translation outside of the classroom is futile. They question how the second language teaching profession can adapt to machine translation as
it seems to have changed the ways of communicating in another language. Therefore, they argue for the need to gain a deeper insight into the strengths, weaknesses, and failures of machine translation in all aspects of language teaching and learning. Putting Google Translate operated on artificial neural networks to the test, Ducar and Schocket (2018) delineate the notable strengths of Google Translate which include a high level of accuracy in verb conjugation, spelling, close-range gender and number agreement (inaccuracies occur as distance increases, such as in maintaining agreement in subordinate clauses), and high-frequency idioms with the support of human verification via the Google shield system (assuming high-level linguistic competence on the part of the humans). Even with these strengths, they stress the need to keep in mind that Google Translate is generally more useful for beginning and intermediate-level language learners.

Though Ducar and Schocket (2018) identify past limitations of Google Translate in previous studies, most have been corrected. These include errors humans do not make, proper nouns translated into the target language, unnatural writing, literal translation leading to issues with translating words with multiple meanings, and misspelled words not translated correctly. However, issues that persist in machine translation include grammatical inaccuracies, formal and informal varieties, cultural aspects, and pragmatic issues related to context, connotation, and denotation (Ducar & Schocket, 2018; Allué, 2017). Commenting on Google’s failures in machine translation, Ducar and Schocket (2018) argue that the perspective of viewing machine translation as good as or better than human “ignores the intercultural pragmatics that underlie human communication” (p. 785). In other words, it does not consider “context, connotation, denotation, register, and culture in language production and comprehension” (Ducar & Schocket, 2018, p. 785). Similarly, Mohammed et al. (2018) also highlight related limitations. Further issues examined in machine translation errors include polysemy and the inability of translation
software to tailor translated texts to fit the language levels of learners. Hence, machine translation, such as Google Translate, is still far from a human’s ability to translate accurately, and the day for machine translation systems to replace human translators is still far in the future (Ducar & Schocket, 2018; Allué, 2017). Therefore, since there are still shortcomings in current machine translation, it is imperative to anticipate further refinements of such technologies to open more spaces for its use in various fields such as the integration of such advanced tools in the domain of bilingual and English language learning pedagogy.

Ducar and Schocket (2018) and Moorkens (2018) discuss the appropriateness of translation for language teaching and learning. Ducar and Schocket (2018) assess those students of lower proficiency who show errors in using verb tenses that have not been covered, high-level vocabulary, complex subordinate clauses, and limited prepositions in their writing of the target language. As Google Translate continues to improve, instructors will be able to detect students’ use of machine translation, especially in less-proficient students. Therefore, Ducar and Schocket (2018) assert the importance for upper elementary, secondary, and postsecondary language instructors to understand how students use machine translation in their studies to develop responsible teaching methods that would make more effective use of this tool. They also indicate the need for open discussion about the moral use of this tool to promote academic integrity.

Applying the second language acquisition theory of motivation is also imperative for curriculum designers and teachers to engage learners in research-based learning activities that actively involve them in the input-output processes of language acquisition. This calls for the need to understand the technology behind machine translation to develop appropriate instructional strategies for its use. Furthermore, for academic growth, pedagogical activities will also be required for students to identify the strengths and weaknesses of machine translation. For
instance, they describe how translating a song requires identifying syllabification, rhyming, alliteration, metaphor, and metonymies. These aspects will engage learners to actively think about the connotative meanings of words that machine translation may not capture. Moreover, Moorkens (2018) claims that machines do not consider ethics or evaluate risk. For instance, feedback from a study he discusses shows machine translation may be appropriate for perishable texts while inappropriate for literary texts, as more risk is involved. Machine learning is limited to mimicking human intelligence and lacks the consciousness about what is right or wrong. Lastly, technical barriers remain high for neural machine translation; therefore, Moorkens’ (2018) study only offers a window for more possibility in building technology into other neural-based translation learning modules that may be designed for a hybrid language learning environment.

Niño (2009) and Clifford et al. (2013) discuss the changing role of machine translation in the language learning arena as well as in academia and personal usage. Traditionally, using machine translation in language learning has not been a popular method with claims that it would “hit a brick wall” (Clifford et al., 2013, p. 109). However, with the introduction of more advanced translation tools, such as Google Translate, this may not be true anymore. Despite the concerns expressed in these studies and as machine translation technology improves, it may change traditional methods of language teaching, signaling a new era of machine translation computer-assisted language learning integrated into hybrid learning contexts. Clifford et al. (2013) further conclude that as the world is becoming increasingly globalized with multiculturalism becoming more of a reality, translation in the classroom is undergoing a resurgence of becoming a common topic for academic discussion. Also, Case’s (2015) and Briggs’ (2018) assertions of significant improvements in machine translation could be a game-changer, rather than just a shortcut, in transforming the language learning process. Ducar and
Schocket (2018) also assert that machine translation is becoming more of a necessity and has even become inescapable. Overall, using machine translation in language teaching and learning has yielded positive responses from both learners and instructors despite certain limitations. Future research should not only continue to focus on students’ perceptions of the value of machine translation in their language learning and its ethical use in academics, but also on the discourse between teachers and students, and between teachers themselves, about effective machine translation use (Clifford et al., 2013). The potential of machine translation tools and the challenges of using machine translation in language teaching and learning may suggest the need for improved hybrid instructional designs to move toward the possibilities of translating machine-learner and hybrid intelligence theories into practice more effectively and efficiently in a hybrid language learning context.

Automated writing assistants are mainly used for the revision process in English as a second or foreign language pedagogy, and its technological capabilities have limitations. Although Parra and Calero (2019) assert that automated writing assistants have enhanced the language learning process, language instruction, and language assessment, they also identify the need for teacher feedback for writing features not supported by technology. Ghuron and Rosyida (2018), Nova (2018), and Parra and Calero (2019) also identify the lack of meaningful interaction between the students and technology as well as the inability of the software to assist the users with higher-order writing skills, such as content and organization. Furthermore, supporting the notions regarding the limits of current artificial intelligence technologies, Dembsey (2017), Nova (2018), and Ghuron and Rosyida (2018) recognize the automated sample feedbacks provided by Grammarly are too generic, explanations may not suit the identified errors, and advanced terminology may not be helpful for second language learners who may not have
developed the linguistic repertoire to understand what the machine generates. Even so, Ghufron and Rosyida (2018) also contend that Grammarly has significantly contributed to improving students' writing, specifically in reduced errors in language use, mechanics, and diction, compared to the teacher's written feedback in an English as a foreign language context. Hence, as machine translators can support learners to an extent, automated writing assistants could further assist in developing learners’ autonomous detection of lower-level grammatical features.

Recent advancements in artificial intelligence-powered voice recognition and evaluation software are regarded as efficient, engaging, and more targeted to the pedagogical process even though its technological capabilities still have limitations. As with other artificial intelligence tools, the notion of human-machine assemblage co-teaching is still needed. Ahmed Ali (2020) asserts the efficiency and engaging nature of Google Assistant to provide more flexible learning opportunities without time and location constraints. The results of the study unveil significant improvement to learners’ oral language development. Also, in line with Ahmed Ali’s (2020) claim, Yong (2020) posits the ubiquitous and efficient nature of this tool that can be utilized anytime and anywhere, as well as offer teachers the opportunity to differentiate instruction with a variety of oral assessment practices. Yong (2020) further explicates that the oral assessment software can be used to pinpoint weak points more precisely to help teachers design lesson plans that can target learning needs accordingly; however, similar to other artificial intelligence technologies, speech recognition technology is still imperfect as analyzing emotion and tone is still difficult. Underwood (2017) also cautions that some responses to student queries were not accurate; even so, students quickly learned how to rephrase their questions to increase the likelihood of having the machine produce the information they need. Furthermore, voice recognition may generate inappropriate responses and have difficulty understanding
simultaneous input from learners. Therefore, Underwood (2017) suggests classroom management is vital for tasks that require this tool. These studies prove that machines are still far from replacing human teachers in evaluating students’ oral language development skills, which suggests the continual need for human intervention and facilitation. Alongside the limitations of machine translators and automated writing assistants in language learning pedagogy, voice recognition software also leaves room for further exploration of expanded spaces for a combination of human and machine intelligences to revolutionize and transform the way language is taught.

**Gaps in the Literature, Implications, and Discussion**

English as a second or foreign language learning in the Taiwanese K-12 setting has been influenced by traditional approaches to teaching and learning as well as cultural factors, such as respecting elders and a “face-saving” mindset. Cortazzi and Jin (as cited in Xie, 2010) identify Asian cultures of learning that seem to affect Asian students’ self-identity as learners, which, in turn, have collided with their English language learning process. As the field of English language teaching and learning is evolving and moving beyond the four walls of the classroom, this has opened up more online channels and different modalities for more language learning opportunities (Johnson, 2013). Whether a hybrid language learning approach that integrates elements of a bilingual or English as a second language method of translation/translanguaging and machine learning will improve the experience of struggling learners remains in question.

Though the literature reveals that the blended mode of hybrid learning has had positive effects on student learning, assembling a seamless hybrid design that ensures a high-level learning and acceptance level on the part of both teachers and students remains a challenge. Limitations mainly fall into the following categories: curriculum and instruction, effective usage
of online technologies to improve the online component of hybrid learning, and quantitative results needed to yield a deeper understanding of the effects of hybrid learning in the context of English language learning. Albiladi and Alshareef (2019) and Oliver and Stallings (2014) discuss the challenges teachers face in terms of instruction and curriculum design. Building students' independent learning skills and collaborative learning skills for both online and offline components of hybrid learning need further effective and efficient implementation. The improvements needed in lesson design will require more focus on designing activities tailored to meet individual learner needs. Linder (2017) further advocates for clear instructions in establishing a connection between online and offline learning components. Adding to the challenge is integrating relevant online technologies and a teacher’s tactful exploitation of these tools to make the online portion of a hybrid learning environment an effective and efficient one (Davies, 2019; Foomani & Hedayati, 2016; Hosseinpour, Biria, & Rezvani, 2019; Senn, 2008).

Lastly, as the studies reviewed focus more on student perceptions, there needs to be a greater emphasis on examining appropriate instructional designs to evaluate student progress in order to truly assess the effects of a hybrid English teaching and learning context.

More advanced hybrid learning environments that mix online and offline instruction and/or tasks, particularly in the context of bilingual or English as a second or foreign language, as well as foreign language teaching and learning, have been identified. Specifically, the instruction methods of translation and translanguaging with the integration of machine translation coded with artificial intelligence elements have been examined. However, even with one of the most advanced tools integrated into the identified hybrid learning environments, limitations continue to persist in several areas.
Two salient areas the literature has unveiled include the need for eliciting more qualitative data that yield deeper insights as to why and to what extent students and teachers may or may not prefer machine translation in language learning, and more quantitative studies yielding numerical data analytics measuring learner success. For instance, Case (2015) recommends that further qualitative research is needed in students’ perceptions about the teachers’ role in machine translation, while current quantitative studies only focused on providing ratings of translation results (Briggs, 2018), and students’ written works were limited to analysis in other mixed-method studies examining the shortcomings of writing instruction with machine translation (Giannetti, 2016; Lee, 2020).

Other shortcomings concern effective pedagogy in a hybrid learning environment that deploys both human (student and instructor) and machine intelligence. Aside from improving writing instruction to fill the gaps presented in this review, improving instructional methods with machine translation as well as a combination of computer-assisted technologies to facilitate and leverage the usage of machine translation, in other language domains, such as listening, speaking, and reading, could also provide more insight into further roles machine translation might play in a hybrid language learning context to better inform the theories of transtheoretical model of hybrid learning, machine-learner assemblage, and hybrid intelligence. Furthermore, there is limited reference to the application, analysis, and critique in the implementation of the bilingual method of translinguaging in bilingual or English as a second or foreign language contexts, as most studies included in this review mainly focused on translation pedagogy with the use of machine translation as a fifth skill in language learning. Also, there is a lack of studies comparing the performances of groups who received translingual instructions to those who did not. As Vogel et al. (2018), Chen et al. (2019), and Lee (2020) assert the potential of online
translation software as an effective learning tool, particularly in the area of expanding the translingual process of leveraging both learners’ first language and second language in the learning process, especially for learners with lower English abilities, there is a need for further investigation into the extent of its effects through measuring and comparing the performances between experimental and control groups with larger sample sizes of low-performing English language learners to support the validity of these scholars’ conclusions. Also, some studies have highlighted ongoing grammatical inaccuracies and lack of attention to formal and informal varieties, cultural aspects, and pragmatic issues related to context, connotation, and denotation. These limitations in current machine translation software operated on artificial intelligence neural networks also require further investigation to ensure effective and efficient hybrid pedagogical facilitation between human learners and teachers and more powerful translation software to overcome the shortcomings of current translation software discussed in this review. In addition, the absence of causal relationships, as identified by Pearl (2018), suggests why machine translation software continue to perpetuate such environmental errors, which means if humans can provide more interventions to establish these causal relationships in machine learning, perhaps, this may improve artificial intelligence technologies and elicit more effective instructional approaches to language learning. Lastly, the issue concerning plagiarism also deserves attention in the pedagogical process, as Yanisky-Ravid and Martens (2019) assert that current artificial intelligence online translation software do not provide clear international copyright laws for creating derivative works of copyrighted material, as well as facilitating people’s access to the culture and knowledge this software provides. Furthermore, the built-in algorithms may also generate further complex issues of bias concerning race, sex, and gender, religion, or national origin. Addressing the issues of machine translation in the language teaching
and learning process in this study suggests the need for opening new learning spaces focused on
the tactful and appropriate usage of this innovative software. Furthermore, other artificial
intelligence-powered technologies, such as automated writing assistants and voice recognition
software, are complementary to the bag of powerful tools needed to further embellish learners’
second or foreign language development. Similar to machine translators, these two programs
could act as supplemental tools in a hybrid language learning environment that calls for both
human and machine intelligences to best facilitate the pedagogical process. Lastly, the literature
reveals the limitations of these tools when operated separately. When these tools are combined,
this endeavor may offer new implications pertaining to bilingual or English as second or foreign
language pedagogy, the rate of English language development, and student and teacher
perceptions.
CHAPTER 3: THEORY & METHODS

Theoretical Framework

Extending the Transtheoretical Model to a Bilingual and English as a Second Language Hybrid Environment

As modeled by Tashior et al. (2011), pinpointing optimality for conducting hybrid learning on a three-dimensional transtheoretical model is elusive. After assigning four main regions on this three-dimensional space as discussed in the literature, Tashior et al. (2011) theoretically conclude that the most effective zone may possibly lie in the K region in which there is high potential for desired learning outcomes, high connectivity for all relevant stakeholders to implement this model of learning, and high resilience for any technical setbacks. However, there is a lack of data confirming the K region would exemplify the best region for hybrid learning. Therefore, to extend the K region of the transtheoretical model for hybrid learning, this study proposes a bilingual and English as a second language hybrid intervention model, as illustrated in Figure 3.1, to combine all the identified traditional learning theories (constructivism and motivation theory), second language acquisition methods (communicative approach and natural approach), and the bilingual method of translinguaging as well as the seven components of the affordance theory. These elements are assembled into this intervention model with a combination of intelligent computer-assisted technologies to generate automated machine evaluations (particularly, machine translators, automated writing assistants, and speech evaluation software) and ongoing teacher facilitation and feedback.
The traditional learning theories and language learning methods discussed in the literature are considered for the bilingual and English as a second language hybrid intervention model of this study because of their potential to further address the limitations in the current hybrid language learning environments presented. Through investigating the following areas, new pedagogical discoveries in the field of second language teaching and learning can be made via a hybrid learning context:
• learners’ ability to construct knowledge through teacher-facilitated communicative interaction

• strategic bilingual and English as a second language instructional strategies to increase learning motivation in a technology-enhanced environment

• the affordances offered through the tactful implementation of selected technologies

• a mixture of how these features are interrelated in order to yield improved English language results

Integrated into the previously mentioned theories and methods are the theories of machine-learner assemblage and hybrid intelligence. As the proposed theoretical model makes connections with several fields of teaching and learning—traditional learning theories, bilingual and English language acquisition methods, and a combination of technologies to leverage machine translation, a writing assistant, and a speech evaluation software as the core intelligent tools for hybrid instruction—the theories of machine-learner assemblage and hybrid intelligence will be applied to two distinct areas. As modeled in Figure 3.1, Dant’s (2004) theory of machine-learner assemblage will serve the application by combining human teaching and learning with a combination of computer-assisted technologies, such as using a learning management system, learning modules, a video conferencing tool, a digital assessment tool, and other relevant apps. Within this pedagogical domain is the core of hybrid intelligence, as put forth by Dellerman et al. (2019) and Kamar (2016) between human teaching and learning and the three aforementioned intelligent tools to activate bilingual and English language teaching and learning as the core learning support.
The Essentiality of Hybridity in Bilingual and English as a Second Language Pedagogy with Machine Learning Translation Software and other Intelligent Tools

A core area for discussion in the proposed extension of the transtheoretical theory of hybrid learning is the rationale behind hybridity in the implementation of machine learning translation software in bilingual and English as a second language pedagogy. As mentioned in the prior literature, current machine translation exhibits errors due to a lack of causality. Hence, we see the following environmental errors when machine translation is used as a support for language teaching and learning:

- Ongoing grammatical inaccuracies in more complex sentence structures
- Lack of attention to formal and informal varieties
- Lack of cultural attention
- Pragmatic issues related to context, connotation, and denotation

Generally, these types of errors are all environmental-related or may involve higher-level linguistic features of the language. As Pearl (2018) delineates in his three-layer causal hierarchy, there will be a need to provide interventions in the second layer to truly achieve causality at this current stage of artificial intelligence development. He further questions and makes the following statement:

“How can machines acquire causal knowledge? That is still a major challenge which undoubtedly will involve an intricate combination of inputs from active experimentation, passive observation, and (not least) input from a programmer—much of the same inputs that a child receives, with evolution, parents, and peers substituted for the programmer” (Pearl & Mackenzie, 2018, p. 18).

Since artificial intelligence is still in its nascent stages of achieving near-human capabilities (also referred to as narrow artificial intelligence), humans still need to provide the
interventions to engage human learners to train the machines to acquire causal knowledge. Pearl provides an analogy of artificial intelligence as the “child” receiving input from external factors that have more ability and knowledge. For the purpose of explaining why humans are needed in the teaching process, a general hypothetical bilingual and English as a second language intervention strategy with the integration of artificial intelligence-powered machine translation is illustrated (Figure 3.2.a) and applied to Pearl’s (2018) three-layer causal hierarchy discussed in Chapter 2.

A sample teacher bilingual and English as a second language intervention strategy in the second layer of the three-layer causal hierarchy could be to engage learners to observe and analyze causality by using situational images as a complementary to their bilingual and English language textual acquisition using online machine translators. In addition, although Google Translate may provide images with their translations, they are only limited to nouns (Snir, 2019), confirming the lack of causality in current machine translation software. If students were engaged in a descriptive story writing process, the use of images might be needed to scaffold and facilitate the teaching and learning process with machine translation. For instance, the use of an image screenshot with unknown birds at a shallow lake for the purpose of instructing learners to produce descriptive text from a video tutorial is given. In writing their descriptive text, students may be asked guiding questions that relate to the cause and effect of images. The image provided in Figure 3.2.a can possibly yield the following responses from students:

- ‘Cause’ of cause and effect: Water flow is due to temperature and basin; there is plankton because of food chain factors, small fish, and big fish.
- ‘Effect’ of cause and effect: The creatures in the shallow lake attract many birds to forage here.
## Figure 3.2.a

### Sample Teaching of Causality with Human Intervention Using Machine Translation

<table>
<thead>
<tr>
<th>Hypothetical teaching intervention with machine translation and human discussion of causality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Listening, reading, and writing development with machine translation</td>
</tr>
</tbody>
</table>

**Screenshot from video (Price, 2009)**

<table>
<thead>
<tr>
<th>Student tasks</th>
<th>Teacher instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write a sentence describing the situation of the picture—a screenshot of a video clip.</td>
<td>Teachers can provide scaffolding questions for students to generate texts in both the first language and the second language to describe the image.</td>
</tr>
<tr>
<td>1) English text in your own words. If you cannot describe it in English, go to 2).</td>
<td>Teachers and students can engage in discussion about how birds do not usually forage in shallow lakes under the bright sunlight during noon. Instead, birds usually forage for food when the sun is not strong. These time periods occur when the colors of the lake reflect the golden late-afternoon colors of the sun, which is also the time for fish to appear.</td>
</tr>
<tr>
<td>2) Chinese text in your own words: 太陽的金色光芒映照下，深的透明的水面波光中，有7隻不知名的鳥，其中有的一隻貪吃水中物，欲奮力飛翔，有的站得直直的站立在波光湖中。</td>
<td></td>
</tr>
</tbody>
</table>

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From this example, translators such as Google Translate and Baidu Translate continue to produce errors when engaging in describing causal situation images. As Cope, Kalantzis, and Searsmith (2020) posit the necessity of the “[embodiment of] human thought and action” in computing machines, human or teacher intervention will be needed to intervene during the teaching process to describe causal situation images which may be a helpful way to explain what a situation means or even improve the comprehension rate of learners in the descriptive story writing process. Since not all causal situation images are easily and correctly described with sentences for English language learners, this study advocates the need for machine translation integration with human teaching of a causal situation image along with machine learning. In the
process of producing bilingual texts, students may experience translation errors in either their first or second language, or errors in both the first and second languages as illustrated in Figure 3.2.a. This may result from a lack of causal reasoning in students’ cognitive processes which will require teacher instruction in facilitating the translanguageing process with the use of machine translation in analyzing texts between the first language and the second language. In other words, the lack of training in the skill of causal thinking (cause and effect) on the part of the learners may result in incorrect translations generated from translation apps. With explicit teaching intervention using both machine translation and student submitted images to acquire higher accuracy in translation, students may be able to better activate the translanguageing corriente in their metacognitive processes to generate more critical and creative spaces for bridging their biliteracy skills and, hopefully, be able to expedite their English language acquisition in all language learning domains. To further validate this theoretical assumption of evidence of effective bilingual and English language acquisition, teachers and students can extend the data collection process by accumulating all these images and uploading them to Google’s Teachable Machine and train a model to generate data for causal connections between similar situation images and corresponding complex text translations produced by the students. Before the day a strong causal machine learning program is born, this method can serve as a bilingual and English language learning instructional intervention strategy with the use of machine translation software, complemented with a manual search for images relevant to the given context in hybrid teaching and learning.

Furthermore, current machine translation software also offer text-to-speech and speech-to-text functions, which go through the same machine and deep learning neural network processes. Chapelle and Chung (2010) discuss the possibilities of advancing technologies in
natural language processing, such as automated feedback from writing assistants offered in Microsoft Word, automated scoring systems, and automated speech recognition functionalities, to advance language testing. These automated systems shed light on “test score meaning, test score use, and possibly to learning, which is central to the academic concerns in language testing” for both oral and writing development (Chapelle & Chung, 2010, p. 309). As the bilingual and English as a second language hybrid intervention model seeks to tackle all domains of English language acquisition, Figure 3.2.b and Figure 3.2.c, respectively, illustrate how students’ can further develop their writing and speaking skills by interacting with automated feedback from Grammarly and Baidu. In this study, Grammarly, an automated writing assistant powered

**Figure 3.2.b**

*Human Intervention Using Grammarly as an Automated Writing Assistant*
by similar machine learning algorithms as machine translators, was used for student revision and evaluative scoring feedback. According to Barrot’s (2021) study, Grammarly’s overall performance text scores are determined by the number of highlighted corrections and offered suggestions generated by the system. Students’ pronunciation was evaluated using Baidu Translate’s new “read text-to-speech” and “speech-to-text” functions. Baidu Translate has
machine-trained its system to read any text input into machine translation in both languages and prompts the listener to practice orally. It then provides a rating on competency, fluency, and accuracy, as well as automated feedback for mispronounced words or letters that need further practice. Hence, with the recursive machine-assisted feedback, it can provide machine-generated data to inform human teachers on providing more informative and targeted instruction of distinctive phonetic features for oral language development. Figure 3.3 and Figure 3.4 provide a more detailed illustration of how this example pertains to Pearl’s theory of the need to train causality in current artificial intelligence systems. After applying the human teaching intervention, a further step may be to gather all the student-produced bilingual text data complemented with causal situation images for further machine training (e.g., using Google’s Teachable Machine platform).

**Figure 3.3**

*The Three Layer Causal Hierarchy*

<table>
<thead>
<tr>
<th>Level (Symbol)</th>
<th>Typical Activity</th>
<th>Typical Questions</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Association $P(y</td>
<td>x)$</td>
<td>Seeing</td>
<td>What is? How would seeing X change my belief in Y?</td>
</tr>
<tr>
<td>2. Intervention $P(y</td>
<td>do(x), z)$</td>
<td>Doing Intervening</td>
<td>What if? What if I do X?</td>
</tr>
<tr>
<td>3. Counterfactuals $P(y_a</td>
<td>x', y')$</td>
<td>Imagining, Retrospection</td>
<td>Why? Was it X that caused Y? What if I had acted differently?</td>
</tr>
</tbody>
</table>

(Pearl, 2018, p. 2).
### Figure 3.4

Application of Pearl's Three Layer Causal Hierarchy

<table>
<thead>
<tr>
<th>Level (Symbol)</th>
<th>Typical Activity (Application; Google-Translated Chinese text using a Taiwanese student's own words)</th>
<th>Typical Questions (Application Question)</th>
<th>Examples (Application Example)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Association</td>
<td>Seeing (Under the golden light of the sun, there are 7 unknown birds in the shallow lake of the rippled water; some of them are grazing for water or cleaning themselves, and some are standing in shallow water. In the lake...)</td>
<td>What is? How would seeing X change my belief in Y?</td>
<td></td>
</tr>
<tr>
<td>P(y</td>
<td>x)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Intervention</td>
<td>Doing Intervening (If the teacher instructs the students to use the mobile phone to search the lake, what kind of plants, fish and what kind of migratory birds migrate to the lake at this time and this month. The teacher asked the students to rethink and compare their mistakes. After the teacher asked the students to rewrite their sentences, they input them into the translation machine again.)</td>
<td>What if? What if I do X? What if we ban cigarettes?</td>
<td>What if I take aspirin, will my headache be cured?</td>
</tr>
<tr>
<td>P(x</td>
<td>do(z), y)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Pearl, 2018, p. 2)
From this hypothetical instructional example of using machine translation in bilingual and English as a second language pedagogy, it is evident that hybridity involving human teaching and learning and computer-assisted technologies is the trend for current bilingual and English as a second language instruction. In other words, if computer-assisted technologies powered by artificial intelligence still require human intervention, then it can generally be concluded that any piece of technology, whether coded with intelligent functions or not, will continue to need humans’ cognitive capacities to operate affordances provided by these technologies in this generation.

**Limitations of the Theoretical Framework**

As the theoretical framework for this bilingual and English as a second language hybrid intervention model is built and layered upon several theories, methods, and concepts, the limitations will be discussed in light of its core components—the transtheoretical model for hybrid learning, the theory of machine-learner assemblage, and hybrid intelligence—and followed by a general discussion of how the traditional learning theories, bilingual and English as a second language methods, and affordance theory may not fully encapsulate the instructional strategies needed to support struggling English language learners in the proposed hybrid learning
environment. Since there are no critiques by other scholars available to assess the viability of the transtheoretical model for hybrid learning, Tashior et al. (2011) emphasize a dearth of rigorous research in this area and stress the need for more empirical evidence to observe and document learning patterns and behavior through experimentation. This data will be essential for a deeper understanding of what hybrid instructional learning designs can truly yield a high potential for effective learning outcomes, high connectivity for the relevant stakeholders involved in implementation, and an extent of resilience to troubleshoot any technology setbacks.

The theories of machine-learner assemblage and hybrid intelligence are analogous; they adhere to similar setbacks. Though hybrid intelligence has more direct reference to artificial intelligence-powered technologies, it also embodies the basic concept of operating a system with the inputs of both humans and any machine-operated device. Kamar (2016) posits that systems built to activate the best of both the human and the machine are not without limitations. For instance, without equipping hybrid artificial intelligence systems with the necessary and appropriate reasoning skills to allow access to human intelligence, making informed decisions may not be as effective. There are also costs and unforeseen constraints associated with combining human and machine input to achieve the desired outcome. Further analyzing Dant’s (2004) theory, Kamar (2016) states that “[in] a setting such as semi-autonomous driving, effectively seeking assistance from a man driver requires an understanding of the cognitive state of the human, including its attention…[even] in a more constrained setting…factors such as task design, incentives, and training may affect human behavior” (p. 25). With these intricacies involved, the theories that combine human and machine input cannot be easily understood without tactful experimentation in modeling various human behaviors or causal situations for hybrid machine training to assess and understand the human input, whether it be text-based or
with the use of visual texts or audiovisual texts. Artificial intelligence-powered technologies, such as machine translation, still require human effort to machine-train artificial intelligence systems in order for these technologies to understand human input and decrease translation errors, specifically in environmental-related situations requiring a greater degree of understanding of causality as put forth by Pearl (2018). If human teachers exhibit poor comprehension of causality in their teaching topic, students’ learning performances may experience adverse effects rather than positive outcomes. Furthermore, Savat (2012) also observes the ever-changing upgrades in technologies and machines which call for different protocols or procedures for various ensembles of human-machine assemblages. This can also pose challenges in formulating a set combination of technologies for a hybrid learning environment. Therefore, flexibility in selecting a combination of technologies to leverage and expand instructional designs for the three core intelligent tools—machine translation, an automated writing assistant, and a speech evaluation software—in hybrid language teaching and learning will be further examined in the research design.

The selected traditional learning theories, bilingual and English as a second language methods, and affordance theory mentioned in the literature present a possible model for explaining this hybrid learning environment; however, as all these components are separate constructs, the most optimal region in a more coherent transtheoretical model for hybrid learning has been identified to assemble these pieces in a single learning paradigm (See Figure 3.1). Although the traditional learning theories of Constructivism and Motivation Theory are linked to hybrid learning as a model for hybrid instructional design (Jin, 2009), there is insufficient empirical evidence of its viability. Likewise, the association of Gibson’s (1979) Affordance Theory may also include intrinsic limitations as teachers’ abilities in the execution of the seven
constructs proposed by Kalantzis and Cope (2015) could vary. As Gedik et al. (2012) posit, the myriad of possibilities for facilitating these seven constructs is an obstacle to implementing the proposed intervention model effectively. These limitations will rely on the identified transtheoretical model for hybrid learning, which itself also needs a more robust empirical basis to prove its efficacy. Although there are distinct studies indicating the potential positive learning effects of the selected English language acquisition methods—Communicative Approach and Natural Approach—and the bilingual method of translanguaging in identified hybrid learning environments, there is no research for critiquing the integration of the three methods to explain how their interconnections may play out in practice in this new learning landscape. Therefore, this may also pose unanticipated limitations during the implementation of the intervention.

In conclusion, understanding these shortcomings further confirm the need for implementing both quantitative and qualitative methods. In supporting this stance, Savat (2012) accentuates the notion that technological shifts, specifically in the arena of human-machine assemblage, “…produce and express quantitative shifts that can result in qualitative shifts in people’s perception and experience, and sense of being in the world” (p. 79). As both quantitative and qualitative data for measuring pedagogical effects in hybrid environments are still limited, an explanatory sequential mixed-methods approach in the research design will be the basis in the data collection process for this proposed intervention model.

**Methodology**

**Framing Research Questions and Hypotheses within the Proposed Theoretical Framework**

As discovered in the shortcomings of the proposed theoretical framework and empirical evidence, both quantitative and qualitative data, is limited in the area of a technology-enhanced hybrid learning environment that diffuses both human and machine inputs (Tashior et al., 2011;
Savat, 2012). Findings from both methods may explain whether the hypothesis of hybridity with the integration of intelligent tools and a flexible combination of technologies for language teaching and learning will be an effective intervention model to support struggling English language learners in a Taiwanese education setting. As the learning effects and students’ and teachers’ attitudes about conducting learning and teaching in this hybrid learning environment remain unexplored to a deeper extent, the following research questions are framed to advance more pedagogical possibilities in this area:

- What bilingual and English as a second language hybrid intervention model that integrates a combination of artificial intelligence technologies, with machine translation as the integral starter tool, and other computer assistive tools leads to improved English language performances among struggling English language learners?
- What is the rate and quality of improvement of struggling English language learners who received instruction via the bilingual and English as a second language hybrid intervention model compared to those who received traditional instruction?
- What are teachers’ and students' perceptions about teaching and learning via the implementation of a bilingual and English as a second language hybrid intervention model?

In developing the applicability of the theoretical framework, the first two research questions have been devised to yield quantitative learning results and the third research question is to yield qualitative data to further and deepen investigation into both teacher and student perceptions about the efficacy of this intervention model. In addition, the third research question is also reflective of the limitation in examining teaching and student roles in Case’s (2015)
discussion of machine translation usage in hybrid learning contexts that require complementary outsourcing of laptops, tablets, and smartphones.

**The Rationale for an Explanatory Sequential Mixed Methods Design**

An explanatory sequential mixed methods approach will be conducted for this study. For the quantitative section, a causal design will be implemented to test the effectiveness of this intervention model. To further evaluate learning evidence at a more granular level, students' works involving translanguaging processes to acquire a second language via the use machine translation software will also be examined and interpreted for meaningful learning outcomes. Acquiring students' and teachers' perceptions about their roles in deploying this intervention model will also be vital; hence, teacher and student written reflections will embody the qualitative sector of this mixed methods study.

**A Brief History of the Emergence of the Mixed Methods Design and its Variations**

Quantitative studies dominated the research arena for the first half of the 20th century until the eventual evolution of qualitative design of the 1970s, which has brought about a heated debate between the two methods or a mix of both (Lund, 2012; Caruth, 2013; Cronholm & Hjalmarsoon, 2011). Generally, quantitative data yield numerical data while qualitative data resort to text and image data (Creswell & Creswell, 2018). Quantitative procedures may include deciding the best sampling methods, conducting a pilot study, defining control and experimental variables, and other statistical methods for data analyses. These procedures are more generalizable and feasible for duplication. Common qualitative procedures comprise observations, interviews, ethnographic image, video or audio documentation, and narratives. These methods yield deeper understandings of a phenomenon studied (Creswell & Creswell, 2018). Proponents of each approach argue not to mix both methods as each has its own set of
empirical methods and philosophical basis/paradigms that are in opposition (Lund, 2012; Caruth, 2013; Creswell & Creswell, 2018). For instance, quantitative studies usually bring forth the testing of a hypothesis while qualitative studies reside in hypothesis generation. As for worldviews, the quantitative approach adheres to a positivist philosophy of conducting traditional scientific research in identifying the causes and determining the effects or outcomes; on the other hand, constructivism resonates with the qualitative approach as it engages individuals to construct and interpret meanings in their environment (Creswell & Creswell, 2018). Other debatable issues between the two methods include the difficulty in replicating and generalizing qualitative approaches in more than one setting and the “immaterial hypotheses and shallow descriptions” (Caruth, 2013, p. 112) that quantitative studies produce. The mixed methods approach evolved from the limitations of quantitative and qualitative designs which brought forth the need for triangulation of various data sources (Caruth, 2013; as cited in Lund, 2012). With the inception of the mixed-methods design around 2000 (Lund, 2012), this third method, which reflects a pragmatic worldview (Lund, 2012; Creswell & Creswell, 2018), is gaining more acceptance in academia, although with a new set of limitations and debates for its soundness in research. Under the branch of a mixed methods approach, there are three primary designs:

- Convergent mixed methods—collecting both quantitative and qualitative data simultaneously
- Explanatory sequential mixed methods—first collecting quantitative data, then qualitative data
- Exploratory sequential mixed methods—first collecting qualitative data, then quantitative data
The gaps indicate the need for deeper exploration of both quantitative and qualitative data to evaluate the effectiveness of the proposed intervention model. As a result, the discussion for the selection of the most appropriate method for data collection will hone in on the three main mixed methods designs.

**Strengths and Limitations of Various Mixed Methods Designs**

Caruth (2013), Almalki (2016), Cronholm and Hjalmarsoon (2011), Lund (2012), Pardede (2019), and Riazi and Candlin (2014) discuss the strengths and limitations in a mixed-methods design. Although Caruth (2013) asserts that “mixing the methods can complement each other, offer richer insights, and result in more questions of interest for future studies” (p. 113), Pardede (2019) and Riazi and Candlin (2014) argue its challenging nature compared to the two traditional approaches of separate quantitative studies and qualitative studies as well as its dearth of studies in the language teaching and learning domain. As more studies start to explore language-related issues in bilingual and second language pedagogy, there is the potential that a mixed methods design can offer a deeper understanding of any phenomena for analysis as it continues to mature. For this particular study, the phenomenon of missing causality in current intelligent tools, particularly machine translation used for this study, and the need for teacher interventions to instill students' awareness and ability to describe the existence of causality in real life via training image-bilingual text data models, will serve as a deeper investigation into whether direct instruction with the use of these tools will have an improved impact on student learning via numerical data as well as student and teacher perceptions and attitudes about the use of these tools.
Caruth (2013) outlines the strengths of using a mixed methods design. The use of words, photos, and narratives can add meaning to numbers and vice versa. A mixed methods design can also cater to a wider range of research questions and offer more robust conclusions. Cronholm and Hjalmarsson (2011) further add that there is also the potential for yielding more validity and insight through triangulation as well as for increasing the capability to generalize results. Specifically, a convergent mixed methods design efficiently allows access to a variety of sources. For explanatory and exploratory designs, they improve the ease of implementation and flexibility as well as maintain research focus while one set of data builds upon the other.

Almalki (2016) also indicates the flexibility and practicality of addressing issues via using both numbers and words to explain the meaning of a given phenomenon. Lund (2012) further identifies several general advantages of conducting a mixed methods research: (1) Answer multiple research questions that quantitative and qualitative approaches cannot accomplish separately; (2) Provide a more complete picture of the phenomenon with different objects for observation and investigation; (3) Enable more validation if both quantitative data and qualitative data can reach convergence after cross-validation; (4) Prompt further reflection, research, and/or revision to research questions and hypotheses if both data types do not reach a consensus, thus leading to new theoretical insights.

Though these benefits seem promising, understanding its shortcomings can provide a better insight into an appropriate selection of a mixed methods design for the data collection process. A mixed method design also has its challenges. Although Caruth (2013) and Almalki (2016) emphasize its value, there are arguments for not mixing both and different attitudes for mixing data. Such oppositions may lead to a decrease in the veracity of mixed methods research. Also, both authors contend that this approach is more expensive and time-consuming. Caruth
(2013) delineates the challenges for all three designs. A convergent mixed methods design requires knowledge to put all the different data sources together and the need for further research and/or investigation due to data discrepancies. Explanatory and exploratory designs require time and resources as well as making a sound decision about selecting participants for both the quantitative and qualitative phases. That is, the researcher needs to decide whether to select the same participants for both methods or not. Riazi and Candlin (2014) also warn a convergent design will need to heed the sample sizes used for both datasets and the paradoxical results from cross-validation. Claims for triangulation to attest for convergence of the datasets need substantiation of how the researcher moves between the datasets and the study's theoretical framework to make plausible inferences. Caruth (2013) further argues the need for researchers to deal with the logistical challenges and be knowledgeable in combining both quantitative and qualitative data effectively and professionally; otherwise, Riazi and Candlin (2014) contend that any superficial ad hoc link between the two datasets without considering strong conceptual implementation in methods design will not reflect genuine mixed methods research. Therefore, to ensure sound mixed methods design, bringing together different types of data will require a theoretical basis as well as a coherent conceptualization of the topic of study.

As convergent mixed methods design poses the greatest number of issues, which may lead to more complications during the data collection process for the proposed intervention model, gathering quantitative and qualitative data in separate phases may result in more structured and organized data. As noted previously, Savat (2012) asserts that for a human-machine model designed for any phenomena undergoing constant changes and upgrades in technology, continuous quantitative data analyses are needed for its practical viability, which can lead to more in-depth, insightful qualitative results based on previous findings. This stance
supports the definition of an explanatory sequential mixed method design. It is also logical that a human-machine intervention model may need numerical data to test its efficacy, which can then enable and inform the most relevant procedures to gather textual data to assess teachers’ and students’ perceptions about its usability.

**The Selection of Explanatory Sequential Mixed Methods Design**

An explanatory sequential design has been applied to this study. Pardede (2019) explicates the aim for this method is to “[provide] relevant information necessitated to understand the research problem more efficiently” (p. 234) via two separate stages of collecting quantitative data in the first phase followed by qualitative data collected to assist with informing more in-depth understanding of the previously collected quantitative results. Both sets of data can be used to strengthen the insufficiency of either method. Quantitative data can also be expanded through qualitative data collection. Therefore, the research problem calls for the need to “[identify]...factors that influence an outcome, the utility of an intervention, or understanding the best predictors of outcomes” (Creswell & Creswell, p. 49, 2018), all of which will yield quantitative results. Qualitative data will need further development for this intervention model. Without addressing both components, adequate information to gain deeper insights into the research problem, as well as the strengths and weaknesses an explanatory mixed methods approach may entail, will not be provided. To support the relevancy of the chosen methodology with prior closely related literature of the many English as a foreign language studies explored, the common mixed method designs identified include convergent mixed methods and sequential explanatory design (Pardede, 2019). In addition, Shams’ (2013) hybrid study for English as a foreign language learners’ autonomy in vocabulary learning also employs a triangulation mixed method design and yielded adequate data for meaningful interpretation of student performances.
Even though Pardede (2019) asserts the limited nature of mixed methods in English as a foreign language studies, the proposed hybrid intervention model for struggling English language learners is relevant to prior English as a second or foreign language contexts. Also, the research questions are more closely aligned to an explanatory mixed methods approach. The present research has adopted this approach as a means to collect quantitative and qualitative data sequentially for a one semester cross-sectional study to offer a deeper and more broadened window into the effects of English language acquisition in a Taiwanese K-12 bilingual and English as a second language setting with Mandarin Chinese as the dominant mother tongue of the student population.

Riazi and Candlin (2014) and Pardede (2019) identify five purposes of conducting a mixed methods research: triangulation, complementarity, development, initiation, and expansion. Triangulation provides the researcher the channel to search for convergence in both data sets to strengthen the findings’ validity. Complementarity enables a deeper and more thorough understanding of the research problem and its results. The component of development guides the research to take one set of data and formulate the instrument for the next data collection. The fourth rationale is the initiation of revealing any contradictions which may call for a recasting of questions or results. Lastly, expansion allows an extension in the scope and depth of inquiry which enables more refined results. These five facets will serve as the underlying basis of the proposed research questions and hypotheses. The formulation of the three research questions for the explanatory mixed methods design address the following:

**Research Question 1** - The quantitative component of the study (related research hypotheses could accompany such questions)

**Research Question 2** - The quantitative component of the study
Research Question 3 - How the responses to research question 1 and research question 2 fulfill the purpose(s) of the study through qualitative findings

A Pragmatic Philosophical Worldview of Using Explanatory Mixed Methods Design Extending into Innovative Zones of Advancing Big Data Computation and Analyses

Pragmatism is associated with “…actions, situations, and consequences… [with] a concern with applications—what works—and solutions to problems” (Creswell & Creswell, 2018, p. 33). Researchers adhering to this worldview place more emphasis on problem-solving using any relevant, practical, and appropriate methods available to understand the reality of an identified real-world phenomenon (Creswell & Creswell, 2018; Lund, 2012; Feilzer, 2010). Hence, flexibility and freedom in combining quantitative and qualitative methods to answer research questions and problems are at the core of a pragmatic attitude. As the current study investigates the viability of this intervention model which operates on different layers of theories and concepts, a “mixed methods research offers to plug this gap by using quantitative methods to measure some aspects of the phenomenon in question and qualitative for others” (Feilzer, 2010, p. 8). Specifically, these distinct layers of understanding will require practical and flexible selections of methods to achieve consistent integration and yield more desirable outcomes that can inform the problem situation more appropriately. This opens the possibility of advancing quantitative and qualitative data collection via the channel of leveraging big data computation through structured and unstructured data analyses. Cope and Kalantzis (2016) assert that such methodological developments are not designed to make traditional methods extinct, but to integrate them into traditional methods in order to yield data at a more powerful and granular detail to identify more plausible evidence of learning despite challenges of accessing such data, designing appropriate data models, and maintaining data privacy. Tonidandel et al. (2018) also express concerns about data integrity (meaningless data that does not serve the purpose of
answering the given problem), ethical issues of data privacy and machine bias, difficulty in making interpretations as neural networks create a ‘black box’ for elusive analyses, and inadequacies of researchers to be knowledgeable in the combination of mixed methods and data analytics. Even with these shortcomings in mind, moving beyond traditional data collection approaches—in this case, big data computation and analyses—allows researchers to critically inquire about the robustness of the data and whether traditional methods are sufficient to answer the questions and problems associated with a given phenomenon.

For the purpose of this study, structured data analyses will be the primary focus as this intervention model deploys machine learning and data mining processes with the integration of neural networks, a data analytic approach suggested by Tonidandel et al. (2018). This will step into innovative zones of designing a mini data model via Google’s Teachable Machine for collecting machine learning-generated data for deeper analyses of evidence in student bilingual and English language acquisition. Specifically, the study will attempt to trace causal effects, as put forth by Cope and Kalantzis (2016), that may not be made possible via traditional methods of research alone. Although large volumes of data will not be readily available for robust data training of images via Google’s Teachable Machine, as such data will take years to accumulate to be considered big data, a challenge Cope and Kalantzis (2015) identify, this initial step may pave the way for new discoveries and insights in the data collection process in the arena of educational data sciences.

**The Aims of the Methodology**

Before discussing the system design and development for the bilingual and English as a second language hybrid intervention model, the aims of the methodology are as follows:
• To determine whether the bilingual and English as a second language hybrid intervention model integrated with intelligent computer-assisted tools will have positive learning effects on struggling English language learners
• To determine whether the bilingual and English as a second language hybrid intervention model will assist students to improve their English language acquisition in all language domains at a quicker rate
• To determine students’ and teachers’ perceptions of learning in a bilingual and English as a second language hybrid learning environment
• To determine whether an explanatory sequential mixed methods design will extend into Computational Linguistics that deploy big data analyses to yield deeper evidence of student learning

**System Design and Development for the Hybrid Intervention Model**

The system design and development will deploy all the components illustrated in the theoretical framework (Figure 3.1). Figure 3.5 illustrates a proposed window into the human mediation and facilitation of artificial intelligence-powered machine translation leveraged with a flexible combination of computer-assisted technologies in this hybrid learning environment. Two other vital artificial intelligence-powered digital tools, an automated writing assistant and a speech evaluation software, will also be included to enhance and extend the translanguaging process with machine translation to develop a more technical and greatly expanded creative and critical space for metacognition development, differentiated learning, active learning, and recursive feedback learning (human teacher and machine feedback) in the process of writing revisions, and machine-supported evaluation of pronunciation skills for the translated text. This learning and teaching process could also be ubiquitous in nature as teachers and students can
continue to engage with these digital affordances beyond the classroom walls. In producing the final project at the end of the unit, students will be able to present their second language acquisition in both writing and speaking.

**Figure 3.5**

*Proposed Flow Chart for Implementing the Proposed Hybrid Intervention*
Figure 3.6 outlines a sample unit that will deploy all the components of the proposed intervention model. In each language domain, similar text-image machine learning activities using Google’s Teachable Machine to help develop students’ listening, reading, and writing skills are embedded throughout the learning process of the unit on an ongoing basis.

**Figure 3.6**

*Sample Learning Module Site with Key Screenshots of Various Combinations of Technologies and the Integration of Machine Learning Activities to Facilitate the Translanguaging Process*

<table>
<thead>
<tr>
<th>Sample Unit Learning Module Site using GoogleSites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note: Below are sample digital reading and writing activities as well as embedded machine learning activities to support video listening, reading assignments, and writing activities. The entire learning module site contains other readings and writing process assignments.</td>
</tr>
</tbody>
</table>

**Artificial intelligence-powered tools**

- Machine Translation Software – Google Translate, Microsoft Translate, Baidu Translate
- Google’s Teachable Machine – human-computer intelligence to generate causal data regarding machine translations
- A writing assistant – Grammarly
- A speech evaluation tool – Baidu Read

**Combination of computer-assisted technologies used to leverage artificial intelligence-powered tools**

- Google Classroom – all activities will be linked from the GoogleSites learning module
- GoogleMeet – The instructor will share screen with everyone in the classroom to enhance the machine-learner assemblage/hybrid intelligence experience

Other online tools embedded in GoogleSites, on-screen digital annotation tools, Quizlet digital flashcards with interactive practice, GoFormative vocabulary and reading comprehension practice that allows for recursive feedback and immediate human intervention in the learning process.
Setting

Background Information of Study Site

In the June 2017 Western Association of Schools and Colleges Report, substantial improvement in providing English support for the large English language learning population is identified as a critical learning need at Kang Chiao International School – Xiugang Taipei Campus. Students need higher English proficiency in all domains to communicate more effectively in speaking, writing, and thinking critically. During the fall of 2017, the school leadership team appointed an English language learner specialist to draft an initial English language learning policy and guideline (which was later integrated into the school language policy) to outline specific procedures for program implementation. In the same year, Kang Chiao International School implemented the International Baccalaureate Middle Year Programme,
which required a complete restructuring of the English program. Under the International Baccalaureate Middle Year Programme framework, two subject areas involve language learning: language acquisition (designed for second language learners) and language and literature (designed for near-proficient to fluent speakers). The English language learning specialist worked with a committee of subject teachers, relevant subject group coordinators, the leadership team, and other relevant support specialists (e.g., the Special Education Needs Specialists) and redesigned the English program. After a year of continual evaluation of student performances based on the Middle Year Programme assessment criteria and other external assessment tools (Northwest Evaluation Association Measures of Academic Progress and Achieve3000), English language acquisition Phase 1 ESL, Phase 3 Support, Phase 3, and Phase 5 have been adopted to bridge students over to language and literature.

Currently, the English language learning specialist works closely with the leadership team (principal, associate principal, academic coordinator, and curriculum coordinator), Phase 3 support English language acquisition teachers, and subject area teachers to oversee the progress of struggling learners placed in English language acquisition phase 3 support. The bilingual and English as a second language hybrid intervention model is designed to measure student learning success at a finer detail generated by the automated scoring features programmed in intelligent tools. The goal is to improve the quality of instruction to enhance learning effectiveness and increase the rate and quality of English language learning in all domains and equip them with the language learning skills needed for a rigorous curriculum at a faster pace.

**Participants and Sampling**

The population for this study includes English language learners who are enrolled at Kang Chiao International School—Xiugang Taipei Campus in either the international program...
or the traditional local program and whose mother tongue is mainly Mandarin Chinese. There are about 1000 students classified as English language learners and are placed in English language acquisition courses. For this study, these learners are referred to as English language learners, and the differentiation between the two school programs is not a primary concern, as the intervention model can be applied to both contexts. A single-stage sampling procedure is adopted in which the researcher has access to the names in the population and can sample the people directly (Creswell & Creswell, 2018). As the English language learners are placed in different English language phases as required by the International Baccalaureate Middle Year Programme, information from various data collection instruments is used to identify students as struggling. Students are grouped into Phase 1 ESL, Phase 3 Support, Phase 3, and Phase 5 based on computer-adaptive tests, Northwest Evaluation Association Measures of Academic Progress and Achieve3000 reading scores, set by the administration. In addition, only students from the secondary domestic program are enrolled in Phase 1 ESL, while all the other levels have a mix of students from both programs. Those performing at a reading Rasch UnIT score below 200 based on the Northwest Evaluation Association Measures of Academic Progress and an Achieve3000 reading Lexile ranging from 100 to 500 for these testing instruments are identified as struggling. Academic grades and teacher recommendations are also considered in placing students in the most suitable English phase.

A brief rationale behind the method of sampling participants from both the experimental group and the comparison group is provided to ensure that the learners are reasonably compared. The Phase 3 Support courses for both Grades 7 and 8 have been selected for this study because this level includes students from both the international and traditional local programs. Sampling students from both programs could provide more insights into whether the intervention model
can work for learners in either program. The same Phase 3 Support students are sampled for both the quantitative and qualitative phases, and they are compared to students with similar academic performances (high end of the Phase 1 ESL group and low end of the Phase 3 group) at the end of the first school term. Students placed at the high end of the Phase 1 ESL group and low end of the Phase 3 group usually have similar performances to the Phase 3 Support group on computer adaptive tests and academic assessments. In addition, as there are so many English levels, placement in the appropriate phase may not always be possible at the beginning of the school year. This discussion could provide a better basis for a causal-comparative analysis concerning intervention effectiveness since student performance levels are neither too low nor too high, making comparison unreasonable. Specific sampling methods will be discussed in the procedures for data collection.
Overview of the Data Collection Plan

Figure 3.7

The data collection plan, illustrated in Figure 3.7, consists of two phases: the quantitative phase and the qualitative phase. The bilingual and English as a second language hybrid intervention model will serve as the independent variable in determining its effects on all language domains after the intervention is applied to the experimental group. Learning results will be compared against participants who did not receive the intervention which consists of a stratified random sampling from students of the experimental group and students of a similar performance level. Pre-test and post-test results from three testing instruments (International Baccalaureate Middle Year Programme Language Acquisition subject group criterion-related scores, the Northwest Evaluation Association Measures of Academic Progress test, and Achieve3000) will be analyzed descriptively and inferentially to determine learning effects that will be explicated numerically. The computation method will also be executed to examine further students' ability to make causal inferences between images and bilingual texts via the use of artificial intelligence-powered machine translation to decipher further how this would deepen a students' metacognition and learning processes in combining human and machine intelligences. The data yielded from this phase will be further explained by qualitative data via student and teacher perceptions.

**Quantitative Phase**

Students at Kang Chiao International School take the Northwest Evaluation Association Measures of Academic Progress and Achieve3000 computer-adaptive tests to track their English literacy and language performances. Computer-adaptive tests are test instruments programmed to tailor test items to students’ ability levels and ensure they are appropriately measured and challenged (Chang, 2015). Taken twice a year, the Northwest Evaluation Association Measures of Academic Progress test includes on-screen testing of English, mathematics, and science. For
the purpose of this study, only English scores (literacy and language development) will be used for evaluation. Achieve3000 is an online reading literacy platform that measures students’ reading Lexiles via engaging in on-screen reading assignments with text adjusted and adapted to their reading levels after taking pre- and post-level test exams. Students’ pre- and post-test scores for both testing instruments will be compared to identify learning evidence, specifically in reading literacy development and vocabulary and language use development. Other quantitative instruments to support evidence in student learning include students’ academic records based on the International Baccalaureate Middle Year Programme criterion-related scores and computational data from machine scoring.

**A Causal-Comparative Design for Computer-Adaptive Pretests and Posttests to Address Research Questions 1 & 2**

To implement a causal-comparative study, the researcher determines whether the various bilingual and English language learning strategies (Figure 3.2 translinguaging intervention example) delineated in the hybrid intervention model positively affect student performances in all language domains. After implementation of the model, which is the independent variable, the effects on the dependent variables (listening, speaking, reading, and writing performances derived from the various test instruments) will be observed and analyzed. Specifically, the English language performances of a group of students that received the intervention, the experimental group, and scores from a group that did not receive the treatment, the comparison group, will be compared.

However, there are also limitations as the causal-comparative design is not an authentic experimental research method but seeks to find possible cause and effect relationships (Salkind, 2010). Not being able to manipulate the independent variable and randomly assign members to experiment or control groups are the main concerns for this study; therefore, it does not
guarantee any causal relationships between the independent and dependent variables (Schenker & Rumrill, 2004). Other variables, such as gender and ethnic background, cannot be manipulated as these factors cannot be changed. Also, their English levels have already been pre-determined by pre-existing data, which makes choosing experimental groups and random assignment impossible as this event has already occurred. The researcher can only make insights about causal connections between the independent and dependent variables (Salkind, 2010).

The following Table 3.1 is the planned causal-comparative design utilized to explicate possible evidence of student learning the intervention may have.

**Table 3.1**

*An A Causal-Comparative Design*

<table>
<thead>
<tr>
<th>Group</th>
<th>Independent Variable</th>
<th>Dependent Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 7</td>
<td>Data instruments used for testing statistical significance of intervention using independent sample t test</td>
<td><strong>Computer adaptive tests</strong> Pre-test Northwest Evaluation System Measure of Academic Progress; Achieve3000 CAT pre-level set Lexile scores</td>
</tr>
<tr>
<td>Duration</td>
<td>(6 months)</td>
<td></td>
</tr>
<tr>
<td>Grade 8</td>
<td>Data instruments used for testing statistical significance of intervention using independent sample t test</td>
<td><strong>Computer adaptive tests</strong> Pre-test Northwest Evaluation System Measure of Academic Progress; Achieve3000 CAT pre-level set Lexile scores</td>
</tr>
<tr>
<td></td>
<td>E = experimental group</td>
<td>T = bilingual and second language hybrid intervention model</td>
</tr>
<tr>
<td></td>
<td>C = comparison group</td>
<td>O = outcomes</td>
</tr>
</tbody>
</table>
Hypothesis. The following hypotheses have been formulated to answer the first two research questions. They test for the overall effectiveness of the interventions based on Middle Year Programme criteria-related summative scores, the Northwest Evaluation Association Measures of Academic Progress test (NWEA MAP) and Achieve3000 performance of selected students:

\[ H_0: \mu_1 - \mu_2 = 0 \] (two-tailed test) There is no effect on receiving bilingual and English as a second language hybrid intervention as measured by NWEA MAP reading and language use and Achieve3000 pre and post-test scores.

\[ H_1: \mu_1 - \mu_2 \neq 0 \] (two-tailed test) There is an effect on receiving bilingual and English as a second language hybrid intervention as measured by NWEA MAP reading and language use and Achieve3000 pre and post-test scores.

\[ H_0 \] null hypothesis

\[ H_1 \] alternative hypothesis

\[ \mu_D \] is the mean difference (International Baccalaureate MYP scores, averages of NWEA MAP and Achieve3000 pretest scores)

Sampling Procedure. Causal comparative research usually involves groups formed prior to research (Schenker & Rumrill, 2004; Salkind, 2010). Participants of this study will already be pre-grouped by phase level determined by pre-existing Northwest Evaluation Association Measures of Academic Progress and Achieve3000 pretest scores prior to implementation of the study. The study focuses on seeking performance differences using the aforementioned test instruments between the experimental and control groups. A stratified random sampling method is used to select participants from pre-grouped English phase levels for both the experimental
and comparison groups. This is also to ensure that an adequate number of participants of the same demographics are selected (Schenker & Rumrill, 2004).

To strengthen the research design and counter threats to internal validity (described more in-depth in the next section), a control method used for sampling is matching. The same number of male and female adolescent participants, as well as their corresponding grade level, will be matched for both the experimental and comparison groups. That is, twenty students from grade 7 and twenty students from grade 8 will be sampled from a pool of approximately 60 students in the English Phase 3 Support subgroup. The same participants will be homogeneously compared and matched by gender and grade level with 40 participants, 20 students per grade level with similar English performances.

**Data Collection Procedure.** After all necessary data have been collected from the test instruments described above, descriptive and inferential statistics will be used to analyze and interpret students’ academic progress. As the researcher hopes to determine a causal relationship between the independent and dependent variables, a two-tailed independent t-test will be employed to test the hypotheses with the application of the method of matching in consideration. The mean scores between the experiment and comparison groups will be compared to determine whether there is a significant difference between the two groups. The results of the independent t-tests will enable the determination of whether there is a statistically significant relationship between the independent variable—the hybrid intervention model—and the dependent variable of overall academic performance determined from the aforementioned test instruments.

**Establishing a Computational Design to Address Research Questions 1 & 2**

A causal-comparative approach to data collection may not be sufficient to gain a deeper insight into students’ learning evidence; therefore, this research attempts to apply a
computational method of gathering quantitative data at a more granular level using machine learning algorithms. As the hybrid intervention deployed entails the use of artificial intelligence-powered machine learning tools, the research design also delves into the computation method, as put forth by Cope and Kalantzis (2015), which they refer to as big data in educational research practice. Image data and students’ voice inputs are trained through Google’s and Baidu’s machine learning algorithms to generate automated percentage feedback. The primary purpose is to detect learning evidence based on the quality of image-bilingual text translations, and secondarily, with a new speech evaluation function in machine translation, machine-rated pronunciation scores are used to further analyze how machine learning algorithms can capture data at a much finer and granular level which traditional methods of research cannot possibly achieve. Cope and Kalantzis (2015) assert that “[technology] now allows us to capture fine-grained data about what individuals do as they interact with their environments, producing an ‘ocean’ of data that, if used correctly, can give us a new view of how learners progress in acquiring knowledge, skills, and attributes” (p. 220).

The computation method also has its challenges. Aside from the issue of causality in machine learning, devising data models to collect data from the proposed hybrid learning environment will require a deeper understanding of data sciences. Cope and Kalantzis (2015) also present the challenge of integrating data from the various computer-mediated environments and engaging in “replication, extension and meta-analysis of educational research data” (p. 231). Current training of deep quantum neural networks may pave the way for more robust machine-generated data. Beer, Bondarenko, Farrelly, Osborne, Salzmann, Scheiermann, and Wolf (2020) explain new advancements of machine learning in which new quantum computing devices are in their advent stages of integration into classical machine learning. These quantum computing
devices can execute quantum machine learning which means classical machine learning can be improved via quantum tasks. Though questions remain about quantum machine learning, it can now demonstrate extraordinary capabilities, including the “ability to generalize [and] tolerance to noisy training data…” (p. 5). Broughton, Verdon, McCourt, Martinez, Yoo, Isakov, Massey, Niu, Halavati, Peters, Leib, Skolik, Streif, Dollen, McClean, Boixo, Bacon, Ho, Neven, & Mohseni (2020) assert these hybrid quantum classical machine learning algorithms are still “fairly noisy” (p. 3), thus limiting their fidelity and may affect the results of the machine scores produced by Google’s Teachable Machine. Nevertheless, machine learning algorithms can compute large quantities of data; with quantum machine learning, the capabilities of classical machine learning are improved in terms of speed computation and intelligence. For instance, Google’s Teachable Machine operates on real TensorFlow.js models, which are a library of machine learning data operated in JavaScript. TensorFlow, “an end-to-end open-source machine learning platform” (TensorFlow, 2020), is currently moving into quantum machine learning (TensorFlow Quantum design, 2020). Perhaps such remarkable improvements in combining quantum theory with classical machine learning could offer more insights into and solutions to the challenge of data integration in various online learning environments as well as support educational research data in terms of replication, extension, and meta-analysis.

Instrumentation in Collecting Computational Data. Students’ academic progress has always been evaluated with various traditional testing instruments. Now, with the availability of intelligent tools that generate automated machine learning scores, assessing learners’ performances at a more granular level can help teachers personalize instruction more accurately. Computational data generated by machine learning algorithms built in Google’s Teachable
Machine, Grammarly’s writing assistant, and Baidu Translate’s speech evaluation software are continuously collected to examine every student participant’s progress.

Appendix D outlines a sample activity that extends the application of Pearl’s three-layer causation theory outlined in Figure 3.4 regarding describing birds at a lake. Student’s intervention via machine learning with Google’s Teachable Machine and a teacher’s teaching intervention could adhere to the following scenario:

**Figure 3.8**

*Extension of Pearl’s Three-Layer Causality in Figure 3*

<table>
<thead>
<tr>
<th>Students’ Translanguaging Machine Learning Intervention (text translations with image training)</th>
<th>Teacher’s Teaching Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responds and discusses different possible scenarios.</td>
<td>Asks a guiding question:</td>
</tr>
<tr>
<td>Downloads images from Google images or other related image search engines.</td>
<td>If there is a photo taken at the same place under the hot sun, or under heavy winds and rain, will there still be birds on the lake?</td>
</tr>
<tr>
<td>Uploads at least 3 images to Google’s Teachable Machine labeled separately as two classes:</td>
<td>Prompts students to download similar images of birds on the shallow lake from the Internet:</td>
</tr>
<tr>
<td>Data Model 1 – Types descriptions of image in English for each scenario, which is classified as separate classes</td>
<td>Photos similar to Figure 11 – birds cleaning themselves at a shallow lake (at least 3)</td>
</tr>
<tr>
<td>Data Model 2 – Types descriptions of image in Chinese for each scenario, which is classified as separate classes</td>
<td>Photos of dead birds on the lake (at least 3)</td>
</tr>
<tr>
<td></td>
<td>Prompts students to train two data models via Google’s Teachable Machine.</td>
</tr>
<tr>
<td></td>
<td>Data Model 1 – Descriptions of image in English</td>
</tr>
<tr>
<td></td>
<td>Data Model 2 – Descriptions of image in Chinese</td>
</tr>
</tbody>
</table>

Downloads images from Google images or other related image search engines. Asks a guiding question: If there is a photo taken at the same place under the hot sun, or under heavy winds and rain, will there still be birds on the lake? Prompts students to download similar images of birds on the shallow lake from the Internet: Photos similar to Figure 11 – birds cleaning themselves at a shallow lake (at least 3) Photos of dead birds on the lake (at least 3) Prompts students to train two data models via Google’s Teachable Machine. Data Model 1 – Descriptions of image in English Data Model 2 – Descriptions of image in Chinese
Figure 3.8 (cont.)

<table>
<thead>
<tr>
<th>Clicks on “Train the Model”.</th>
<th>Prompts students to search for one more photo of each scenario to test the model for the degree of causality in text-image translation accuracy.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Searches for two more images, one for each class, to test the two data models. Exports model for each data model to generate two separate links for further model training.</td>
<td>Discusses with students that if the model is trained correctly with similar pictures, Google’s Teachable Machine should be able to recognize the image with the corresponding text description in both languages. Percent of accuracy will be generated.</td>
</tr>
<tr>
<td>Takes a screenshot of the model with the percentage accuracy and copy/paste it to the activity sheet.</td>
<td></td>
</tr>
</tbody>
</table>

Appendix D presents a complete writing activity sample that extends the application of Pearl’s three-layer causation theory outlined in Figure 3.4, describing birds at a lake. After students engage in the translanguaging process of describing causal descriptions of images with the support of machine translation, using both languages and teacher facilitation as illustrated in Figure 3.2 (English and Chinese), Figure 3.8 further initiates student tasks and teacher instructions on how to train image-bilingual text models explaining causality via human intervention (students and teachers) in Google’s Teachable Machine platform. Appendix D also contains screenshots of these data models. After training a model via machine learning, a student or teacher can upload similar images that match the causal text descriptions and the machine learning platform will generate percentages per class trained. Through machine learning, the data model should be able to match the uploaded images with the corresponding texts that explain causality via human intervention and provide a percent of accuracy. These generated percentages can be considered computational as they have gone through machine learning. Hence, computational data generated by these data models for each student via Google’s Teachable Machine will be recorded for further data analysis and interpretation of learning evidence at a more fine-grained level.
Currently, there is a word limit to inputting text descriptions in any language to be labeled as classes in Google’s Teachable Machine platform. The original descriptions (See Appendix D) have been shortened for the purpose of training the model to detect the extent of causality measured in percentages generated by Google’s Teachable Machine neural network algorithms. The percentages yield vital computational data for evaluating whether learners have engaged in thoughtful translations via testing for causality in this method of image-bilingual text translation model training.

In examining deeper insights into detecting the degree of training causality through human intervention in machine translation software, computational data generated by Grammarly’s automated essay scoring system and Baidu’s new human speech-to-machine recording with machine-trained automated oral rating in speaking fluency, accuracy, and competency are also examined. Using Baidu Translate’s Read function, students practiced speaking their final writing product with causal text descriptions trained through Google’s Teachable Machine. See Appendix E for a detailed illustration of this process—an extension of Figure 3.2’s descriptive writing activity. Students’ machine-generated scores will be evaluated for learning evidence of writing and oral language development.

**Sampling Procedure.** The same participants sampled from the previous causal design will be selected for data analyses.

**Data Collection Procedure.** Descriptive statistics will be used to calculate the score averages generated by Google's Teachable Machine data models as well as Grammarly’s automated scoring and Baidu Translate's Read function.

*Academic performances based on criterion-related scoring to address research questions 1 & 2*
To ensure the integrity of the machine scores produced by computer-adaptive tests and automated feedback scoring, the academic scores rated by human instructors are also considered to determine more reliable and valid feedback about the intervention model’s learning effects on the students. Data are collected from the same sampled students.

“Assessment in the Middle Year Programme is criterion-related and directly linked to the aims and objectives of the subject groups. Middle Year Programme criterion-related assessment leads to teaching and learning that is grounded in inquiry while maintaining disciplinary rigor” (International Baccalaureate Organization, 2014, p. 29). According to the International Baccalaureate Organization (2014), the criterion-related approach does not follow a norm-referenced or criterion-referenced approach to assess learners as the program does not aim to compare learners to an expected distribution of achievement, nor does it enforce mastery of all achievement levels at a lower level before advancing to a higher level. The rationale behind this is to support ongoing continuous feedback, focus on the teaching process, promote positive motivation for learning, foster critical and creative thinking skills, and develop a reflective nature of international-mindedness. Throughout the unit, students are assessed formatively, allowing teachers to collect, analyze, and interpret student learning evidence and seek strategies to help students improve before the summative tasks, which are taken at the end of each teaching unit. Authentic summative assessments provide learning evidence for evaluating overall achievement using the Middle Year Programme subject group-specific assessment criteria. Further task-specific clarifications for each criterion tailoring specific assessment procedures are set by the teachers.

The English language acquisition subject group has four main assessment criteria under the International Baccalaureate Middle Year Programme. They include listening (Criterion A),
reading (Criterion B), writing/speaking (Criterion C), and language use (Criterion D). Student academic performances in these four domains will be evaluated for one semester to determine the overall learning effects of the intervention model. As a way to decrease bias, the English language acquisition support teachers designed the assessment rubrics and evaluated them by the subject group coordinator. All summative tasks underwent moderation with all support teachers and the subject group coordinator to increase inter-rater reliability. Instructors determine term grades based on overall performance throughout each assessment period. Appendix C includes sample International Baccalaureate Middle Year Programme Language Acquisition rubrics used to assess all four language domains.

**Qualitative Phase**

The qualitative aspect of this research will include individual student written reflections and classroom observations to understand students’ responsiveness to the new learning approach. Only the treatment group who received intervention will write reflections based on the following variables—collaboration, motivation, and other natural learning occurrences via teacher facilitation. The types of questions that are used in student reflections will relate to the level of satisfaction with the bilingual and English as a second language hybrid learning model, students’ perceptions of how the instructor implements the model, and students’ perception of using technology for English language learning. Also, teachers’ perceptions about the implementation of this model are obtained with an extensive reflection survey about the intervention model. The data are used to support the results of the quantitative data to provide further insights about student performance after the implementation of this new variation of hybrid learning in the domain of bilingual and English language pedagogy.
**Sampling Procedure.** Since the number of participants sampled for each grade level is small, the same participants sampled from the quantitative phase will be included in the data collection process for the qualitative phase.

**Data Collection Procedure.** Qualitative research designs elicit empirical evidence from three basic forms: interviews, observations, and/or through documents and artifacts (Salkind, 2010). This study seeks to conduct student and teacher reflections as part of the research process. Student and teacher reflections, collected as documents, will consist of questions that seek deeper understandings of their roles in a bilingual and second language hybrid learning environment (See Appendices E & G). A concern for this approach, also identified by Creswell and Creswell (2018), is most participants might find the language use challenging; therefore, the reflection questions will be translated into Chinese for better understanding.

**Data Analysis for Reliability and Validity**

**Quantitative Tools**

**Causal-Comparative Design**

Internal validity and external validity are important factors to take into account when conducting causal-comparative designs. Since the main limitations of the causal-comparative method include no control over independent variables, there is no guarantee of any causal effects between the independent and dependent variables which weakens internal validity (Schenker & Rumrill, 2004; Salkind, 2010; O’Dwyer & Bernauer, 2013). To reduce the threat to internal validity, a control method—matching—is applied to participant samples (Salkind, 2010). Schenker and Rumrill (2004) also suggest increasing external validity as a strategy to offset the lack of control which is a threat to internal validity. Therefore, researchers may strengthen this method by randomly selecting participants from previously formed groups.
Computer-adaptive tests, Northwest Evaluation Association Measures of Academic Progress and Achieve3000, are also utilized to assess student performances. A discussion about the reliability and validity of computer-adaptive testing is also of importance. As two sets of data will be collected (pretest and posttest) for each test instrument, understanding how the test items are assigned via these computer systems is crucial in accounting for reliability and validity. As a test item is dependent on a student response to the test item before it, test-retest reliability is more “accurately described as a mix between test-retest reliability and a type of parallel forms reliability, both of which are spread across several months” (Northwest Evaluation Association, 2011, p. 61), with the second test (retest) including test items comparable to the first test in terms of content and structure but differing in difficulty level. In other words, reliability is maintained between the first and second tests with related but different item pools. As for content validity, all test items are matched with content standards using keyword matching of content descriptors (powered by artificial intelligence software) as well as expert human verification of the matches made by the software (Northwest Evaluation Association, 2011). Therefore, the likelihood of test items accurately measuring students’ knowledge and skills are high. Achieve3000 also employs a similar test-retest reliability in conducting its level set tests and matching test items to content standards. Specifically, the level set test adheres to a criterion-referenced computer-adaptive test measuring reading comprehension skills. Similar to the Northwest Evaluation Association Measures of Academic Progress test, students complete test items that match their reading levels measured by their most current reading Lexile to ensure content validity. If successive test items are missed, the program will adapt to an easier version of the test. To ensure internal consistency and reliability, Achieve3000 executes five versions of the level set test with the pre-level set test taken according to their grade level and the post level set test taken according to their current
Lexile level (ranging from 150 to 1350 points) (Mathematica Policy Research & What Works Clearinghouse, 2018).

Computational Design

The computational design for this study seems to meet the traditional general definitions of reliability and validity. All translinguaging machine learning activities (resulting in image-bilingual text translations machine percentage ratings) executed through Google’s Teachable Machine are evaluated based on similar neural network algorithms as well as human teacher ongoing formative evaluations, though this may only be a theoretical assumption. Also, task types are designed to assess and measure a learner’s ability to acquire the English language actively, collaboratively, and metacognitively through the automated feedback support of machine translation software and machine learning image-bilingual text training models. Machine scores generated by Grammarly’s writing assistant and Baidu’s speech evaluation software are also considered when examining computational data to detect learning evidence. In other words, this method seeks to look at a learner’s learning outcome via machine-learner interaction. Although the benefits of the computational method seem promising and present a strikingly different perspective compared to the traditional data collection process, this new territory of data mining in education also raises issues of validity and generalizability (Scharkow & Mahrt, 2013). Primary concerns include the difficulty of engaging in sampling randomly (any data that is accessible and legal are used), limited variance in machine scoring generated by a particular platform, and difficulty in generating enough samples (though a platform may present millions of observations) from different sources. Despite these setbacks, the individualized data models produced per student could represent variability in different data models, a degree of context awareness, and modest deployment of automated data production as every learner, acting
as the human agent in providing interventions through the natural use of the learning affordances offered by machine learning technologies, generated their own text translations and search for a different image to seek verification of their text translations after model training. Cope and Kalantzis (2016) also stress that the “distinction between what is being taught and what is being assessed is reduced or eliminated when assessment is designed into the learning” (p. 5).

Therefore, validity should not be a huge concern as the machine learning activities and student assessments designed for this intervention are embedded into this learning domain. These limitations further validate that teachers are still integral in facilitating technologies powered by narrow artificial intelligence. The issue of reliability may still be in question, as the embedded text-image translinguaging machine learning activities only assess learners at a sentential level and possibly short paragraph level (See Appendix D) and may not present interrater reliability when evaluated against human ratings of an entire essay sample.

**Criterion-Related Scoring by Teacher Raters**

Authentic assessment reliability and validity also require consideration. Reliability refers to the consistency of measurement, regardless of the evaluator, time, location, and other test variables (O’Dwyer & Bernauer, 2013); validity is defined as the extent to which an assessment measures the knowledge or skills it is designed to measure (Herrera et al., 2013; McKay, 2006). The selection of test instruments is vital to measuring and evaluating student performances effectively. Herrera, Murry, and Cabral (2013) provide an overall definition of authentic assessments as derived from classroom instruction and activities, valid and reliable in the sense of assessing a student’s classroom performance, facilitative on the part of eliciting learner participation in evaluation processes, and relevant to both the teacher and student in terms of measurements and evaluations. Based on this definition, the summative tests administered can be
categorized as authentic. Moreover, the learners assessed are considered culturally and linguistically diverse learners; therefore, it is essential that the designing of assessment tasks reflect language, content knowledge, and acculturation (Herrera et al., 2013). All summatives for all criteria are moderated by two support teachers and the English language acquisition subject group coordinator to ensure reliability, particularly interrater reliability, in the International Baccalaureate Middle Year Programme assessments. Threats to reliability, such as test administration location, anxiety, or other disturbances, are considered and minimized.

Content validity, referring to the extent to which the task types or items measure knowledge and skills, could be an area of concern. An approach to minimize this threat is the alignment of all task types to the International Baccalaureate Middle Year Programme objectives with descriptors aligned to the Common Core State Standards, included under the English language acquisition subject group.

**Qualitative Tools**

Johnson (1997) provides literature that argues the constructs of validity and reliability may not apply to qualitative research; however, more recent studies reveal certain qualitative research as more exemplary than others. The term “validity” has often been used to describe these differences. Therefore, in terms of qualitative research, validity is defined as “…plausible, credible, trustworthy, and, therefore, defensible” (p. 282). In reference to documenting reflections by participants, Johnson (1997) discusses maintaining descriptive and interpretive validity in terms of accurate accounts of participant reflections in the areas of inner thought and perspective. As a result, the questions used for the reflections for teachers and students are designed to elicit their perceptions of this hybrid mode of teaching and learning with artificial intelligence-powered tools as a way to obtain the most authentic responses. Furthermore,
Stodolsky (1990) asserts that “[t]o produce generalizability and validity as well as reliability, samples of central lesson types in a number of subjects would have to be observed” (p. 10), as well as “…both the instrument itself and the sampling plan with which it is used, must adequately reflect the definition of teaching held by the school district or other evaluation agent” (p. 11). Observing students from other subject areas may not be feasible, and as the intervention will only be implemented in the English classes, questions regarding whether any skills related to the translingual technique via the use of machine translation and/or machine learning are integrated into the reflection component.

Consent Procedures, Privacy, and Ethical Considerations

Since the research concerns human subjects, certain factors in conducting this research ethically are considered. Ramrathan, le Grange and Shawa (2017) discuss several ethical dilemmas to consider when conducting educational research; informed consent and data dissemination are relevant ones to this research. As this study consists of quantitative and qualitative components, participants’ privacy and prudent handling of data are treated as of the utmost importance for this study. Furthermore, since this study involved a new teaching method, the researcher took part as a teacher participant. Though this is not encouraged, as this action may cause the potential for coercion, the researcher followed university guidelines by taking precautions to reduce the potential of students experiencing pressure to participate. Another teacher participant from a different grade level was recruited to increase the validity of this study. When providing the informed consent form to students and parents of students, the researcher was blind to the identity of participants until after all grades and test scores were made available. In other words, the researcher did not know who participated in the research until all the data were gathered for interpretation.
Summary of Theory and Methods

Empirical research in examining the pedagogical effects of operating artificial intelligence-powered tools in language teaching, students’ attitudes toward using these tools, and teacher perceptions/preparation in the deployment of such tools, is limited (Pokrivcakova, 2019). Because there are limitations in human teaching/learning and artificial intelligence-powered tools, the extension of Tashior et al.’s (2011) transtheoretical model for hybrid learning is established as a possible niche for the deliverance of innovative zones for hybrid intelligence between human teaching/learning and intelligent tools used in bilingual and English as a second language pedagogy. Particularly, an expanded form of translanguaging via human training image-bilingual text translations is implemented to activate metacognitive processes between human learning and machine learning. Furthermore, machine-learner assemblages between human teaching/learning and a combination of computer-assisted technologies are designed to leverage the hybrid intelligence zone, as the mere uses of machine translation and other intelligent tools in current research have limitations. In order to cater to other domains of English language teaching and maximize learning to a greater extent, such as reading, listening, and oral production, using various multimodalities (images and audio functions) afforded by a combination of technologies via the proposed hybrid learning domain not only will expand more possibilities of tactful assembling of various computer-assisted tools, but also will assist both the teachers and learners to step into a new era of combining both human and machine intelligences to enrich the English language learning experience.
CHAPTER 4: FINDINGS

This chapter presents and discusses the results of the following three research questions to determine the overall effects of the proposed bilingual and English as a second language hybrid intervention model through an explanatory mixed methods approach:

**RQ1**: What bilingual and English as a second language hybrid intervention model that integrates a combination of artificial intelligence technologies, with machine translation as the integral starter tool, and other computer assistive tools leads to improved English language performances among struggling English language learners?

**RQ2**: What is the rate and quality of improvement of struggling English language learners who received instruction via the bilingual and English as a second language hybrid intervention model compared to those who received traditional instruction?

**RQ3**: What are teachers' and students' perceptions about teaching and learning via the implementation of a bilingual and English as a second language hybrid intervention model?

The results of the first research question answer how the hybrid intervention model illustrated in Figure 3.1 of Chapter 3 unfolded various combinations of teacher and machine instructional task designs used to deliver bilingual and English as a second language strategies in this study. The quantitative findings that embody the use of independent t-tests between the treatment and comparison groups to determine the effects of the intervention, the use of computation scores generated from artificial intelligence-powered tools, and academic scores based on human ratings attempt to answer the second research question in overall rate and quality of learning. Teacher and student perceptions of all facets of the intervention have been gathered to answer the third research question to draw further interpretations of these quantitative measures to
explain the effects of student learning. Both sampling and quantitative and qualitative data
collection methods described in Chapter 3 were used to obtain the results.

**The Emergence of a Bilingual/English as a Second Language Hybrid Intervention Model**

The first research question attempts to address the viability of the extension of the
Transtheoretical Model for Hybrid Learning (Figure 3.2). Also, an optimal region for hybrid
learning proposed by Tashior et al. (2011) has been difficult to pinpoint as every instructor has a
different teaching style, and every group of students brings a diversity of learning characteristics
to their respective classroom setting. Creating a set of instructions for instructors to operate a
specific hybrid learning model verbatim is challenging. Offering a set of critical ingredients that
would lead to new discoveries of what works best for the learners may be a better, more flexible,
and more effective channel to transition and immerse both instructors and learners into a hybrid
learning environment.

Figure 4.1 (next page) is a flowchart modeling the process of intervention
implementations conducted via computer-mediated instruction in the classroom. Teacher-
directed instruction and notetaking were main traditional, offline learning components. At the
start of the unit, teachers apply the classical learning theories of constructivism and motivation
by initiating two vital tasks: (1) set new classroom management and online learning rules,
provide learning expectations, and gradually transition students from a teacher-centered
classroom to a student-centered classroom which establishes a hybrid learning space that
integrates the best of both worlds—online and offline learning; and (2) select integral computer
tools (e.g., module sites with Google Sites, Google Classroom, and Google Meet) to establish the
main channel for sharing teaching materials and facilitating a natural and safe learning
environment that encourages intrinsic and extrinsic learning motivations.
Figure 4.1

The Emergence of an AI-based English Learning Intervention Model Based on the Extension of the K region of Tashior et al.'s (2014) Transtheoretical Model for Hybrid Learning

[Diagram showing the model with various components and processes labeled, including vocabulary development, reading, writing, and speaking tasks, as well as hybrid intelligence applications.]
Figure 4.1 proceeds to interweave a series of machine-learner assemblage and hybrid intelligence applications (Dellerman et al., 2019; Kamar, 2016), each having relevance with a combination of the seven digital affordances proposed by Kalantzis and Cope (2015). In addition, Pokrivcakova (2019) asserts that pedagogical effects, teacher responses, and student reactions to applications of artificial intelligence-powered tools in foreign language classes are lacking. Thus, this intervention not only explored a combination of basic computer tools used for interactive teaching/learning but also endeavored to explore more possibilities of leveraging multiple intelligent tools to make learning more personalized, flexible, and inclusive for every struggling learner in this study.

For machine-learner assemblage application 1, the instructor provided direct vocabulary instruction with words related to the unit by using digital flashcards with Quizlet, which offers a variety of modalities. Goformative, a digital assessment tool used to check student understanding, was used with preset answers for students to self-check and correct their mistakes. After multiple practices, students were able to independently engage with using these two tools anytime, anywhere, as well as actively work with their peers and initiate inquiries to determine the correct answers independently or collaboratively.

Machine-learner assemblage application 2A and 2B, illustrated in Figure 4.1, expanded on Clifford et al.’s (2013), Giannetti’s (2016), Briggs’ (2018), Voget et al.’s (2018), Chen et al. (2019) and Lee’s (2020) studies regarding more critical, analytical, and pedagogical uses of machine translators. These applications included two expanded digital translanguaging spaces for motivating students to understand listening, reading, and writing assignments better. In the process, students engaged in processing their thoughts in a novel and creative bilingual space, breaking free from traditional rules of language use (machine-learner assemblage application 2B
will be discussed later.). In addition, machine-learner assemblage 2A also extended into a creative, bilingual machine learning space using Google’s Teachable Machine to establish hybrid intelligence applications 1A and 1B in generating automated machine scores for learners to continue processing higher-order meta-bilingual thinking skills with the support of visuals and machine scoring. In machine-learner assemblage application 2A, students continued to engage in vocabulary development with visual support at the sentential level with the teacher’s facilitation in diction, morphology, syntax, semantics, and pragmatics when leveraging the use of machine translators and images. In this digital translanguaging space with visual support, students either engaged in a pre-listening or pre-reading activity describing images related to the video or text by using their first language to support their second language production of words. During the process, students were able to think meta-linguistically about how they could use their first language to support their vocabulary development and write basic grammatical sentences. In doing so, students are able to train their minds to emulate and operate similarly to their online machine translator counterparts.

Next, hybrid intelligence applications 1A and 1B served to develop students’ meta-bilingual thinking skills in training image-bilingual text models related to the unit's video or reading activities (See Appendix D). The learners input self-written/machine-edited dual texts (in English and Chinese, using online machine translators) into Google’s Teachable Machine for machine learning. After training bilingual text descriptions with corresponding images into two to three classes via teacher facilitation, the learners uploaded a new image for each image-bilingual text model and received machine-generated percentage scores signifying the degree of relevance to each image-bilingual text model previously trained. In the process, learners think critically about improving the texts they have written in both languages, the images selected and
described, and how to increase their scores by training better image-bilingual text models by finding appropriate images for the machine to detect and match their written sentences in either language. After repeated trials, students had to determine what the machine scores meant, which was to train models of similar images to match their sentences in either language. Their goal was to figure out that the models they are training could be the next-generation machine translation tools supplemented with images at the sentential level. After repeated cycles of vocabulary development with digital flashcards and digital cloze exercises and digital translanguaging spaces using machine translations and teacher facilitation to correct errors at the sentential level, students were assessed using digital formatives and summatives that followed the International Baccalaureate Middle Year Programme Language Acquisition rubrics (See Appendix C for an example).

After completing activities related to listening and reading, students wrote about what they viewed or read with a teacher-selected writing topic. At the brainstorming stage of every writing task, students engaged in machine-learner application 2B, producing sentences similar to machine-learner assemblage application 2A. The teacher provided digital feedback in Google Docs, focusing on the linguistic aspects machine translators cannot correct (as of yet) and monitoring proper usage of machine translators to prevent students from over-relying on these tools. Upon completion, students immediately corrected their writing errors at the sentential or paragraph level. They then pieced their writing into a four or five-paragraph essay, with continuous teacher modeling and facilitating.

The last two hybrid intelligence applications 2 and 3 used a writing assistant and a speech evaluation tool that provided automated machine feedback and scoring. As the training of bilingual text-image models was limited to the sentential level, and previous studies have
identified the limitations of writing tasks with machine translators (Niño, 2009; Ducar & Schocket, 2018; Lee, 2020), another endeavor of this intervention model was the continuation of integrating artificial intelligence-based tools that offer students more spaces for automated feedback in assessing writing and speaking skills, using longer pieces of written work. Grammarly, a writing assistant tool also embedded with machine scoring, and Baidu, a current speech recognition tool that offers automated machine scoring evaluation and feedback for competency, fluency, and accuracy, were selected to complete this intervention model. Similar to the first activity of training images and sentences, students improved their writing and speaking via Grammarly’s automated feedback and machine scoring and Baidu’s automated speech machine scoring. Both tools developed students’ intrinsic motivation to revise their written works or repeat their spoken words until they received a near 100% percentage score. Baidu’s cutting-edge speech evaluation machine learning programming (offering automated speech scoring) may potentially change how we evaluate speaking. The students of this study engaged in one-to-one collaborative intelligent learning with a near human-like speech-bot that reads text to the learners, waits for learners’ voices to be recorded, and evaluates the learners’ ability to pronounce the words accurately by identifying incorrectly pronounced words for learners to practice speaking at the phonological and morphological levels. During the process, the teacher monitored the types of words students struggled with and later reinforced them in mini speaking lessons.

Both tools used in the writing and speaking lessons also required ongoing teacher facilitation as the types of higher-level corrective feedback vary for every learner. For Grammarly, necessary higher-level feedback from the instructor included giving advice on revising monotonous sentences, accurate diction, more complex grammatical features (e.g., active versus passive voice), and other forms of writing (analytical, persuasive, informative) that
the machine may not accurately detect as machine learning algorithms have limitations, a similar assertion to that made for machine translators (Pearl, 2018; Bengio et al., 2020). Therefore, in leveraging both digital tools effectively, teacher facilitation was needed with every learner, providing one-to-one sessions on how to engage with the automated corrective feedback. Instructors needed to be perceptive of the imperfections of these digital tools and highlight the beneficial features and limitations during the teaching and learning process. Furthermore, mini grammar and speaking lessons of similar errors (produced by most students) were also essential to transform these tools for instructional purposes. Students submitted their final revised written work, which provided a record of the entire process of ongoing revisions, based on human and machine feedback/scoring at the different stages of the writing process, as well as the speaking scores at the end of the unit. To activate this intervention model to its full potential, engaging learners with strategic step-by-step digital instructional designs written for teachers, students, and the computer tools deployed is vital (Appendix B offers general steps and tasks of this intervention in implementation as well as sample units and student samples.)

**The Rate and Quality of Improvement of Struggling English Language Learners**

Computer-adaptive tests, machine scoring, and human assessors gauged the rate and quality of student improvement. Computer adaptive tests were used to measure the overall reading and writing development after the intervention. Specifically, independent t-tests were conducted to determine any statistical significance between the treatment groups and comparison groups for both grade levels. To examine students’ performances in finer detail, computational data were also gathered from three major components that have had learning effects on the struggling learners: bilingual text-image writing activities with Teachable Machine as pre-reading/pre-listening assessments, Grammarly’s automated feedback machine scoring, and
Baidu’s speech evaluation machine scoring. In order to support or refute the results generated from computer-adaptive tests and machine scoring, students’ academic records based on human assessment were also examined. Then, an overall summary interpretation that cross-examined computer adaptive test scores, machine scores, and academic records was conducted to determine how these quantitative findings may explain students’ rate and quality of improvement after receiving the intervention.

**Interpreting the Results of Computer-Adaptive Tests via a Causal-Comparative Design**

An independent t-test was selected to evaluate the mean difference, \( \mu_1 - \mu_2 \), between two groups—the treatment group and the comparison group (Gravetter, Wallnau, & Forzano, 2018). For this study, the goal of running an independent t-test using IBM SPSS Statistics (Version 25) is to determine any statistical significance after a treatment group received the teaching intervention compared to a group that did not receive the teaching intervention while controlling for grade level and gender. That is, the students from each grade level were compared to students of similar English proficiency levels. The null hypothesis \( H_0 \) as represented by \( \mu_1 - \mu_2 = 0 \) (two – tailed test) states that there was no effect on student learning after receiving the intervention as measured by NWEA MAP reading and language use and Achieve3000 pre and post-test scores. The alternative hypothesis \( H_1 \) as represented by \( \mu_1 - \mu_2 \neq 0 \) (two – tailed test) states that there was an effect on student learning after receiving this intervention as measured by NWEA reading and language use and Achieve3000 pre and post-test scores.

As Gravetter, Wallnau, and Forzano state (2018), to ensure that the final interpretation of the independent t-test is meaningful, the following three assumptions are considered:

1. Observations within each sample are independent, indicating samples from each group have no relation.
2. The two samples selected from two populations are normally distributed.

3. The two samples selected from two populations have equal variances. As both groups have equal sample sizes, this assumption may not be as critical yet should not be neglected.

For this study, the independent t-tests for both the comparison and treatment groups at the Grade 7 level were executed for both pretests and posttests of all computer adaptive testing instruments.

Tables 4.1, 4.2, and 4.3, respectively, illustrate the results for the mean and standard deviations for NWEA MAP Reading, NWEA MAP Language Use, and Achieve3000 level set test for the pretests of both the comparison and treatment groups. These descriptive measures show that the two groups are similar in performance.

**Table 4.1**
*NWEA MAP Reading Pretest Group Statistics*

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest Reading</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comparison</td>
<td>20</td>
<td>188.00</td>
<td>6.7901</td>
<td>1.5183</td>
</tr>
<tr>
<td>Treatment</td>
<td>20</td>
<td>191.45</td>
<td>7.5217</td>
<td>1.6819</td>
</tr>
</tbody>
</table>

**Table 4.2**
*NWEA MAP Language Use Pretest Group Statistics*

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest LanguageUse</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comparison</td>
<td>20</td>
<td>196.80</td>
<td>6.662</td>
<td>1.490</td>
</tr>
<tr>
<td>Treatment</td>
<td>20</td>
<td>200.75</td>
<td>8.675</td>
<td>1.940</td>
</tr>
</tbody>
</table>

**Table 4.3**
*Achieve3000 Pre-level Set Test Pretest Group Statistics*

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest AchieveLevelSetTest</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comparison</td>
<td>20</td>
<td>342.00</td>
<td>155.152</td>
<td>34.693</td>
</tr>
<tr>
<td>Treatment</td>
<td>20</td>
<td>387.00</td>
<td>98.761</td>
<td>22.084</td>
</tr>
</tbody>
</table>
Tables 4.4, 4.5, and 4.6 illustrate that there is no significant difference between the two groups for the three pretests after running two-tailed independent t-tests (NWEA MAP reading: $t(38) = -1.523, p > 0.05$; NWEA MAP language use: $t(38) = -1.615, p > 0.05$; Achieve3000: $t(38) = -1.094, p > 0.05$). Therefore, the sampling of the two groups present meaningful results.

**Table 4.4**

*NWEA MAP Reading Pretest Independent Samples Test*

<table>
<thead>
<tr>
<th></th>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
</tr>
<tr>
<td>Pretest Reading</td>
<td>Equal variances assumed</td>
<td>.076</td>
</tr>
<tr>
<td></td>
<td>Equal variances not assumed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-1.523</td>
<td>37.60</td>
</tr>
</tbody>
</table>
Table 4.5
*NWEA MAP Language Use Pretest Independent Samples Test*

<table>
<thead>
<tr>
<th></th>
<th>Levene's Test for Equality of Variances</th>
<th><em>t</em>-test for Equality of Means</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
</tr>
<tr>
<td>Pretest Language Use</td>
<td>Equal variances assumed</td>
<td>2.403</td>
</tr>
<tr>
<td></td>
<td>Equal variances not assumed</td>
<td>-1.615</td>
</tr>
</tbody>
</table>

Table 4.6
*Achieve3000 Pre-level Set Test Pretest Independent Samples Test*

<table>
<thead>
<tr>
<th></th>
<th>Levene's Test for Equality of Variances</th>
<th><em>t</em>-test for Equality of Means</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
</tr>
<tr>
<td>Pretest Achieve Level Set Test</td>
<td>Equal variances assumed</td>
<td>3.165</td>
</tr>
<tr>
<td></td>
<td>Equal variances not assumed</td>
<td>-1.094</td>
</tr>
</tbody>
</table>

After running independent *t*-tests for these testing instruments, results demonstrate that the intervention positively affected student learning. Table 4.7 indicates that the students who
received the intervention reported higher reading performance on the posttest than those who received traditional reading instruction. As shown in Table 4.8, the mean difference for reading was, however, insignificant, $t(38) = -1.939, p > 0.05$.

**Table 4.7**
*NWEA MAP Reading Posttest Group Statistics*

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparison</td>
<td>20</td>
<td>194.90</td>
<td>7.152</td>
<td>1.599</td>
</tr>
<tr>
<td>Treatment</td>
<td>20</td>
<td>199.30</td>
<td>7.197</td>
<td>1.609</td>
</tr>
</tbody>
</table>

**Table 4.8**
*NWEA MAP Reading Posttest Independent Samples Test*

<table>
<thead>
<tr>
<th></th>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
</tr>
<tr>
<td>Posttest Reading</td>
<td>Equal variances assumed</td>
<td>.1459</td>
</tr>
<tr>
<td></td>
<td>Equal variances not assumed</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.9 indicates that the students who received the intervention reported higher performance language use scores on the post-test than those who received traditional language use instruction. The mean difference, as shown in Table 4.10, for language use was significant, $t(38) = -2.11, p < 0.05$. The results provide evidence that the intervention has had a more positive effect on language use than on completing the reading section of the NWEA MAP test. Specifically, the student participants have improved in three language use skill areas prescribed
by NWEA MAP: editing for mechanics, editing for grammar and usage, and revising texts for purpose and audience. It is also important to note that the p-value for the posttest decreased compared to the p-value for the pretest for the reading section of the NWEA MAP test. In addition, the qualitative responses in Appendix Q also reveal students’ ability to construct better phrases, sentences, or paragraphs to convey their thinking.

<table>
<thead>
<tr>
<th>Table 4.9</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NWEA MAP Language Use Posttest Group Statistics</strong></td>
</tr>
<tr>
<td>Group</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>Posttest Language Use</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 4.10</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NWEA MAP Language Use Posttest Independent Samples Test</strong></td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Posttest Language Use</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

As for Achieve3000, Tables 4.11 and 4.12 illustrate that the students who received the intervention reported higher Lexile scores on the posttest than those who received traditional reading instruction. The mean difference for Achieve3000 level set tests was significant, \( t(38) = -2.773, p < 0.05 \). Although the results for the reading section are insignificant for NWEA MAP,
the results for Achieve3000, which have more reading test types tailored to students’ current reading ability compared to the NWEA MAP reading test types, may present a better measure.

### Table 4.11

<table>
<thead>
<tr>
<th>Achieve3000 Post-level Set Test Posttest Group Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>Posttest Achieve LevelSetTest</td>
</tr>
<tr>
<td>Treatment</td>
</tr>
</tbody>
</table>

### Table 4.12

<table>
<thead>
<tr>
<th>Achieve3000 Post-level Set Test Posttest Independent Samples Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Levene's Test for Equality of Variances</td>
</tr>
<tr>
<td>F</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

For the Grade 8 treatment and comparison groups, the independent t-tests for both the comparison and treatment groups were also executed for both pretests and posttests of all computer adaptive testing instruments for the Grade 8 participants. Tables 4.13, 4.14, and 4.15, respectively, illustrate the results for the mean and standard deviations for NWEA MAP Reading, NWEA MAP Language Use, and Achieve3000 level set test for the pretests of both the comparison and treatment groups. These descriptive measures show that the two groups are similar in performance.
Table 4.13  
*NWEA MAP Reading Pretest Group Statistics*  
<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>PretestReading</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comparison</td>
<td>20</td>
<td>191.85</td>
<td>15.632</td>
<td>3.495</td>
</tr>
<tr>
<td>Treatment</td>
<td>20</td>
<td>191.00</td>
<td>6.266</td>
<td>1.401</td>
</tr>
</tbody>
</table>

Table 4.14  
*NWEA MAP Language Use Pretest Group Statistics*  
<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>PretestLanguageUse</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comparison</td>
<td>20</td>
<td>196.95</td>
<td>13.461</td>
<td>3.010</td>
</tr>
<tr>
<td>Treatment</td>
<td>20</td>
<td>202.80</td>
<td>7.281</td>
<td>1.628</td>
</tr>
</tbody>
</table>

Table 4.15  
*Achieve3000 Prelevel Set Test Pretest Group Statistics*  
<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>PretestAchieve</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LevelSetTest</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comparison</td>
<td>20</td>
<td>348.50</td>
<td>112.649</td>
<td>25.189</td>
</tr>
<tr>
<td>Treatment</td>
<td>20</td>
<td>409.25</td>
<td>92.740</td>
<td>20.737</td>
</tr>
</tbody>
</table>

Tables 4.16, 4.17, and 4.18, respectively, illustrate no significant difference between the two groups for the pretests for all components of both testing instruments, as the two-tailed independent t-tests unveil p-values > 0.05. Therefore, the sampling of the two groups presents meaningful results.

Table 4.16  
*NWEA MAP Reading Pretest Independent Samples Test*  
<table>
<thead>
<tr>
<th></th>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
<td>t</td>
</tr>
<tr>
<td></td>
<td>Equal variances not assumed</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>.226</td>
<td>24.952</td>
<td>.823</td>
</tr>
</tbody>
</table>
Table 4.17
*NWEA MAP Language Use Pretest Independent Samples Test*

<table>
<thead>
<tr>
<th></th>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-----------</td>
<td>------</td>
</tr>
<tr>
<td><strong>Pretest Language Use</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equal variances assumed</td>
<td>4.385</td>
<td>.043</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-1.709</td>
<td>29.240</td>
</tr>
</tbody>
</table>

Table 4.18
*Achieve3000 Prelevel Set Test Pretest Independent Samples Test*

<table>
<thead>
<tr>
<th></th>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-----------</td>
<td>------</td>
</tr>
<tr>
<td><strong>Pretest Achieve LevelSet Test</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equal variances assumed</td>
<td>.300</td>
<td>.587</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-1.862</td>
<td>36.648</td>
</tr>
</tbody>
</table>

After running independent t-tests for these testing instruments, results demonstrate that the intervention had moderate effects on student learning. Table 4.19 indicates that the students who received the intervention reported slightly higher performance reading scores on the posttest than the students who received traditional reading instruction. The mean difference shown in Table 4.20 for reading was, however, insignificant, t(38) = −1.160 .
Table 4.19
NWEA MAP Reading Posttest Group Statistics

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>PosttestReading</td>
<td>20</td>
<td>194.35</td>
<td>11.940</td>
<td>2.670</td>
</tr>
<tr>
<td>Treatment</td>
<td>20</td>
<td>198.40</td>
<td>10.070</td>
<td>2.252</td>
</tr>
</tbody>
</table>

Table 4.20
NWEA MAP Reading Posttest Independent Samples Test

<table>
<thead>
<tr>
<th></th>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
</tr>
<tr>
<td>PosttestReading</td>
<td>.235</td>
<td>.631</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.21 indicates that the students who received the intervention reported a slightly higher performance language use scores on the posttest than the students who received traditional language use instruction (M = 202.85, SD = 10.132). The mean difference, as shown in Table 4.22, for language use was also insignificant, t(38) = −0.769, p > 0.05. The intervention has had a slight positive effect on language use development as the mean score increased by only 2 Rasuch UnITs and there was no significant difference when compared to the comparison group.
As for Achieve3000, Table 4.23 indicates that the students who received the intervention reported higher Lexile scores on the posttest than those who received traditional reading instruction. The mean difference, as shown in Table 4.24, for Achieve3000 level set tests was significant, \( t(38) = -4.356 \ p < 0.05 \). Similar to the Grade 7’s, although the results for the reading section and language use are insignificant for NWEA MAP, the results for Achieve3000, which have more reading test types tailored to students’ current reading ability compared to the NWEA MAP reading test types, may present a better gauge. The quantitative data present evidence that the intervention is unveiling a positive learning effect on students’ reading ability, as the p-values decreased for all three independent t-tests. That is, students’ improved
performance demonstrated that they had acquired more vocabulary knowledge to achieve higher scores on the post-level set test independently.

<table>
<thead>
<tr>
<th>Table 4.23</th>
<th>Achieve3000 Post-level Set Test Posttest Group Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group</td>
</tr>
<tr>
<td>Posttest</td>
<td>Comparison</td>
</tr>
<tr>
<td>Achieve</td>
<td>Treatment</td>
</tr>
<tr>
<td>LevelSetTest</td>
<td></td>
</tr>
</tbody>
</table>

In sum, after examining the computer adaptive test results for both grade levels, the Grade 7’s seem to have demonstrated more improvement than the Grade 8’s, considering that both grade levels had similar performances at the beginning of the research. Even so, the results for the Grade 8’s revealed a salient positive change in improved reading development. However, the results did not indicate significant improvement in language use. As these computer-adaptive assessment tools only capture students’ literacy development and specific writing features (grammar and vocabulary) (Cope & Kalantzis, 2016), there is a need to examine other facets of assessments that could measure students’ writing, listening, and speaking skills. However, the current school setting has not adopted computer-adaptive tests that could perform such tasks.

<table>
<thead>
<tr>
<th>Table 4.24</th>
<th>Achieve3000 Post-level Set Test Posttest Independent Samples Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Levene’s Test for Equality of Variances</td>
</tr>
<tr>
<td></td>
<td>F</td>
</tr>
<tr>
<td>Posttest</td>
<td>Equal variances assumed</td>
</tr>
<tr>
<td>Achieve</td>
<td>Equal variances not assumed</td>
</tr>
</tbody>
</table>
Hence, the study attempts to leverage available tools that could provide more learning evidence, indicating an increase in student motivation to acquire the English language better and more efficiently. In the next section, computation data from artificial intelligence-powered technologies that provide automated scoring feedback are cross-examined to determine any trend in further elevating students’ English language skills in all domains.

**Interpreting Learning Evidence via Computation Data**

This section presents the results of the computation data compiled from image-bilingual text model training scores using Google’s Teachable Machine and machine scores generated by Grammarly and Baidu. Computation data were examined across three units for both grade levels.

One of the benefits of Google’s Teachable Machine scoring algorithms is their ability to engage in the metric of providing accuracy machine scores which is defined as the ratio of the number of correct predictions to the total number of predictions made (Mishra, 2018). Interpreting their viability applies to this study because every model is trained with the same number of images (or samples) for each class. For the purpose of this study, how these machines provide scores may have motivated learners to activate their metacognitive processes to think more deeply about the translingual process in support of their English language learning. A complete record of every student participant’s machine scores generated by Google’s Teachable Machine is charted in Appendix G.

The bilingual text-image model training yielded machine scores that unveiled the participants’ awareness of the importance of selecting images of high resemblance to generate meaningful bilingual text-image models. The Grade 7 students started image training in mid-October of the 2020-2021 school year alongside learning all the different technologies for the very first time. The Grade 8 students had prior experience using computers to learn in Grade 7
and did not begin image-training until late November as they spent more time learning the basic technologies needed to engage in these activities. Both grade levels engaged in the full intervention model with bilingual text-image training with Teachable Machine to build a sample of computation data for three consecutive units. Appendix G, which provides a chart visualization for each student in detail about how students performed on the bilingual text-image training with Teachable Machine, has been used to report the following findings.

In Unit 1 for both grade levels, learners examined images relevant to a reading passage or chapter in a novel to increase background knowledge as a before-reading activity (Grade 7 sample– Appendix H; Grade 8 sample– Appendix I). For this first image-bilingual text model training activity, student participants engaged in the translingual space of making a causal observation of what the image means in English and Chinese (written by themselves). To check for the English text's contextual, semantic, and syntactical accuracy, they input the Chinese text into an online translator (mainly Google). Then they compared their original English text and machine-generated translated English text, while referencing their Chinese text, to make further revisions along with the support of a teacher since online translators are imperfect (Niño, 2009; Case, 2015; Clifford et al., 2013; Briggs, 2018; Moorkens, 2018; Ducar & Schocket, 2018; Lee, 2020). Next, the learners trained the bilingual texts with a corresponding class of images. After the first formal trial of image-bilingual text training, only ten Grade 7 learners understood how to train one class of images, so most machine scores are only available for class 1. A few were able to produce scores for both classes. By examining the machine scores for the first unit, about one-half of the learners generated image recognition scores lower than 50% to as low as 1%, while the rest were able to achieve accuracies above 50% for both languages for the most part. As with the Grade 8 students, they were asked to train three classes of images for the first formal unit
with machine learning. Most were able to complete all three classes of image training, with a few who only completed one class or two classes. Scores were more consistent across both languages, though about eight students who trained images scored in the range of 1% to 50%.

For Unit 2, Grade 7 students trained classes of images related to a novel study. The Grade 8’s trained images related to short autobiographies to acquire ideas for writing a bilingual identity paper about themselves. (Grade 7 sample– Appendix J; Grade 8 sample–Appendix K). Grade 7’s were asked to predict what might happen in the novel with a preassigned image for a collection of chapters. When the machine scores generated from the training of four classes of images were examined, the scores were quite erratic with no overall trend. If examined in finer detail for most students, the corresponding Chinese and English texts generated low scores ranging from 0% to 60%, which explains the images used for training did not have a high resemblance, while classes of images with high resemblance generated relatively high scores ranging from 60% to 100%. Resemblance refers to the similarity between the images trained and the machine’s ability to classify an image into a discrete class of trained images. However, there are a few anomalies in which a participant received a high score for the Chinese text but a low score for the English text, and vice versa. For instance, Student 11 has a Class 1 image-text detection of 82% for the Chinese text and a 0% for the English text. This occurrence may be a machine error or an error in the training of numerous classes of image-bilingual text models, which may require repeated retraining to reduce noisy data (Broughton et al., 2020). Overall, scores for both languages were more consistent and resulted in higher score ranges for most students. The Grade 8’s were also asked to observe the images and predict the plot of two nonfiction narratives. Then they trained two classes of images, with each class representing one of the narratives. Over half of the students trained models that produced 70% to 100% accuracy.
in image classification for both languages. Similar to Student 11’s case, there were also a few cases of anomalies of a high score for Chinese and a low score for English (and vice versa) when training one of the classes of images. There were some instances of low accuracy rates for both languages ranging from 30% to 60%. The images had dissimilar features, multiple objects for detection, or image conflicts between classes (images were too similar between classes).

In Unit 3, all participants trained three classes of images (Grade 7 sample—Appendix L; Grade 8 sample—Appendix M). Higher image-text detection scores for both grade levels reveal the likeliness that the participants gained a better understanding of identifying more similar images to match their written bilingual texts. Most were able to produce machine scores ranging from 80% to 100% accuracy. The similar pattern of a few low scores, which occurred in Unit 1 and Unit 2, confirmed the dissimilarities in the groups of images trained. In addition, there were low occurrences of students (e.g., Student 20 and Student 27), with a high image-text detection score for one language text but a low score for the other language. This observation again confirmed another machine error. These findings resonate with current literature regarding the imperfections of artificial intelligence technologies (Pearl, 2018; Bengio et al., 2020).

Overall, students from both grade levels improved their machine scores through practice. About 60% of the Grade 7 students and 55% of the Grade 8 students figured out that they needed to train similar images to produce higher scores by the end of Unit 3. These students who exhibited more learning motivation based on their feedback from the qualitative data and their works were attentive to writing complete sentences in both languages to train meaningful bilingual text-image models.

The initial writing scores generated by Grammarly for every unit produced a score between 1 to 100. The rationale for using Grammarly is the continuation of gauging students’
writing ability beyond the sentential level. This writing assistant tool that operates on natural language processing can compare text to a given corpus of human-graded text (trained in a particular writing assessment application) and detect writing errors using analytical text parsing (as cited in Cope & Kalantzis, 2016). Students were able to use these features to understand their own writing mistakes.

If the participants attended to the suggestions generated by the writing assistant, the machine scores could increase to as high as 100 percent with the premium version. For the most part, the basic version will only enable users to improve their scores to about 80%. For the first three units that both grade levels participated in, initial scoring could range from as low as 30% to as high as approximately 80%~90%. (A few Grade 8 students did not record their initial scores for the first unit. Due to the COVID-19 pandemic, the Grade 8’s had to use the free version for the last unit, so most scores were capped at approximately 80%.)

For both grade levels, initial machine scores averaged as low as 30% to as high as approximately 80% to 90% depending on the quality and quantity of the text; post scores ranged from as low as about 80% to as high as 100%. Every participant had an equal opportunity to reach a near-perfect to perfect score regardless of their writing proficiency, as their work was compared against similar quality work trained in Grammarly’s database. Referring to Appendix G, all participants demonstrated moderate to significant gains, which gives insight into the learners’ will and motivation to improve their machine scores by independently correcting their work with automated machine feedback. However, some errors related to higher-level grammatical features, such as active and passive voice, and writing features, such as monotonous passages, still require occasional teacher facilitation and one-to-one instruction.
Baidu presents three specific features in training its oral speech evaluation: refined problem diagnosis, intelligent error correction, and high-precision scoring (Baidu Brain, n.d.). Its oral evaluation machine learning algorithms can detect errors that relate to fluency, accuracy, and competency. Some of these include misreading, mispronunciation, and inaccurate pauses. The machine provides high precision scoring feedback at a multidimensional phonemic level. When the speaker mispronounces a word, the machine can intelligently highlight error correction and initiate the speaker to practice mispronounced words. The machine can produce scores ranging from 0% to 100%.

Approximately 68% of the student participants for both grade levels demonstrated moderate gains per unit, while about 12% of the students maintained consistent scores throughout the units (as presented in Appendix G). The Grade 7 students' average scores were in the range of 70% to 95%, while the Grade 8 students yielded average scores in the 65% to 98% range. However, about 20% of the students exhibited erratic behavior or no consistency with their machine scores. Every participant practiced reading their written work in segments of their own choice at least three times and recorded the three highest scores. As learners are learning at their own pace, word count was not factored into gauging student improvement. These findings provide insight into how automated machine scoring for speech may further enhance participants’ motivation to produce higher machine scores. The repeated speaking practices to generate better scores helped them improve their English speaking skills via Dellerman et al. 's (2019) and Kamar’s (2016) theory of combining human and machine intelligences for learning.

The overall increasing scores for most students reveal that all three automated machine scoring feedback instilled in students the ability to construct knowledge and enhance learning motivation by interacting with different intelligent machine feedback types. This finding not only
supports the components of the proposed intervention model but also confirms Cope and Kalantzis’ (2016) assertion that learning and assessment may occur almost simultaneously, and both teachers and learners may have immediate access to the data to track learning progress. The shortened wait time for assessment feedback promotes more effective and efficient learning opportunities for students in attending to their errors immediately and for teachers to address the shortcomings of instructional strategies with minimal delay. However, the students who did not demonstrate improvement with their machine scores experienced trouble understanding the intervention or did not show motivation to consider how machine scoring can help them, which are revealed in the qualitative data.

**Interpreting Learning Evidence via Criterion-Related with Teachers as Raters**

According to the Kang Chiao International School’s assessment policy for the International Baccalaureate Middle Year Programme, students are assessed with the criterion-related method for the English language acquisition subject group (International Baccalaureate Organization, 2014). Each criterion is subdivided into four achievement level bands: 1-2, 3-4, 5-6, and 7-8. Generally, 1-2 indicates rarely, 3-4 refers to sometimes, 5-6 demonstrates often, and 7-8 nearly always. Also, each criterion has a set of specific strands that can be assessed. Each summative assessment is designed to enable teachers to identify the criterion and the strand(s) to assess, using task-specific clarifications to describe further what each prescribed criteria and strand indicate for a particular task. The assessor makes a “best-fit” judgment by navigating through each band until a student’s work reaches task-specific statements that most accurately reflect the band level. Meeting every strand of a criterion for criterion-related assessments is not required but rather relies on teachers’ professional judgment to reach consensuses of what quality work is, which is executed through standardization of teachers moderating and
communicating shared expectations regarding all criteria and achievement levels as a means to establish interrater reliability as a rater.

After a period of about six to seven months and ongoing summative moderation with the English language acquisition subject group coordinator and English support teachers, the initial and final term grades, as illustrated in Table 4.25, for the Grade 7 participants demonstrated moderate increases for all four criteria: listening, reading, writing/speaking, and language use. Most students, on average, were able to maintain or improve their criteria scores, albeit confronting more difficult material by the third unit. The performances for the Grade 8’s, as depicted in Table 4.26, were similar to the Grade 7’s, with the exception of Criterion C, in which the Grade 8’s were able to maintain the same level of performance with increased difficulty in the material throughout the units. As the students from both grade levels began at similar English levels, their similar rate of improvement for Criteria A and B was a notable result that may explain that the image-bilingual text writing activity with Teachable Machine, mainly implemented as pre-listening and pre-reading lessons, had a positive effect on students’ ability to make greater comprehensible input after engaging in describing images in both languages to increase background knowledge about the videos and readings assessed. However, for Criteria C and D, increases for both grade levels were not as significant, which points to the need for more coherent and explicit instructional designs to strengthen their translingual skills needed for comprehensible output tasks, such as writing, speaking, and language use.
Table 4.25

*Grade 7 Academic Records*

<table>
<thead>
<tr>
<th>Duration: 6-7 months</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Listening</td>
<td>Reading</td>
<td>Writing/Speaking</td>
<td>Language Use</td>
</tr>
<tr>
<td></td>
<td>Treatment</td>
<td>Comparison</td>
<td>Treatment</td>
<td>Comparison</td>
</tr>
<tr>
<td>Term 1</td>
<td>4.9</td>
<td>5.7</td>
<td>5.1</td>
<td>6.1</td>
</tr>
<tr>
<td>Term 3</td>
<td>6.1</td>
<td>6.0</td>
<td>5.4</td>
<td>6.1</td>
</tr>
</tbody>
</table>

Table 4.26

*Grade 8 Academic Records*

<table>
<thead>
<tr>
<th>Duration: 6-7 months</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Listening</td>
<td>Reading</td>
<td>Writing/Speaking</td>
<td>Language Use</td>
</tr>
<tr>
<td></td>
<td>Treatment</td>
<td>Comparison</td>
<td>Treatment</td>
<td>Comparison</td>
</tr>
<tr>
<td>Term 2</td>
<td>4.0</td>
<td>5.0</td>
<td>4.6</td>
<td>5.4</td>
</tr>
<tr>
<td>Term 4</td>
<td>5.1</td>
<td>5.7</td>
<td>5.3</td>
<td>5.9</td>
</tr>
</tbody>
</table>

Machine scoring and teacher rating each have their disadvantages and advantages. Machine scoring may undergo interference of noisy data that would require humans to train astronomical data sets made available via machine-mediated tools; teacher scoring is time-consuming (Cope & Kalantzis, 2016; Broughton et al., 2020). As most students are expected to move up the band levels throughout the units, increases in overall performance based on teacher raters’ best-fit judgment, even with interrater reliability, may not fully explain student performances at a more fine-grained detail in all language domains as compared to machine-generated scores. On the other hand, machine-generated scores are trained through algorithms that produce scores based on how the machine model is taught and programmed. Perhaps, to increase the reliability and validity of both assessment methods, the collaboration of both machine scoring and teacher rating can provide a better explanation and gauge student performances.
Examining Every Participant’s Progress with Available Data from Computer-Adaptive Tests, Computation Data for Writing and Speaking, and Academic Records

Whether computation scores from the three machine scoring activities increased students’ learning motivation and metacognitive processes for translingual development remains inconclusive. For image-bilingual text model machine scores, the consistencies between training the model in Chinese and in English with the same classes of images were examined across the three units. Whether students were eventually able to activate their constructive thinking skills and motivation to increase their Teachable Machine scores across the three units was also considered. Grammarly’s writing assistant and Baidu’s speech evaluation machine scores were examined for increases or decreases to support further whether automated scoring technologies can motivate the participants to work independently with machine feedback and teacher’s facilitation to improve their writing and speaking skills.

After cross-examining the three automated machine-scoring activities with results generated from computer-adaptive tests and human-rated criterion scores, a general evaluation of students’ overall performance for all testing instruments (significant, moderate, and minimal increases or decreases; no effect) was conducted to determine any possible trends that the intervention may have helped students’ English language acquisition. For the Grade 7 participants, there were indications that increased computation scores aligned with substantial improvement in both comprehensible input skills of listening and reading but a moderate improvement for writing, speaking, and language use. According to Appendix G, twelve students (Students 1, 2, 3, 4, 6, 8, 9, 11, 13, 16, 17, 19, and 20) demonstrated overall moderate increases in both computational score performance and most computer-adaptive tests/academic records. Another five students (Students 5, 10, 12, 14, and 18) exhibited significant increases for all assessment components. The remaining three students’ (Student 7, 15, and 19) computational
score performances did not affect the computer-adaptive tests and academic records, as some academic criteria scores and at least one computer adaptive test score remained stagnant or fell. For the Grade 8 participants, overall moderate increases can be identified in the results for thirteen students (Students 23, 25, 26, 27, 28, 29, 30, 31, 32, 35, 36, 39, and 40) though not all academic criteria scores and computer adaptive test components showed increases. More apparent significant increases across all machine and teacher scoring methods occurred among two students (Students 37 and 38). However, five students’ (Students 21, 22, 24, 33, and 34) low inconsistent computational scores could have resulted in their stagnant or decreased performances in more than one academic criterion scoring and computer adaptive test results.

By evaluating all testing instruments and cross-examining the results (See Appendix G), approximately 60% of the students experienced moderately improved performances in most language domains, while 25% of them exhibited significant improvement in all language domains. However, about 15% of the students did not appear to have benefited from this intervention due to a lack of understanding of the instructions or low learning motivation. Furthermore, computation scores appeared to support criterion-related scoring with multiple human raters and independent t-tests hypothesis testing for computer-adaptive tests. Increases tended to occur amongst students who showed higher motivation and constructive thinking skills. Hence, to explain the rate and quality of improvement based on these results, a period of six to seven months across three module units is the minimum amount of time needed to help these learners (currently placed in support classes) to reach the full Phase 3 English level requirements prescribed by the International Baccalaureate Middle Year Programme (Refer to sample rubrics in Appendix C). Students who consistently engaged with all the components of the intervention model demonstrated quality work for all language domains, which resulted in high academic
criterion scores and/or computer adaptive test scores. These quantitative measures are further explained from qualitative findings to support further connections and to ascertain whether these measures explain a learner’s extent of improvement.

**Teacher and Student Perceptions of the Hybrid Intervention Model**

Documentation from teacher and student reflection questions based on extending Tashior et al.’s (2011) transtheoretical framework for hybrid learning (Appendix N; Appendix O) were gathered and analyzed, using some aspects of a qualitative directed content analysis approach with predetermined codes to seek further information from open-ended questions about an existing theory, framework, or prior research (Hsieh & Shannon, 2005). Figures 4.2 and 4.3 illustrate the three main categories the selected theory of study embodies. Predetermined codes derived from the teacher and student open-ended questions were further delineated to pinpoint whether teacher and student responses can provide further insights about teaching and learning outcomes. Emerging themes, which focus on pedagogy, teacher’s instructive reactions, students’ learning responsiveness, and issues with the digital tools experienced, were determined from teacher and student written reflection responses. Appendix P and Appendix Q contain a complete and original record of the written reflection responses in typed format by all participants. In analyzing the data, the Grade 7 teacher is referred to as Teacher Participant 1 (female, 38), and the Grade 8 participant teacher as Teacher Participant 2 (male, 50). As for the students, the first twenty sampled Grade 7 student participants are numbered 1-20 and 31-40 for the sampled Grade 8 students. The analysis is divided into two subsections: teacher perceptions and student perceptions.
**Figure 4.2**

*Directed Content Analysis for Teacher Perceptions Based on the Extension of the K region of Tashior et al.’s (2014) Transtheoretical Model for Hybrid Learning*

Codes and themes for teacher perceptions

<table>
<thead>
<tr>
<th>Theory</th>
<th>Category</th>
<th>Codes</th>
<th>Themes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tashior et al.’s (2011) transtheoretical framework for hybrid learning</td>
<td>Extent of potentiality in learning outcomes</td>
<td>difficulties in instruction</td>
<td>pedagogical aspects</td>
</tr>
<tr>
<td>Tashior et al.’s (2011) transtheoretical framework for hybrid learning</td>
<td>Extent of connectivity</td>
<td>effectiveness of implementing digital resources</td>
<td></td>
</tr>
<tr>
<td>Tashior et al.’s (2011) transtheoretical framework for hybrid learning</td>
<td>Extent of connectivity</td>
<td>learning effectiveness of AI-powered technologies</td>
<td></td>
</tr>
<tr>
<td>Tashior et al.’s (2011) transtheoretical framework for hybrid learning</td>
<td>Extent of connectivity</td>
<td>teacher self-perception</td>
<td>instructive response from relevant teachers</td>
</tr>
<tr>
<td>Tashior et al.’s (2011) transtheoretical framework for hybrid learning</td>
<td>Extent of connectivity</td>
<td>teacher-student interaction</td>
<td></td>
</tr>
<tr>
<td>Tashior et al.’s (2011) transtheoretical framework for hybrid learning</td>
<td>Extent of connectivity</td>
<td>collaborating English teachers</td>
<td></td>
</tr>
<tr>
<td>Tashior et al.’s (2011) transtheoretical framework for hybrid learning</td>
<td>Extent of resilience</td>
<td>setbacks of technologies</td>
<td>issues with using digital tools for teaching</td>
</tr>
</tbody>
</table>

**Figure 4.3**

*Directed Content Analysis for Student Perceptions Based on the Extension of the K region of Tashior et al.’s (2014) Transtheoretical Model for Hybrid Learning*

Codes and themes for student perceptions

<table>
<thead>
<tr>
<th>Theory</th>
<th>Category</th>
<th>Codes</th>
<th>Themes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tashior et al.’s (2011) transtheoretical framework for hybrid learning</td>
<td>Extent of potentiality in learning outcomes</td>
<td>learning difficulties</td>
<td>perspectives about initial pedagogical aspects of assessments</td>
</tr>
<tr>
<td>Tashior et al.’s (2011) transtheoretical framework for hybrid learning</td>
<td>Extent of potentiality in learning outcomes</td>
<td>effectiveness of learning from digital resources (AI-powered / non-AI-powered) for all language domains</td>
<td>perspectives about pedagogical aspects of integrated technologies in all language domains</td>
</tr>
<tr>
<td>Tashior et al.’s (2011) transtheoretical framework for hybrid learning</td>
<td>Extent of potentiality in learning outcomes</td>
<td>student learning response in a bilingual/English language learning hybrid environment</td>
<td></td>
</tr>
<tr>
<td>Tashior et al.’s (2011) transtheoretical framework for hybrid learning</td>
<td>Extent of connectivity</td>
<td>student self-perception</td>
<td></td>
</tr>
<tr>
<td>Tashior et al.’s (2011) transtheoretical framework for hybrid learning</td>
<td>Extent of connectivity</td>
<td>teacher-student interaction</td>
<td></td>
</tr>
<tr>
<td>Tashior et al.’s (2011) transtheoretical framework for hybrid learning</td>
<td>Extent of connectivity</td>
<td>student learning response to initial difficulties with digital learning</td>
<td></td>
</tr>
<tr>
<td>Tashior et al.’s (2011) transtheoretical framework for hybrid learning</td>
<td>Extent of connectivity</td>
<td>student learning response to teacher as facilitators</td>
<td></td>
</tr>
<tr>
<td>Tashior et al.’s (2011) transtheoretical framework for hybrid learning</td>
<td>Extent of connectivity</td>
<td>student learning response to teacher and machine feedback</td>
<td></td>
</tr>
<tr>
<td>Tashior et al.’s (2011) transtheoretical framework for hybrid learning</td>
<td>Extent of resilience</td>
<td>setbacks of technologies</td>
<td>benefits and limitations with using digital tools (AI-powered/non-AI-powered for learning)</td>
</tr>
<tr>
<td>Tashior et al.’s (2011) transtheoretical framework for hybrid learning</td>
<td>Extent of resilience</td>
<td>setbacks of technologies</td>
<td>broader technological issues</td>
</tr>
</tbody>
</table>
Teacher Perceptions

The first section of the teacher reflection questions explored the extent of learning outcome potentials of the intervention. Pedagogical aspects emerged as a salient theme from three codes: learning difficulties, the effectiveness of learning from digital resources for all language domains, and learning effectiveness of artificial intelligence-powered technologies.

Pedagogical aspects

Both teachers expressed similar and different difficulties in implementing the different technologies. The first teacher participant expressed the beginning of the intervention as the most difficult.

*Overall, the beginning of implementing the units was the most difficult, as the learners were not completely accustomed to computer learning or the basic tools, such as Google Classroom, Google Suite apps, Google Meet, Goformative, and the teaching material organized into website module units. Every unit differs, so there will be slight variations with every module for the learners to navigate the information. To move into the operation of the three core pieces of AI-powered technologies effectively, students needed to be first immersed into a digital hybrid environment. Keeping the instructions simple for students to understand and follow was another challenge.* (Teacher Participant 1)

Furthermore, the second participant teacher needed more time to learn the tools, teach the tools to the students, and understand the instructional designs for leveraging the tools effectively.

*Time issue — both teacher and students were unfamiliar with using the tools, so it was difficult to complete the tasks on time.*

*Teaching materials — although all the units were already prepared and ready to go, it still took some time understanding the instructions and getting used to the format and*
procedures on how to implement them in class. Though after being more familiar with the designer’s purpose and logic behind each unit, I was able to implement the lessons with ease. (Teacher Participant 2)

Both teachers reported different difficulties when conducting the formative and summative assessments. Teacher Participant 1 discussed having to vary assessment methods using both traditional-based testing and progressive approaches to engage learners to receive both human and machine feedback.

For the listening and reading formatives and summatives, students continued with traditional paper-based pencil testing. For the writing assignments, the process of providing on-screen one-to-one feedback at the sentential level with GoogleDocs was time-consuming and requires the teacher to think quickly to provide human support for differentiated learning. It took time to be able to develop the skill of providing immediate feedback similar to what machine feedback, such as Grammarly, does. (Teacher Participant 1)

Teacher Participant 2 identified issues with conducting listening formative and summative tasks as well as assessing students in a fully online environment during the last month of instruction due to a sudden outbreak of the COVID pandemic in Taiwan.

For the majority of my students, they found the videos too fast and struggled even more when the CC [captions] was taken away. For example, for formatives the CC [captions] is turned on but during the summative it’s not. Since the classroom was drawn to the internet due to Covid. One immediate problem when assessing the formatives online, students were directly searching the questions online and copying the answers. (Teacher Participant 2)
As for the effectiveness of learning from digital resources for all language domains, both teachers identified the positive learning effects of deploying a combination of digital tools during the intervention. Examples are discussed from each teacher’s perspective.

Teacher Participant 1 discussed the use of module sites and digital affordances provided by machine learning feedback.

*Organizing all the lessons into a module unit using Google Sites with a combination of technology tools provided an efficient and organized way of giving students easier navigation of the content taught. These resources also provided ubiquitous access anytime, anywhere. The machine learning resources provided various affordances, especially with allowing students to think metacognitively about their learning and actively constructing the skill of thinking bilingually to support their English language development via various multimodal learning designs.* (Teacher Participant 1)

Furthermore, Teacher Participant 2 described the pedagogical benefits of implementing digital resources with a combination of basic tools.

*Using Google Classrooms was most useful. Especially when transferring to fully online classes. With a click of the ‘Meet’ button, and poof we are back in the classroom. Whether it’s announcing an upcoming test, or assigning an in-class activity Google Classroom makes it easy to use and organizes everything in a folder. Another big advantage is when other apps are linked to Google Classroom, such as GoFormatives. So after creating a quiz on GoFormatives, it gives the option to directly link and publish in your Google Classroom.*

*GoFormatives was most useful when answering reading comprehension problems. The first few students would receive extra points if their answer turned ‘green’. And*
immediately once someone got a green, everyone suddenly became your best friend. At this point, the rule is you could speak out, spell out if you have to, but can’t leave your seat, and can’t text message. This is in hopes to have more verbal practices.

The activities using the Baidu apps were proven most effective. Students automatically would aim for a high 80-90 score. And for those who are competitive, when seeing a student get a higher score, they would want to top that score. (Teacher Participant 2)

As for the learning effectiveness of artificial intelligence-powered technologies, several pedagogical aspects were analyzed. These include guiding students to become natural inquirers and active learners, enabling a learner-centric environment through teacher scaffolding, increasing effectiveness and efficiency in the learning process, and leveraging artificial intelligence-powered tools tactfully to differentiate instruction and improve learning outcomes.

Both teachers mentioned students’ natural questioning of how to improve their machine-generated scores.

Most student inquiries occurred when implementing the three AI-powered tools. After engaging in several bilingual image-text machine learning activities, students began to inquire more about unfamiliar vocabulary, as well as the accuracy of their sentences after checking with Google Translate. Most were noticing the imperfections of Google Translate. Then, students were asking what some of the automated machine feedback Grammarly provided meant, and how they could further improve their machine scores.

As for Baidu, when they had trouble improving their scores, they sought help from the teacher. (Teacher Participant 1)

There was one student who did ask how to raise the machine learning score in Teachable Machine. Similar reaction was more prevalent when using the Baidu app. Few students
would huddle together and trade notes/tips on how to better their scores. I also noticed that instant gratification plays an important role. The faster and more accurate the app responses, the greater the willingness of the student is willing to try again. (Teacher Participant 2)

In addition to students’ natural development as inquirers, both teachers expressed high student engagement and learning motivation while using these tools.

*Participants who exhibited higher learning motivation engaged in more constructive thinking. These learners tend to have higher performances in all testing instruments, as well as machine learning activities (image-bilingual text translation models, Grammarly and Baidu writing/speaking scoring). With the teacher’s ongoing facilitation and immediate feedback combined with machine feedback, students were able to redress their errors more quickly.* (Teacher Participant 1)

*Depending on which class the levels of engagement for certain tools is better accepted than the other. For example, Class 1 likes (more like loves) to use the Baidu app, and some of the boys would haze the other boys how high their score was. So immediately, they would have to raise their scores or be ridiculed for the rest of the day.* (Teacher Participant 2)

Furthermore, both instructors generally agreed that automated machine scoring tools provided more channels for scaffolding.

*Also, using writing assistants and speech automated scoring software have also made these learners curious as to how the tools will help them improve their English faster.* (Teacher Participant 1)
Ideally having peer to peer support and giving intrinsic rewards while using writing assistants or speech automated scoring software has proven useful. For example, after a student completes a task an automated score is given (ex.88%) then the student is rewarded with a star. A star = to a chance to throw the ball and win a prize (ex.candy). Setbacks are very time consuming and whenever extrinsic rewards are given, human greed follows. (Teacher Participant 2)

Both teachers expressed the effectiveness and efficiency of the integrated technologies powered by artificial intelligence improved in time and practice.

For the first unit, it took more time and scaffolding, as the combination of technologies have their own distinct features. However, the same technologies used in each unit became more second nature for the students, as we moved through more units. As machine automated scoring gave learners immediate feedback of their performances and their English language development, learners developed the autonomy to do better. (Teacher Participant 1)

After students worked out the kinks and were familiarized with the technologies, learning was most effective and at a more efficient pace. For example, in one of my classes there was heavy (yet friendly) competition as to who got the highest audio-automated score (Baidu). So much that they were waiting on the same device due to fairness and authenticity. Because of this, it has forced the weakest student to learn, adapt and improve exponentially. (Teacher Participant 2)

Both teachers agreed that the machine learning interventions via machine translation software had supported student learning. Teacher Participant 1 noted students’ metacognitive development in tactfully using online translators to support their learning.
Overall, the machine learning interventions that involve the use of machine translation software had moderate support on students’ learning ...In engaging in these activities using a variety of topics, students were able to develop a deeper metacognitive awareness about the affordance machine translators can offer in activating their translingual skills when writing in both languages, mainly to bridge over to their English language acquisition. (Teacher Participant 1)

However, though Teacher Participant 2 recognized students’ ability to effectively understand the need to use online translators, he noticed that many students continued to depend on teachers’ facilitation when deciphering the proper usage of unfamiliar words generated by online translators.

When working on the machine learning interventions at the beginning of the first semester, minimal translation was used, because students were not taught how to properly use the translation tools. And even after they knew how to use the translation tools, they still had difficulty differentiating which word(s) was correct and appropriate for their use. This was because their English level was still too low. But as the semester went on, students were building up a habit of using the translator not only for machine learning exercises, but also in other activities as well. Only a few students were able to accurately use the translators independently. Whereas the rest of the students had to still rely on the teacher to give the correct suggestion. (Teacher Participant 2)

Both teachers indicated that the scaffolded approaches that combine human teaching/learning and artificial intelligence-powered technologies and/or other combinations of technologies have allowed students to reach the highest achievement levels. Appendix P contains
learning evidence and student artifacts from the various machine translation/learning activities with Teachable Machine.

Yes, the intent of key AI-powered tools used is to give these learners more opportunities to achieve the highest score possible after multiple tries. (Teacher Participant 1)

Yes, when using the scaffolding approach combined with human teaching, AI technologies and an interesting factor (something fun that triggers student's interest in learning) will allow students to reach the highest achievement levels. (Teacher Participant 2)

As for identifying which specific machine-learner teaching strategies were effective, Teacher Participant 1 stated that the three major activities involving machine scoring embedded in each unit were effective. Teacher Participant 2 discussed the benefit of having students interact with online translators regarding comprehensible input skills of listening and reading.

The bilingual image-text machine learning activity helped students think metacognitively. The automated writing assistant and automated speech scoring supported students’ output of the English language, both in written and spoken texts. (Teacher Participant 1)

Students tend to write the same way as they speak. Hence by improving their writing through listening and reading, their speaking will follow. Take the ML-Prediction activities for example, a student looks at a picture and guesses what is depicted in the picture. Then the student is asked to write a sentence in mostly English (with some Chinese). Next student has to translate a complete English sentence (using any translator app). Lastly the student has to form a sentence using his own words. From this exercise the student has a chance to ‘read’ and ‘listen’ to the translator’s sentence; decide which word(s) best fits his intended meaning; take that sentence and change it into his own
words. So when he finally reads out the newly formed sentence it more or less becomes a part of him. (Teacher Participant 2)

In discussing how these tools enabled differentiated learning, Teacher Participant 1 and Teacher Participant 2 offered different insights. Teacher Participant 1 discussed the immediate feedback both humans and machines can offer together to facilitate differentiated learning.

The model allows the teacher to instruct each learner in real-time/in person both online and offline and provide comments continuously. Also, the use of AI-powered technologies allowed students to move at their own pace and recognize the types of errors they tend to make on an individual level. (Teacher Participant 1)

Teacher Participant 2 discussed strategies of grouping students based on the machine scores they receive to differentiate instruction in this learning environment.

In class B, I have separated the students into groups of 2 and 4. The groups of 2, pairs one strong and one weak. This is more of an intimate one-on-one set up. Reason being most of the teacher’s instructions needs to be translated, and also less distractions. The groups of 4 are mostly in the middle range, so they should be independent enough to complete the task themselves. And if not they could help each other out as a group.

(Teacher Participant 2)

These comments from both teachers provide evidence that the intervention model has offered more channels for better learning outcomes in terms of English language development in three areas. First, the teachers’ reflections support Albiladi and Alshareef’ (2019) and Oliver and Stallings’ (2014) previous discussion of experiencing initial difficulties and challenges of undergoing a gradual transformation through a changing landscape from a traditional classroom to a more progressively hybrid environment of activating online and offline technologies. Second,
both teachers were able to offer detailed insights into how the integral artificial intelligence-powered tools, as well as other basic tools, have enabled more digital learning affordances and positive learning outcomes for the different language domains, which were similar results reported in Arispe and Blake’s (2012) and Gedik et al.’s (2012) studies. These aspects are illustrated through student work provided by both teachers and in the teachers’ descriptions regarding greater learning engagement by taking a more active role in becoming natural inquirers and collaborators. Third, the teachers’ descriptions regarding students’ active engagement with the various machine learning tools, such as Google Translate via the image-bilingual text activity, Teachable Machine, Grammarly, and Baidu, also exhibit the related theories of humans and machines collaborating and generating higher productivity translated into practice (Dant, 2004; Dellerman et al., 2019; Kamar; 2016).

The second section of the teacher reflection questions explored the extent of connectivity from the following codes: teachers’ stance regarding all stakeholders (namely the teachers themselves), the interaction between teachers and students, and the collaboration with other teachers. The overall data focused on the theme—instructive response from relevant teachers.

**Instructive Response from Relevant Teachers**

Both teachers gave their viewpoints regarding teaching in this hybrid learning environment. In responding to how they see themselves in this new learning environment, both teachers expressed a shift in roles from a didactic instructor to a facilitator. Teacher Participant 2 also inquired the extent to which how these computer tools may have affected this transformation.

*Teaching and learning have become more student-centered rather than teacher-centered.*

*I was mostly acting as a facilitator.* (Teacher Participant 1)
As a bilingual learner, I tend to see myself as the perfect role model for my students, but when adding these new tools with machine-learning and all, I am not so sure anymore. At times I pause and think what goes through my students mind? What does this new generation of students think? What is their thinking process? What makes them tic? How much should a teacher facilitate and how much should be modeled? I honestly don’t know. (Teacher Participant 2)

Questions related to the interaction between teachers and students pertained to teachers’ reaction to students’ ability to learn the technologies, learning effectiveness, and learning rate.

When teaching the technologies used in the study, both teachers stated similar difficulties relating to language barriers and unfamiliarity with the tools/devices.

*Language difficulties, students’ lack of knowledge in the tools.* (Teacher Participant 1)

*Language barrier is usually the first hurdle ...After language, the next hurdle would be the lack of knowledge in the tools or their own devices.* (Teacher Participant 2)

After establishing better student rapport and clearer rules for computer use in the classroom, both teachers eventually overcame the difficulties of familiarizing the students with all the tools.

*Coming up with a simple set of classroom management instructions regarding the use of computer-mediated instruction helped with overcoming these difficulties.* (Teacher Participant 1)

*Yes, after getting used to the class dynamics and knowing my students better, I would usually ask certain student(s) to help translate my instructions.* (Teacher Participant 2)

It was reported that the recursive feedback offered by many of the tools deployed allowed both teachers to express their ability to detect higher learning quality.
Yes, I was able to track student learning not only with computation scores but also use the combination of technologies to follow the effect of student learning almost instantaneously. With traditional teaching, reaching every learner takes more time, especially with paper and pencil-based assessments. (Teacher Participant 1)

Yes, with certain programs such as Grammarly, the outcome is almost instantaneous. And by taking that score and the specific errors the student had made, the teacher was able to give a relatively appropriate assessment grade to the student. (Teacher Participant 2)

Furthermore, both teachers expressed detecting a higher rate of learning compared to a traditional non-hybrid course. Teacher Participant 1 discussed being able to teach the students higher-level writing skills by the second unit.

Overall, I was able to provide more differentiated instruction for all the students compared to a traditional non-hybrid course. I was able to provide more scaffolded instruction with the instantaneous machine learning scores and tailor learning to individual language learning needs for every language domain at a faster pace. With the tactful usage of translators through the bilingual text-image writing activities with Teachable Machine, I was able to teach the students the skill of not only recognizing their own errors but also identifying how Google translate could help or not help them and how they can use the tool to their advantage more effectively. As we moved into the second unit, less time was spent on fixing students writing at the morphological and sentential level. I was able to spend more time teaching higher-level linguistic skills, such as attending to more advanced syntactical features, semantics and pragmatics of writing longer paragraphs, or essays. (Teacher Participant 1)
Teacher Participant 2 stated noticeable increases in students’ reading summative grades throughout the year, most likely due to engaging with the bilingual text-image prediction activities.

Yes there is an overall level-up in student’s rate of learning compared to the traditional non-hybrid way. Take summative B for example, looking at the data in Term 1 the class average is at 4.4, then in Term 3 a large increase at 4.8 and lastly in Term 4 slight increase at 4.9. Also bear in mind the level of difficulty from terms 1-4 has increased significantly, making the last unit the most difficult. And even with that, the average of both classes combined still shows an increase. This is mainly due to the attribution of ML-Prediction activities. Possibly the predicting of the pictures and relating to the novel, then consciously or subconsciously translating their thoughts into a readable sentence creates a link between the two languages and allows for the student to gain faster access from both sides. (Teacher Participant 2)

As for collaboration between teachers and the subject group coordinator, both teachers indicated minimal disagreements in providing teacher-rated summative scores.

Yes, most of the time, we agreed with giving similar scores. There were a few occasions when re-assessments needed to be done. (Teacher Participant 1)

During moderations, the vast majority of the scores given are always usually fairly close (0.5~1.0). But on some rare occasions, when there is a difference of 1.5 or more, teachers would take turns explaining their reasoning(s) and then all come to a full agreement. (Teacher Participant 2)

Generally, these comments reveal evidence that the extent of connectivity amongst all stakeholders in this hybrid learning environment yielded positive teacher responses in two areas.
First, although both teachers experienced difficulties in providing instructions to the students initially due to the need to familiarize students with the various tools, they established new classroom management rules that involved the use of computers to reduce the barriers to delivering instruction. Secondly, the teachers’ responses indicated a better learning quality and a higher learning rate through the bilingual text-image writing activities with Teachable Machine. This activity, which intends to build students’ translingual development, correlates with Vogel et al.’s (2014) study in assisting the students’ reading and writing development in a more expanded digital space, operating not only machine translation software but also the multimodal aspect of training images associated with the student-generated bilingual texts via Teachable Machine to hone deeper metalinguistic thinking skills.

**Issues with Using Digital Tools for Teaching**

The third section of the teacher reflection questions examined the theme of issues with the technologies deployed for teaching and learning based on code setbacks in the technologies used. When responding to the setbacks, Teacher Participant 1 expressed concern about the intervention coming to a complete halt with no internet connection, as computers are the main tool for delivering instruction as well as learning. Teacher Participant 1 also discussed the long process of conducting the bilingual text-image activities and needed to make adjustments so that the technological aspects of the activity would not hinder the learning process.

*Sometimes, the tools lag in speed due to poor internet connection. It would be great to have offline capabilities just in case there is no internet...Also, the bilingual text-image writing activities with Teachable Machine, initially, took a lot of time for students to understand the steps, as this part of the intervention required manual uploading of images...Also, the training of images sometimes produced strange machine scores, as in*
one high image recognition score for one language and one low image recognition score for another language. Therefore, this required retraining of the models to make the numbers make more sense. (Teacher Participant 1)

Teacher Participant 2 expressed the drawbacks of various tools that may need further addressing.

When using programs such as Goformatives and using the automatic correction function, it is troublesome when setting up an answer key that fits all possible answers. When using Teachable Machine, there were some inconsistencies when testing out the same sentences, but different pictures. Maybe a ‘kink’ in the program that needs to be updated.

When lessons are conducted online, monitoring student’s progress is difficult. Often they are off task or multi-tasking and miss out on the lesson at hand. Or when there is a technical problem, it is difficult to talk through the problem due to language barriers.

(Teacher Participant 2)

Building on Gedik et al.’s (2012) findings regarding the drawbacks of a hybrid learning environment that operates online and offline teaching components, these comments reveal the imperfections of all technologies, whether they be basic tools or tools operated by artificial intelligence.

**Student Perceptions**

Every participant expressed their views about how learning in this hybrid learning environment impacted their English language development. The same categories—the extent of potentiality in learning outcomes, the extent of connectivity, and the extent of resilience—are used to draw implications and generate codes and themes for student perceptions.
In section one, the codes used to analyze the data include learning difficulties, the effectiveness of learning from digital resources for all language domains, and artificial-intelligence-powered technologies. The data revealed two themes: students’ perspectives on initial pedagogical assessments and integrated technologies in all language domains.

**Perspectives about Initial Pedagogical Aspects of Assessments**

Thirty-nine students discussed their perspectives about initial difficulties with the pedagogical approach to assessments. The listening and reading assessments were mainly conducted digitally in the classroom. Many student participants from both grade levels expressed difficulties in understanding the words on the test. For instance, Student Participant 3 (Grade 7 female, 13) and Student Participant 32 (Grade 8 female, 14) shared their experiences of their limited vocabulary knowledge.

*Sometimes I want to write and describe something, but I don’t have the vocabulary to describe it.* (Student Participant 3)

Similarly, Student Participant 32 (female, 14) expressed a similar perspective.

*There are some difficult to understand words, so answering questions will be a bit difficult…* (Student Participant 32)

Two Grade 8 male student participants indicated technological issues with sound on listening exams.

*I have difficulty with criterion a because I can’t hear the sound clearly.* (Student Participant 30)

"A”, because the people in the video’s sound is strange. (Student Participant 33)

A Grade 8 male student participant wrote about the difficulty in concentration.
The difficulties during the formative that I have is that it’s a bit hard to concentrate, because there are some classmates talking while I’m doing the formative. (Student Participant 29)

Student Participant 13 (Grade 7 female, 13) and Student Participant 22 (Grade 8 male, 14) stated that they did not experience trouble.

It [referring to exams] is not that hard, and you don’t need to spend too much time, but still need some preparation. We just need to spend some time and more concentrate on it, then we can get a good score. (Student Participant 13)

Say the ture, I don’t have any quaction. (Student Participant 22)

Perspectives about Pedagogical Aspects of Integrated Technologies in All Language Domains

After receiving the intervention, all forty student participants described their learning experience concerning pedagogical aspects of integrated technologies in the different language domains. They commented on how the teachers used a digital tool for a specific activity to help them develop their English. Some thoughtfully shared their perspective about the new learning experience and their ability to learn better with specific artificial intelligence-powered technologies and other combinations of digital tools. Notable vignettes illustrating this notion from both grade levels are reported.

Student Participant 10 (Grade 7 male, 13) discussed the benefits of how machine scoring apps and the activities related to Teachable Machine and online picture translators can help him learn more productively.

We use Baidu to practise speaking, if I have some mistake that I don’t know, the teacher will explain clearly, such as give an example to let me know. After I finish my writing, the teacher will check and get some advice to help me write more currently and clearly.
I think teachable machine is a very helpful website, it helps me to fix the writing for more describing. It uses images and my words that I type to give a score. For Google translate, it has images for a word, it can help people learn English more faster; Also, Google translate has grammar fix for the sentence, it can help people to learn English, too. The grammarly has some examples to explain why my grammar is wrong, it will make my grammar faster. A little bit of a bad part is sometimes grammarly gives me a wrong answer. The Baidu scoring is good because it uses some pronunciation examples to show why my English pronunciation is wrong, it can practice more time to get a more than 90 score. The biggest weak point is this software is from China, I hope that Google or Microsoft can have pronunciation scoring. Teachable machine, Achieve 3000, grammarly both can help me with English. (Student Participant 10)

Using a descriptive approach, Student Participant 13 (Grade 7 female, 13) gave a strong response by describing her understanding of how the teacher assesses every language domain. She also wrote about how the different machine learning apps have helped her learn. She delved into a deeper discussion of the possible benefits of building a picture translator using Teachable Machine.

There will be some tests about listening. On the test, the teacher will play a video, and the narrator will talk when it reaches a point, it will stop and give us a question about what it says in front. If we don’t understand what the narrator says, we can use what we have just seen and describe the picture.

The teacher changes the way to let us read. Like when we are reading the book hole, the teacher will let us open google meet, and the teacher will put her screen on our screen so we can see it. Then she will open the book on the screen. There will be a person reading
the story, and the word will follow the person and move to that word. When the reader finishes reading one to two paragraphs, the teacher will stop it, and start writing the setting, character, and plot about those paragraphs.

After we finish our own essay, the teacher will let us bring our phones to class, and we need to download Baidu translate. First, we copy and paste our essay to the translation and then listen to the machine talk, after that, we need to read and record our sound. Last, we type our score into the essay. The teacher will make it into many parts, and eerie class we will do some of it. The teacher will check each part and until the end, we will make all of them into an essay.

Yes, Grammarly helps us to fix the grammar in our essay, Baidu helps us speaking. So each machine can make us better in different places. Translators, when I have some words that I don’t know, I can use it to let me know what the word means. I think the picture translators can let us write better by looking the picture and tell. But when I use the picture translators I must find a picture that is very similar to my sentence, or my score will be low. (Student Participant 13)

Continuing this line of discussion, Student Participant 14 (Grade 7 female, 13) reflected on her journey of acquiring more confidence in effectively and efficiently applying the English language in her studies. Specifically, she initially expressed not having much knowledge about how to perform well on formatives and summatives. Then, she described how the teacher had transformed her approaches to learning and how the different technologies had changed the way she learns English. She further emphasized that she can understand spoken English better now. She also expressed the benefits of the Teachable Machine activity.
We have the listening test, and I need to concentrate very well so I can write something
down. And now I am listening to the people who said English I can quickly understand.
(formative & summative). The reading at the class we do some of the reading we read on
the book, frequently we read on the computer. I think reading on the computer is better
because when I don’t understand the word I can use the dictionary to help me to know
what the word means and explain it in English. We use the app to help us speak, and the
app gives us the score. We have written 3 the story. At first, I wrote the essay I cannot
think very well, I thought about Chinese and translated it on my own. At that time I even I
don’t know I am writing about. The technologies that help me are computer and phone
when having computer typing, in my opinion, I think typing can let me think very
carefully when I need to change but I am not at the class. The teacher is not beside me, I
can take out my computer. When it comes to paper writing I need to change something. I
need to go to find that teacher and take the paper to change something. I think [the
teacher] has very good teaching strategies to let me have very fast improved my English,
she uses many technologies to help us improve our English. In class, [the teacher’s]\nteaching strategies are very happy and don’t have many pressures, she helps the students
to improve very fast... Teachable Machine activity is very well to me because the thing let
me learn about “use complete sentence to describe the image” and the machine will give
me the score so I know my sentences are good or bad. So I think this technologies are
very helping me learn. (Student Participant 14)

Similar to the Grade 7’s, many Grade 8 student participants also expressed similar
positive learning effects in this new learning environment. The following two vignettes from
Student Participant 29 (Grade 7 male, 14) and Student Participant 35 (Grade 8 female, 14) relate
to the learning effectiveness of the digital resources, integrated with the use of artificial intelligence-powered tools in the different language domains.

Yes! These things helped me a lot. For example, Baidu helps me speak more fluently, not making my tongue tied, Grammarly lets me know more about the grammar mistakes etc. Listening increases my concentration of listening and...

Yes, because if the text... English and Chinese, everytime we see the book we will deepen our impression of the meaning of these words [referring to Teachable Machine].

I think Grammarly and Baidu help me the most at my own pace. To me it helps the most important things in English, Baidu helps me communicating, help me speak more clearly, to express the thing I want to say, at future, like persuading our products, you have to speak clearly to let the people can trust you. Through this they can tell your attitude, if you not speak clearly, they will think you are not trust to your product, automatically they will not trust you either. But if you speak clearly, they might think that you have so much confidence in the product, it should be good. Grammarly is helping me on the grammar part... (Student Participant 29)

Listening - ...I think it only helps my listening, because I only find the word I didn’t listen to.

Reading - learn more words...

Speaking - better pronunciation of using 百度 [Baidu]

Writing - use more words because I can learn words just on pictures so I won’t forget.

[Teachable] Machine helps me about the writing and reading the Machine province a lot of my times, because I can just learn from the picture, and...
I can understand words I don’t know from pictures better than the only words describing.

I think the pictures help me to remember vocabularies and also understand those words faster. (Student Participant 35)

While most students wrote about how specific artificial intelligence-powered tools and other computer assistive tools helped them learn better, there was a case of Student Participant 12 (Grade 7 male, 13) who found most of the integral tools helpful for his learning but did not think the Teachable Machine activities were beneficial at all since he can picture images in his mind without looking at stimuli. He also reflected on how the Baidu speaking exercises could be more efficient and beneficial for learning.

Listening: videos cut into pieces. I can’t understand what the video maker talks about, need to repeat the video to let me understand the video better.

Reading: On-screen reading. Some of the vocab I can’t understand very well, I need translater to understand vocab better.

百度 My pronunciation of English is terrible, it tells me how to pronounce the word correctly.

My grammar is bad need Grammarly to help correct me.

The Teachable Machine activity doesn’t help me very much, because I can picture a sentence without machine. Translators: It helps me learn more vocabulary and understand the article better. Grammarly scoring: Improve my grammar, but sometimes I won’t understand all of the grammar I’m wrong, and sometimes I will make the same mistake. Baidu scoring: Improve my pronunciation, but takes a lot of time, also everyone’s has a different amount of word in an essay, someones is longer, I think the person has longer essay can just read some of their essays, this can save a lot of time. I
think the translator helps me most because there’s not a lot of vocabulary in my brain.

(Student Participant 12)

In summation, most Grade 7 and 8 students initially experienced trouble reading and understanding the formative and summative assessments due to insufficient vocabulary knowledge in the English language. Most students were able to identify the key technologies used to improve their English in most language domains. These include segmented video listening tasks, on-screen reading, speaking practice with Baidu automated scoring app, and Grammarly automated feedback/scoring. Also, most Grade 7 students identified how the Teachable Machine activity helps them write better sentences, which is an advancement in previous studies regarding leveraging machine translators as tools for writing development. Some Grade 8 students acknowledged that they could learn vocabulary faster, a finding that supports prior studies about machine translators used for pedagogical purposes (Clifford et al., 2013; Giannetti, 2018; Lee, 2020). Eight students from both grade levels were able to think about how the Teachable Machine activities are connected to more challenging writing tasks such as essays. Ten student participants were able to reflect on how the images supported their writing. However, one student participant stated that the activity was not helpful because he could picture images in his mind to support his writing without using the machine. Only four students responded directly to how these technologies are helping them learn at their own pace.

For the extent of connectivity, the two codes used for analysis include how students perceive themselves in this hybrid learning environment and their views about how teachers, as facilitators, interact with students in a student-centered learning environment. Students’ written reflections on self-perception revealed two emerging themes: student learning response in this hybrid environment and student learning response to expanded forms of digital
translingualism activities leveraging artificial intelligence technologies. Their responses to a novel way of teacher-student interaction—a learner-centric mode—generated three themes: student learning response to initial difficulties with digital learning, student learning response to the teacher as facilitators, and student learning response to teacher and machine feedback. (Refer back to Figure 4.3.)

**Student Learning Response in a Bilingual and English as a Second Language Hybrid Environment**

Twenty-eight students provided responses to learning in this hybrid learning environment. The data generally revealed positive reactions with minimal negativity. The following sample vignettes by Student Participant 2 (Grade 7 female, 13), Student Participant 12 (Grade 7 male, 13), student participant 22 (Grade 8 male, 14), and Student Participant 36 (Grade 8 female, 14) represent these aspects.

*Nontraditional because the computer can teach more faster it correct our grammar mistake and spelling mistake.* (Student Participant 2)

*I think I’m very lucky in an L2 hybrid learning environment, I learn a lot in this class, I handling this class very seriously.* (Student Participant 12)

*I think mix two [referring to traditional and non-traditional teaching] …is a good idea, it make me be easter to understand.* (Student Participant 22)

*I think it is very great, because that makes me not just listen to the teacher to learn. We use technology and we can have some online quizzes or games. It’s very helpful.* (Student Participant 36)

Furthermore, Student Participant 14 (Grade 7 female, 13) diligently expressed increased confidence while learning in this environment.
And now I need to say English for almost class, sometimes I said in a low voice I am very scared about other people will hear I said English. But now I feel it is ok to speak English very loud because there are people with me at the same level, so I think I can do better than giving me confidence. In our English class, the teacher has given us the robot to help us with speaking so we will have the score. My score sometimes is high and I know I improve my speaking. (Student Participant 14)

Other comments regarding the challenges of learning in this environment include confusion. For instance, Student Participant 3 (Grade 7 female, 13) admitted not knowing how to use a particular digital tool such as Teachable Machine. Student Participant 40 (Grade 8 female, 14) experienced trouble deciding which language to use.

*I think sometimes I will be confused about it. I was confused about the teachable machine.*

*But I will ask teacher or classmates to figure out and learn things from the machine.*

(Student Participant 3)

*Sometimes I get confused, and suddenly I don’t know what language to use.* (Student Participant 40)

Four students also expressed the need for increased effort. Student Participant 5 (Grade 7 female, 13) noted the following.

*I need to work very hard.* (Student Participant 5)

Seven students developed awareness of nontraditional elements in instruction and the helpful nature of mixing traditional and nontraditional instruction. The following are three salient observations from Student Participant 11 (Grade 7 female, 13), Student Participant 33 (Grade 8 male, 14), and Student Participant 39 (Grade 8 female, 14).
Before we won’t use computers, but now we will use computers to learn many different things. And the computer tools help a lot like translate, to translate the words, Achieve 3000, help reading. (Student Participant 11)

It should be said that each has its own advantages. Just like traditional learning has better stability, it is more convenient to learn science and technology, and it is much more convenient. Almost only one device can complete many aspects of learning, but it can be further improved. A variety of devices can be used. (Student Participant 33)

In kcis, English class uses technology to study, but other classes still use traditional teaching, and I think in the future we will fully change to technology teaching, we need to adapt to this shift. (Student Participant 39)

There were minimal indications that traditional forms of learning were preferred. Student Participant 16 (Grade 7 male, 13) directly expressed that the teacher’s role is more important than independent learning.

I think the teachers is more important than the computer itself because the teacher teaching me is better than the self-learning by using translators. (Student Participant 16)

Student Learning Response to Expanded Forms of Digital Translingualism Activities

Of the forty student participants, twenty-eight students provided reflections about their translingualism development in an expanded digital space that operates hybrid intelligence. Most of these responses related to machine translators and Teachable Machine bilingual text-image training activities.

Five students indicated that they have become less reliant on machine translators after initially using them for support. Their reflections also exhibited their increased independent,
cognitive bilingual transfer. Particularly, Student Participant 6 (Grade 7 female, 13) reflected on developing this vital transfer skill between her native language and English.

Yes, I can transfer the language between Chinese and English faster, sometimes can thinking about English in my brain easily. (Student Participant 6)

However, Student Participant 17 (Grade 7 male, 13) stated his difficulty in translating more difficult vocabulary words and may need to continue to rely on Google Translate.

Yes, we can put Chinese to google translate to help English. Some words I can translate to English, but the harder word I cannot transfer to English. (Student Participant 17)

There was also evidence that students developed more effective translingual skills through machine translation activities with Teachable Machine. Student Participant 5 (Grade 7 male, 13) noted the following.

Because when I just started school, I can’t type a sentence very well but using the machine I think that I can type more and better sentences. (Student Participant 5)

A further notable finding included Student Participant 18’s (Grade 7 male, 13) realization of how the bilingual text writing and image training activities helped him write better essays and perform better on formative and summative assessments.

Yes, we use Chinese language to help English in google translate. Then, use a teachable machine to train picture models to get a score. They help me learn how to write essays and formatives/summatives. (Student Participant 18)

Furthermore, seven students noted that they were able to transfer skills to other classes. Student Participant 19 (Grade 7 female, 13) discussed her experience.

When I use google translate or the other machine I can remember the words or the things I learned, so I use it in other subjects. (Student Participant 19)
Though Student Participant 27 (Grade 8 female, 14) did not specifically state how she used translators in other classes, she described how this tool could help her finish work from other subjects.

*Yes, in Design class, I will use Google translate to help me finish my work.* (Student Participant 27)

Three students indicated better retention in the English language learning process. Particularly, Student Participant 19 (Grade 7, female, 13) expressed the following.

*When I use google translate or the other machine I can remember the words or the things I learned, so I use it in other subjects.* (Student Participant 19)

However, there was one student who expressed not understanding translingualism. Twelve other students provided no response, which leaves room for discussion about redressing learning activities related to translingual development in this learning environment.

**Student Learning Response to Initial Difficulties with Digital Learning**

Thirty-four students of the forty participants provided feedback about their initial difficulties with digital learning. The most common hurdles indicated include slow typing, low vocabulary, lack of understanding of how to use the tools, limitations of machine translators, the Baidu speech evaluation tool, and difficulty finding suitable pictures for training with Teachable Machine.

Student Participant 1 (Grade 7 female, 13) stated the need to learn how to type efficiently.

*At the beginning our typing speed is not fast. Yes, I was able to get better.* (Student Participant 1)

Limited vocabulary knowledge was another concern for students. The following remark from Student Participant 29 (Grade 8 male, 14) illustrated this limitation.
The words are hard to understand and some words are hard to use in essays or sentences. (Student Participant 29)

Twelve students mainly expressed the need to learn a variety of technologies that are unfamiliar to them. Student Participant 29 (Grade 8 male, 14) noted the following.

Some initial difficulties encountered while learning the technologies is that I might not know how to use them. (Student Participant 29)

Five students were able to identify the limitations of artificial intelligence-powered tools. For instance, Student Participant 33 (Grade 8 male, 14) noticed that Baidu does not work on all devices. Student Participant 10 (Grade 7 male, 13) identified further limitations in online translators.

The device can’t use baidu (It would be better if that application/website can be completed on a computer) (Student Participant 33)

The biggest problem is sometimes the machine translations are still incorrect, or the machine gives me suggestions that are unnecessary. (Student Participant 10)

One student participant had difficulty locating suitable images for image training. Student Participant 35 (Grade 8 female, 14) expressed this frustration.

A can’t find out the picture that really matches the first time, and I can’t understand how to use the machine. (Student Participant 35)

Student Learning Response to Teacher as Facilitators

Twenty-six students of the forty participants made comments about their learning response with teacher facilitation. As these students were accustomed to traditional teacher-centered learning environments before the start of the school year, having about two-thirds of them respond to a question regarding a student-centered learning landscape is notable. Although
the responses are very general, there are indications that students are taking a more active role in being inquirers instead of passive learners. Student Participant 14 (Grade 7 female, 13) noticed her need to take on a more active and independent role as a learner.

\textit{Yes, the teacher has to help me with the school thing and more explain it to me so I can understand more. The teacher will not just tell me the answer I need to do it myself so that I can learn something before I don’t know.} (Student Participant 14)

In addition, Student Participant 27 (Grade 8 female, 14) expressed careful usage of online translators and the need to take a more active role in seeking teacher’s assistance.

\textit{Maybe, if there is something I don’t know and google translate does not translate it correctly, then I can ask the teacher to help.} (Student Participant 14)

There were minimal instances of students expressing frustration or not needing the teacher as facilitators. Student Participant 35 (Grade 8 female, 14) stated not being able to obtain immediate support due to wait time.

\textit{No, because the teacher can tell us how to solve the problem, but they need to think at the first time so I can’t get the support at the first time.} (Student Participant 35)

\textbf{Student Learning Response to Teacher and Machine feedback}

Thirty-five of the forty students wrote about their experiences in a learning environment that leveraged both machine and teacher instruction. The high number of responses demonstrated that a majority of the students were aware that human instructors were not the only ones teaching them. Most of them were able to express how artificial intelligence-powered tools helped them learn better. However, a few expressed concerns about over-reliance on automated machine tools for learning.
Thirty-three students discussed the benefits of the recursive feedback nature of artificial-intelligence-powered tools that could address their errors “just-in-time.” The following vignettes by Student Participant 6 (Grade 7 female, 13), Student Participant 17 (Grade 8 male, 13), Student Participant 36 (Grade 8 female, 14), and Student Participant 40 (Grade 8 female, 14) are indicators of these benefits.

Yes, because the machine will tell me where I have wrong for the grammar and the spelling, I can remember and I won’t make the same mistake for the same place. (Student Participant 6)

Yes, because don’t need to wait for the teacher to check. (Student Participant 17)

They can fix my problem at the right time and the right way. (Student Participant 36)

I can ask the teacher at any time and I can use the machine to help myself. (Student Participant 40)

Three students expressed the increased rate of learning which created more time for other activities, such as homework. For instance, Student Participant 4 (Grade 7 female, 13) and Student Participant 30 (Grade 8 male, 14) remarked about this notion.

Yes, the teacher tells me many ways to use it because the more ways to learn better, the faster time to improve. (Student Participant 4)

Some machines help teachers to answer or correct student sentences. The machines really help the teacher a lot. Teachers can spend less time correcting or answering students' words, and do more meaningful things. (Student Participant 30)

Fifteen students mentioned their increased understanding of the content and higher motivation to learn. Student Participant 7 (Grade 7 male, 13) and Student Participant 14 (Grade 7
female, 13) described a better understanding of how to learn and the willingness to persevere in doing better and earning a higher score.

*Through the machine and the teacher's advice, I have a better understanding of how to learn.* (Student Participant 7)

*I think teachers and machines will help me get better. Because when I use the machine there might be words I don’t know so I can translate. When the time teacher or machine gives me something that I improve at, I will be thinking about where I can improve and try it again.* (Student Participant 14)

Adding on to Student Participants 7 and 14’s comments, Student Participant 22 (Grade 8 male, 14) and Student Participant 26 (Grade 8 male, 14) discussed their motivation to improve their work by adhering to human and machine feedback.

*Yes ofcouse, I can get two different explantion.* (Student Participant 22)

*Yes, I can learn better when the machine and the teacher provide me feedback. I can listen to teacher’s feedback and machine’s feedback and I can mix teacher’s feedback and machine’s feedback together and learn better and better.* (Student Participant 26)

The building of metacognition in learning from two Grade 7 student participants was another notable find. Student Participant 10 (Grade 7 male, 13) mentioned feedback from two sources helped build his thinking skills.

*Yes, the machine and the teacher will let me learn better because sometimes the machine will give me wrong things, the teacher will tell me why the machine is wrong, it helps me for my thinking skills.* (Student Participant 10)

Student Participant 13 (Grade 7 female, 13) wrote about altering machines to respond to students’ needs. Her ability to metacognitively think about how machines can better support her
learning, though not explicitly described, gave insight into her development in critically reflecting on the limitations of computer learning and taking a further step to think about what else can be done to help her.

*Yes, but I wish the machine can change something if the machine can add the things that can make students better, I think it can help students more.* (Student Participant 13)

However, a few students expressed downsides to machine feedback. Student Participant 21 (Grade 8 male, 14) expressed his preference for teacher feedback over machine feedback.

*Teacher, because machine is not better than people...* (Student Participant 21)

Two others discussed the uncertainty about whether using machine feedback is beneficial. Student Participant 15 (Grade 7 female, 13) remarked about the danger of reduced independent thinking skills and becoming over-reliant on Google Translate.

*I think the machine and teacher teach me is a better way to help me in my homework and class, in before I did do will in class. Because it can not use much machine help and it just teacher saying the important things, and also not use too many computer teaching in class. But now teacher let us use computer teaching and machine learning, it let me understand more, But if I always rely the google translate my head will be not thinks so it have a good ways and the bad ways. But I like the computer learning more.* (Student Participant 15)

Student 24 (Grade 8 female, 14) expressed her worry about distractions digital tools created.

*Maybe yes maybe no, because using technologies may make me distract but the traditional teaching will make sure we stay attentive.* (Student Participant 24)

There was one student who expressed strong disapproval of these tools.
I think the machine is useless because it is very inefficient. (Student Participant 33)

In general, most Grade 7 students responded positively to this hybrid learning environment, though some indicated that they needed to study harder. Twenty-seven students voiced how the use of the mother tongue Chinese has supported their translingual thinking skills, which further supports García et al. ’s (2017) and Wei’s (2018) more current definition of translingualism. Seven students were able to clearly discuss how they transferred the skill of translingual thinking to other subject areas, such as science, math, drama, and design classes.

However, for the Grade 8 students, a little over half of the participants were able to generally describe the benefits of learning in this new learning environment from multiple perspectives, recognizing the importance of using their bilingual knowledge to support their English language development. Although indications by the student participants regarding translingual development were limited, over fifty percent of the responses by the Grade 8’s demonstrate that they may have applied tactics of translingualism in building their vocabulary knowledge in English. One student stated the need to learn more about translingualism, while twelve students did not reflect on this concept. Pointing to the need for more direct instruction regarding translingualism, incremental instructions throughout the learning units are needed to help students understand the steps required to naturally develop and activate their translingual capacity through the image-bilingual text writing activities. A corollary is that more teacher training regarding translingualism also needs further reinforcement. When discussing their perceptions about teachers as facilitators of vital computer tools for English language learning as well as receiving both human and machine feedback, most Grade 7 and 8 students recognized that they are learning better with both the machine and the teacher providing them immediate feedback. However, four students did indicate the drawbacks of over-reliance on certain
technologies such as Google Translate. Most have developed a good extent of metacognition of learning how to learn with these tools, although some experienced difficulties learning how to use these tools or found them impractical due to technological setbacks.

In examining the extent of resilience, two themes emerged from the following code for analysis: setbacks of technologies. The first theme pertains to the benefits and limitations of integrated technologies. The second theme presented in the data analysis relates to other broader technological setbacks.

**Benefits and Limitations with Using Digital Tools**

Seventeen students expressed their viewpoints regarding the benefits and limitations of tools powered by artificial intelligence. In their written reflections, data reveals that they were actively thinking about the extent of support they could receive from a machine translator, a writing assistant, a speech evaluation tool, and a teachable machine activity.

Of these seventeen students, eight students expressed concern about the inaccuracies produced by online translators as well as unknown words that students may not know how to use correctly in writing. Student Participant 10 (Grade 7 male, 13) and Student Participant 15 (Grade 7 female, 13) discussed these issues.

… sometimes the machine will give me wrong translations or wrong suggestions.  
**Therefore, the machine cannot replace humans at now, we need to use technologies also humans to learn, however, maybe in the future, the technology will get better and better, the machine can replace humans for learning.** (Student Participant 10)  
**If I use a machine to learn I have some problems. Machine translation is hard and many people use that word ,so I need to think of an easy word to help me in my story in some**
paragraph. Because if u use translate world teacher will know that was not my word.

(Student Participant 15)

Three students expressed technical issues with Baidu. Student Participant 26 (Grade 8 male, 14) described the issue when using Baidu for speaking practice.

_Baidu-problem is sometimes the machine doesn’t record it properly, the first time I use my earphone, it don’t record properly, and next I use my phone, but it doesn’t record properly too._ (Student Participant 26)

Two students also detected issues with the Teachable Machine activities in which they experienced trouble searching for relevant images to match the given situation. As a result, low machine scores resulted. Student Participant 32 (Grade 8 female, 14) noted this situation.

_I think the technologies have a part that wasn’t really good because There is no way to find a suitable photo to describe the current situation, so the score given by the system will be very low._ (Student Participant 32)

Over-reliance on machine-operated tools for learning is also another concern. Student Participant 13 (Grade 7 female, 13) provided a thoughtful reflection regarding this issue.

_The machine can help us to improve the English, but it also can’t let us be focus on our work, and after we started to use the machine to help our English, we will be too dependent on it._ (Student Participant 13)

Four students noted the difficulties in learning the different tools. They expressed confusion and the excessive time spent learning the tools. Comments by Student Participant 3 (Grade 7 female, 13) and Student Participant 35 (Grade 8 female, 14) portray these two areas of concern.
It’s quick but sometimes I will be confused by the apps. (Student Participant 3)

It takes too much time for me to learn. It takes a lot of time to understand how to use it.

(Student Participant 35)

Three students commented that learning in a digitalized space may lower student concentration or cause other distractions. For instance, Student Participant 9 (Grade 7 male, 13) expressed the concern of computer gaming as a distraction.

sometime have student will not very concentrate and they play games (Student Participant 9)

Although the student participants identified several issues, three students expressed positive reactions to leveraging digital tools within the learning process. Student Participant 14 (Grade 7 female, 13) gave a detailed reflection regarding the hurdles yet emphasized the need to acquire digital skills for the future of learning.

At first, I am very not used to technologies because I think “we use the computer to learn?” I am very not understanding why we need computers to learn. And now I think using a computer is better. In the future we all use the computer to do everything, the test might be on the screen, and now we need to get with the computer. (Student Participant 14)

Broader Technological Issues

Four students briefly mentioned broader issues, such as strict monitoring of when to use the computers, as part of the new classroom management rules for computer use during the learning process, poor internet connection, and peer influence in using the tools. The following Grade 8 student participants provided the following comments that reflect the aforementioned issues.
We can’t always use the computer any time. (Student Participant 25)

The internet and bug will influence when we using it. (Student Participant 28)

It just depends on whether your classmates can use it. (Student Participant 29)

The comments by the forty Grade 7 and 8 student participants can be generalized into the following: limitations of online translators, difficulty in concentrating in a digital learning environment, over-reliance on machines, difficulty in learning some of the more advanced tools such as Teachable Machine, the time-consuming nature in learning some of the more complex tools, and the instability of some integral apps used in this intervention model (e.g., Baidu). Supporting Gedik et al.’s (2012) stance about learning barriers in hybrid learning environments, the findings in this section continue to exhibit new barriers even with digital affordances offered by high-end technologies. A notable comment from Student Participant 10 (Grade 7 male, 13) regarding the need for both humans and machines in this era demonstrates a moderate success for this intervention model in activating a learner’s independent thinking skills. His further speculation that machines may perhaps replace humans one day is also a notable find, which may suggest that his metacognitive skills have improved tenfold compared to the original goal of improving his English language learning skills. Student Participant 15 (Grade 7 female, 13) commented on her concern about using unfamiliar English words generated by translators in her writing. This occurrence demonstrates further evidence that the student is thinking metacognitively about whether to use the word directly in her writing or make an effort to search for familiar synonyms. The issues regarding the impracticality of the tools and the ongoing machine errors produced by tools, such as Google Translate, Baidu, and Grammarly, are also imperative to conclude that human instructors are still integral in delivering tactful digital instructions and demonstrating to the learners how to correctly use these intelligent tools by
recognizing their benefits and limitations. For students to develop such metacognitive/linguistic awareness, human instructors are still integral to developing traditional elements of English language learning (e.g., grammatical features relating to phonology, morphology, semantics, syntax, and pragmatics). Furthermore, Student Participant 32’s (Grade 8 female, 14) reference to the difficulty in finding suitable images to train image-bilingual sentence models also suggests the need to improve resource designs that would reduce technological barriers and enable more practicality for students to easily locate images that relate to the teaching material. Lastly, ten students did not find any problems with the technologies used, suggesting that the selected artificial intelligence-powered tools, in addition to a combo usage of other technologies for support, are promising for further usage in this hybrid intervention model.
CHAPTER 5: CONCLUSION & RECOMMENDATIONS

Discussion

The findings for all three research questions support the initial hypotheses to some degree. An initial hypothesis of a hybrid landscape with a set of digital instructional designs evolved into a new digital ecosystem that flexibly operates a combination of human teaching facilitation and machine automated feedback by various intelligent tools. Also, translanguaging with tactful use of machine translators was an essential bilingual strategy used to motivate the learners to acquire the background knowledge needed to understand the content better. Even though there is evidence of improved quality of learning, the rate of improvement was not as prompt as expected. Both data from the written reflection by the teacher participant and the student participants supported the hypothesis that mixed reactions toward the intervention model would ensue.

For the first research question, the original hypothesis was to establish a set of digital instructional designs written to pinpoint a particular bilingual and English as a second language hybrid landscape for the struggling learners to navigate and acquire the information more efficiently and effectively. However, as previous studies state, for online and offline components to work seamlessly in a hybrid learning environment, clear instructions, as well as teachers’ ability to tactfully exploit these tools effectively and efficiently, are needed to bring forth the best of both worlds (Linder, 2017; Davies, 2019; Foomani & Hedayati, 2016; Hosseinpour, Biria, & Rezvani, 2019, Senn, 2008). With a wide array of technologies available today, defining one universal hybrid intervention model of instruction does not seem possible as there are endless combinations that can be written and personalized for instruction and learning for any learning context. Adding to the complexity of this situation is the existence of many different types of learners with various learning needs, even within the context of struggling English language
learners. Hence, there is possibly no one set of instructions that can deliver an optimal hybrid learning environment. The fact that a set of instructions may work for one teacher may not work for another teacher clearly purports Albiladi and Alshareef’s (2019) and Oliver and Stallings’s (2014) discussions regarding the challenges teachers face when confronting instruction and curriculum design in a hybrid learning environment. Rather, a recommendation for teachers is to place more focus on what tools can be applied to their learning context and the acquiring of the skill of devising instructional strategies that hone in on how to use the tools and how to apply and integrate the tools effectively to learning objectives, and also encourage teachers and students to continuously and periodically reflect on the practicality and usefulness of the tools. In essence, instead of seeking a one-size-fits-all hybrid intervention model that cures all learning issues, developing a flexible mindset of how a hybrid intervention model can be permuted, adapted, or even evolved to fit different learning contexts would be more purposeful and meaningful.

The results presented for the second research question appear to reveal that this hybrid intervention model that activates the collaborative nature of human and machine intelligences contributed to a faster and a higher quality level of learning for most learners from both the international program and traditional local program, though not highly significant compared to a traditional learning environment. As both grade levels are immersed in this study for the first time, the quantitative results present only an adequate measure to conclude the viability of this intervention model in supporting struggling English language learners to fill in the gaps in their English language development with more efficiency and effectiveness. This study’s expanded form of digital translingual learning spaces to increase learning motivation through machine training of images-bilingual text models and the facilitative support of both machines and human
instructors underpinned the learners’ improvement. Some students who demonstrated high performance in nearly all English language learning domains exhibited gradual increases in image-bilingual text scoring results. Hence, this salient finding of the study contributes to the limited body of research in the areas of integrating digital translingual practices with translation software in a hybrid learning environment as a potential support for English language learners (Vogel et al., 2018; Chen et al., 2019; Lee, 2020). In addition, extending a further creative translingual practice by using Google’s Teachable Machine to describe images with bilingual texts and then train the images supported students’ bilingual thinking processes and helped them write better English sentences. That is, this extension in using Teachable Machine to build students’ deeper understanding of the operation and mechanics of artificial intelligence-powered machine translators instilled in students a curiosity to train their own bilingual text models more meaningfully and produce higher image recognition percentages. If humans do not train the bilingual texts correctly with matching classes of similar images, then the future of translation technologies that may push into the zones of sentence-image translations will continue to produce errors related to higher-order level linguistic domains as presented in prior studies (Ducar & Schocket, 2018; Allué, 2017; Mohammed et al., 2018; Lee, 2020).

Furthermore, this study attempts to advance prior quantitative studies that mainly pinpointed one learning domain, particularly writing (Giannetti, 2016; Briggs, 2018; Lee, 2020). That is, this study’s system design for this hybrid intervention model (illustrated in Figure 3.1, Figure 3.5, and Figure 4.1) made bold investigations of student learning on a more extensive level of how the engagement of translanguaging practices in pre-reading and pre-listening lessons at the beginning of each learning unit could improve students’ learning in all language domains. Hence, this endeavor aligned with the overall moderate gains in the quantitative results
of the mixed methods explanatory study. The evolving nature of online translators programmed with images could further provide language learners with more images serving as multimodal supports (Currently, Google Translate provides only images for single word noun translations). However, as this integral piece of the intervention model is still unstable due to its novel nature in bilingual and English language instruction, Grammarly and Baidu served as key intelligent tools to enhance the recursive feedback teaching and learning experience. Similar to the automation feature of Google Translate and Teachable Machine, the writing assistant tool and speech evaluation tool appeared to motivate and engage learners to practice more often or continuously and improve their machine scores in time, which contributed to their increased performances in their overall average academic performances and computer adaptive test scores.

In expounding on prior studies regarding teacher and student perceptions of machine learning tools such as online translators, writing assistants, and voice recognition software (Niño, 2009; Clifford et al., 2013; Case, 2015; Moorkens, 2018; Lee, 2020; Nova, 2018; Parra & Calero, 2019; O’Neill & Russell, 2019a; Koltovskaia, 2020; Ahmed Ali, 2020; Underwood, 2017), the reflection questions attempted to draw more responses from three areas: the various learning perspectives that pertain to learning outcomes/effects of specific machine learning activities (as well as other basic combination of tools), the instructors’ and learners’ degree of connectivity in this learning environment, and their ability to confront setbacks in all technologies deployed whether advanced or basic. Findings supported the initial hypothesis of mixed reactions from both teachers and students, with positive responses exceeding the negative. Unlike previous findings that revealed more positive responses from students but less acceptance from teachers for each tool in separately conducted studies, this section of the study yielded mixed reactions in
applicability and responsiveness of the synchronization of a wide array of basic/advanced tools used for English language learning in a hybrid learning sphere.

First, although both teachers expressed that the overall intervention model yielded better learning results when compared to traditional learning environments, the Grade 8 teacher identified that different students developed different aptitudes toward learning each tool which may have hindered instruction until all students were on par. The Grade 7 teacher questioned the efficiency of the translanguaging activity with Teachable Machine as it required a few revisions and the breaking down of the steps to mini lessons as well as the issue of poor internet connection issues that would slow down or halt the digital-based lessons completely. Second, both teachers also recognized that the tools operating on machine learning (enabling automated scores) gave them and students the immediate feedback needed to address shortcomings faster. However, supporting previous findings regarding hybrid learning in an English as a second or foreign language context (Albiladi & Alshareef, 2019; Oliver & Stallings, 2014; Linder, 2017; Davies, 2019; Foomani & Hedayati, 2016; Hosseinpour et al., 2019; Senn, 2008), factors, such as time for teacher training and practice, content development, and time needed for students to learn all the technologies, need more analysis to discover the extent to which students are responding well with such intervention models.

As for the students, most expressed optimism and a high acceptance level about learning in a highly computerized, hybrid learning environment, although there could be pitfalls apparent in a few students’ criticisms regarding the limitations of certain tools or their confusion when learning the tools. Their reactions toward the image-bilingual text training with Teachable Machine ranged from low understanding levels to fairly deep comprehension levels. Particularly, six Grade 7 learners expressed that they may have acquired the translingual metacognitive
awareness in order to train meaningful data models, which required accurate texts in both languages in addition to corresponding classes of images. However, Grade 8 students were not able to describe their translingual development in full detail, which suggests the need for more teacher training about the concept of translingualism and more explicit instructions to let students understand how to incorporate and apply the knowledge of translingualism in all facets of learning involving the use of the English language to communicate. Similar to prior studies (Clifford et al., 2013; Giannetti, 2018; Lee, 2000), most students expressed that using Google Translate allowed them to acquire more vocabulary and writing skills; however, one student did indicate hesitancy about borrowing unfamiliar words from Google Translate or being unaware of translation accuracy—an issue also identified in Chen et al.’s (2019) study. Furthermore, twenty-six students expressed a high level of engagement, motivation, and the usefulness of Grammarly’s automated feedback and Baidu’s technological advancement in voice recognition software in evaluating human speech. One Grade 8 student realized that Baidu helped them with speaking and listening, a salient finding that may suggest that this tool may have also contributed to their improvement in the listening assessments throughout the units. Although quantitative measures did not reveal overall significant improvement for most students, qualitative data revealed both teachers and most Grade 7 students and some Grade 8 students have expressed increased ability to listen, read, write, and speak better, or at least a combination of two or three of these language skills.

**Limitations and Future Research**

Whether the proposed hybrid intervention model will serve as a promising solution to bridge the gap in English language development amongst struggling learners still requires further research, as the applications and instructional designs integrating artificial intelligence
technologies in K-12 education remain relatively new in the education sphere. Moreover, they portend the revolutionization of the dynamics of classroom pedagogy and the changing roles of both teachers and students (Murphy & RAND Education and Labor, 2019; Zhao & Liu, 2019; Almutairi, Gegov, Adda, & Arabikhan, 2020). The limitations of artificial intelligence-powered tools in this hybrid learning context and the teachers' and students’ readiness in using these tools for language learning are at the core of this discussion for future research.

The integral artificial intelligence-powered tools selected to create and activate more digital learning spaces for translanguaging and English language learning deployed in this intervention model are merely a small window into more possibilities of a myriad of innovative pedagogical possibilities. The forewarning of the challenges associated with tools operated on machine learning delineated by Murphy and RAND Education and Labor (2019) was also apparent during the implementation of this intervention. First, teachers and students did not always have the appropriate data to train the image-bilingual text models with Teachable Machine, as some students may not have edited their bilingual texts for model training or experienced trouble locating appropriate images for training. The uncertainty in biases, such as the degree of accuracy of these texts and images, the human-trained corpus of texts for writing comparison in writing assistants, and the natural language processing processes encoded in voice evaluation software, is generated through training machine learning models. Although Teachable Machine may provide a mapping of how data sets are trained, there is still a degree of non-transparency in how these models' algorithms are executed. The same holds true for writing assistants and voice evaluation software as they are also powered by machine learning. Murphy and RAND Education and Labor (2019) continue to contend that “[w]ithout an understanding of how a model arrived at a particular decision, it is difficult to identify the source of any bias and
inaccuracies and then correct them…[and] trust the system’s output…” (p. 12), which was confirmed in this study through student feedback. Future studies may continue to make further evaluative measures to ascertain how computation scores can be further calibrated reliably and validly to extend quantitative understanding. This may require more knowledge in data science for education.

Also, in conducting the quantitative piece of this study, a small random sampling of forty students from sixty students only presents a window into the possible potential of this intervention model. Fully executing this intervention model with a larger pool of students and deeply capturing the mechanisms behind the fine-grained detail on instruction and learning that can be explained through automated machine scores (evaluating not only corpus of texts and human sound, but also images and videos, and many more forms of modalities) will require more time and maturity. The bilingual and English as a second language instructional designs that integrate these tools will evolve, as well.

Furthermore, immersing both teachers and students into a hybrid learning environment that attempted to seamlessly synchronize all components of traditional learning theories of constructive and motivation, a more recent theory of digital affordances, traditional bilingual and English language acquisition teaching strategies, and artificial-intelligence-powered technologies, added to the complexity of the challenges previously discussed. The main limitations of hybrid learning with the integration of artificial intelligence technologies to support struggling English language learners were multifaceted. Training teachers to transform the learning landscape by combining traditional with non-traditional English language pedagogy methods and the wide variety of technologies proposed in this intervention, requires time. Another time factor is having students learn how to leverage the technologies to support their English language development.
Therefore, future studies may need to explore the training of teachers alongside experienced teachers in the classroom before teachers new to such interventions independently take on a group of struggling English language learners. Also, future instructional designs in this area of research may have to focus on specific digital learning methods/strategies for different types of student learning needs as well as attend to every teacher’s different teaching style, preferences, and level of acceptance with digital tools. Every tool requires tactful instructional designs as there are different learning preferences with these tools and setbacks that both teachers and students may need to face and overcome.

Are teachers and students generally ready for instruction with artificial intelligence? Many may have already noticed the computers they are using for teaching are already coded with such tools. Zhao and Liu (2019) describe the inevitability of human and computers co-teaching together and bring attention to the fact that although the teaching profession will not be rendered outdated by these advanced technologies (as there is no natural emotional quality in these cold machines); however, teachers who do not learn new ways and adapt to this changing era of digital instruction may become undesirable. As presented above, the computer tools utilized in this study required the collaboration of both human teachers and students and machine operations to fully activate the digital affordances to support English language development in this intervention model. As a teacher, the need to continuously learn, adapt, apply, and reflect on new digital tools may be vital. For students, this study revealed middle school students’ mostly positive reactions to combined human and machine co-teaching, although Yoon’s (2019) study on artificial intelligence instruction for English as a foreign language at the university level indicates otherwise. This study found that university students preferred human instruction over machine instruction and did not find artificial intelligence technologies appropriate for language
learning. Even so, the possibility of the applicability of artificial intelligence technologies in language classrooms can enhance learning, depending on user preference (Yoon, 2019). Teachers and students may move forward with teaching and learning without these tools, yet, with these tools and with the development of more open-mindedness, the learning experience can be made more effective and efficient. This push and pull effect of new digital technology draws current pedagogical practices into the intersection of combining human and machine intelligences. Yet, the dearth of research in this area of teacher and student perceptions regarding the use of such tools for hybrid learning at different stages of education requires more attention to truly bring forth new wisdom about the development of more effective digital instructional designs in the education field.

There is no perfect intervention model with these advanced technologies. Murphy and RAND Education and Labor (2019) further assert that “[a]s long as these applications are used within the narrow contexts in which they were designed to operate and learn, their performance is quite accurate and reliable…[h]owever, once the applications are used in a new or different context, they can become prone to error and have limited utility” (p. 3). The likeliness of the development of improved translation technologies programmed with bilingual texts and human-trained images that may depict causality leaves room for future studies to explore more comprehensive digital bilingual teaching strategies as support for English language acquisition in a hybrid learning environment. However, when the learning context changes, perhaps to other academic subject areas, these tools will require different instructions for relevant applications. Therefore, this calls for the need to combine human and machine intelligences to shape the ever-changing digital learning spheres in order that they are more adaptable for specific learning contexts, teachers, and learners. At the same time, keeping in mind that even though artificial
intelligence and other algorithmic networks may simulate certain aspects of English language learning, these machines operating on narrow artificial intelligence is far from replicating human emotion and consciousness; hence, they may never deliver the joy of language learning that can only be experienced by the human mind (Ali, 2018). Human instructors and artificial intelligence-powered tools need to go together to ensure the tactful use of a combination of computer-mediated tools to support human learners. Educators need to collaborate effectively to maximize the potential of this new hybrid learning environment that has the capacity to synchronize the intelligences of both humans and machines.
REFERENCES


Horn, M. B. (2010). K-12 online education is increasingly hybrid learning. Distance Learning, 7(2), 18-20.


http://doi.org/10.1080/00313831.2011.568674


APPENDIX A: IRB LETTER

Notice of Approval: New Submission

October 6, 2020

Principal Investigator: William Cope
Protocol Title: A Bilingual/L2 Hybrid Intervention Model: Combining Human and Machine Intelligences
Protocol Number: 21152
Funding Source: Unfunded
Review Type: Expedited 6, 7
Approved Subparts: D
Status: Active
Risk Determination: No more than minimal risk
Approval Date: October 6, 2020
Closure Date: October 5, 2025

This letter authorizes the use of human subjects in the above protocol. The University of Illinois at Urbana-Champaign Institutional Review Board (IRB) has reviewed and approved the research study as described.

The Principal Investigator of this study is responsible for:

- Conducting research in a manner consistent with the requirements of the University and federal regulations found at 45 CFR 46.
- Using the approved consent documents, with the footer, from this approved package.
- Requesting approval from the IRB prior to implementing modifications.
- Notifying OPRS of any problems involving human subjects, including unanticipated events, participant complaints, or protocol deviations.
- Notifying OPRS of the completion of the study.
# APPENDIX B: STEPS AND TASKS TO THE INTERVENTION

## BILINGAL/L2 HYBRID INTERVENTION MODEL INSTRUCTIONS

<table>
<thead>
<tr>
<th>Student Instructions</th>
<th>Teacher Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>What Is Your Story – Module Website</td>
<td>Revive – Our Mother Earth</td>
</tr>
</tbody>
</table>

## FOCUS FOR STEPS 1-6: READING, LISTENING, VOCABULARY DEVELOPMENT (INPUT)

### STEP 1 - Defining a bilingual/L2 environment

<table>
<thead>
<tr>
<th>Students</th>
<th>Teacher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Familiarize with teacher-established classroom and online learning rules</td>
<td>Sets new classroom management and online learning rules</td>
</tr>
<tr>
<td>Familiarize with teacher’s intent to make the transition from a traditional classroom to a hybrid classroom</td>
<td>Introduces the students the transition: teacher-centered classroom → student-centered classroom → a hybrid learning space to integrate the best of both worlds in the classroom or online (flexible to teacher’s teaching style)</td>
</tr>
</tbody>
</table>

Familiarize with the general tools

- Module sites designed with Googlesites
- Google Classroom
- Google Meet shared screen instruction

Captivates and immerses students into a digital learning environment by introducing suggested general tools for communication and motivation:

- Module sites designed with Googlesites
- Google Classroom
- Google Meet shared screen instruction

### STEP 2 – Vocabulary Development

(at least 2-3 lessons for either a video listening lesson or a reading lesson from a reader or from a novel)

<table>
<thead>
<tr>
<th>Students</th>
<th>Teacher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Familiarize with the digital affordances offered by the Quizlet sets coded on the Google module sites</td>
<td>Models how to navigate the vocabulary Quizlet sets that come with images and text-to-speech functions</td>
</tr>
</tbody>
</table>

Sample Quizlet Vocabulary Set and Goformativ e practice
| **Write notes in their notebooks or type notes on their laptops** | **Instructs the vocabulary terms using any traditional method of directed vocabulary instruction** |  |
| **Completes digital Goformative vocabulary cloze practice independently or with their classmates** | **Directs students to the Goformative vocabulary cloze exercises and creates a natural environment for students to either go at their own pace or work with someone they are comfortable** |  |

**STEP 3 – Pre-reading or pre-listening digital translanguageing activities with Google Translate and Google’s Teachable Machine in training bilingual text-image models**

<table>
<thead>
<tr>
<th><strong>Students</strong></th>
<th><strong>Teacher</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Respond and discuss different possible scenarios</td>
<td>Initiates guiding questions/instructions or provide sentence structure templates:</td>
</tr>
<tr>
<td>What do you see in the picture?</td>
<td></td>
</tr>
<tr>
<td>Describe the situation in the picture.</td>
<td></td>
</tr>
<tr>
<td>What is causing the situation in the picture? What are the effects?</td>
<td>Establishes a digital translanguageing space to have students leverage their first language to support their second language.</td>
</tr>
<tr>
<td>Write a sentence in English to describe the image in Step 1. If you cannot describe it in English, type Chinese to help your thinking process in Step 2.</td>
<td>As struggling learners have difficulty determining words to string a sentence together, they will use Google Translate, as a sentence kick starter with their ideas. Then, they will compare and contrast their written English text (if any) and Chinese text to the English text generated by Google Translate. Facilitate the process by provided digital GoogleDoc feedback or live feedback regarding any inaccuracies in word choice and grammar by Google Translate.</td>
</tr>
<tr>
<td>Use Google Translate to help you translate the Chinese into English to generate unfamiliar vocabulary words. Copy/paste what Google Translate generated in Step 3.</td>
<td></td>
</tr>
<tr>
<td>Compare and contrast what you’ve written in Step 1 to what Google Translate generated in Step 3. Check the Chinese text in Step 2 to determine whether Google Translate has corrected your English text in Step 1 with the teacher’s support.</td>
<td></td>
</tr>
<tr>
<td>If you did not write anything in Step 1, compare and contrast your Chinese text in Step 2 to what Google Translate generated in Step 3. Determine whether you need to</td>
<td></td>
</tr>
</tbody>
</table>
make further edits in terms of word choice and grammar based on the grammar focus for the unit. Seek assistance from the teacher, if needed.

Revise your sentence in Step 4 using Google Translate’s correction, as well as any teacher’s digital or live feedback.

Downloads pictures similar to the given image from Google images.

Uploads at least 3 images to Google’s Teachable Machine labeled separated as two or three classes:

- Data Model 1 – Types
descriptions of a picture in English for each scenario, which is classified as separate classes

- Data Model 2 – Types
descriptions of picture in Chinese for each scenario, which is classified as separate classes

(repeat for each class of images for both languages)

Clicks on “Train the Model”.

Searches for more pictures to train each class of images for both data models.

Takes a screenshot of the model to record the **percentage accuracy (machine scores)** in bilingual-text image training and copy/paste it to the activity sheet (See templates).

Write a short reflection on what you think the scores mean.

<table>
<thead>
<tr>
<th>Prompts students to download similar pictures for each Data Model (at least 3 per class).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prompts students to train data models via Google’s Teachable Machine.</td>
</tr>
<tr>
<td>Data Model 1 – Descriptions of a picture in English</td>
</tr>
<tr>
<td>Data Model 2 – Descriptions of a picture in Chinese</td>
</tr>
<tr>
<td>(repeat the above process for the next one or two classes of images)</td>
</tr>
<tr>
<td>Prompts students to do a screen capture to record their machine scores.</td>
</tr>
<tr>
<td>Prompts students to reflect on what the scores mean.</td>
</tr>
</tbody>
</table>
**STEP 4** – Administer Criterion A and/or Criterion B formative digitally with GoogleDocs or using traditional paper pencil-based testing

(repeat Steps 1-4 at least 2 times)

**STEP 5** – Administer Criterion A and/or Criterion B Summative

| FOCUS FOR STEPS 6 -10: WRITING, SPEAKING, VOCABULARY DEVELOPMENT/APPLICATION (OUTPUT) |
| Sample reading formative | Sample listening formative |

**STEP 6** – Writing – Brainstorm

| Sample writing packet 1 | Sample writing packet 2 |

**Students**

Similar to the pre-reading (or pre-listening) digital translinguaging activity, in the pre-writing steps of the digital writing packet, write (type) your ideas in English first. If you need further support with Google Translate, make a record of what you translated and check your own English text with Google’s English text to acquire more vocabulary to establish your ideas more coherently. Seek help from the teacher if you are not sure whether Google gave you the correct words or sentence structure.

Search for similar images to help you describe or generate ideas. Record your images in the space provided in the digital writing packet.

**Teacher**

At this writing stage, students experience the most difficulty generating ideas. Continue to tactfully instruct students the idea of translinguaging and how to leverage Google Translate, so that they understand this tool is used in a similar fashion as a digital bilingual dictionary. Establish a minimum number of sentences they can translate at a time to prevent students from merely writing in Chinese and then translating into English without engaging in metacognitive thinking of the sentence writing process.

Model how to brainstorm using traditional teaching writing methods via Google Meet shared screen. There may be a need to break down the process into smaller steps (e.g., story writing process – model how to establish the exposition, rising action, climax, falling action, resolution in mini-lessons)

Continue to provide ongoing digital corrective feedback in GoogleDocs focusing on the following: diction, morphology, syntax, semantics, and pragmatics.

(Note: Differentiate instruction – Some students may need direct corrections, while others may only need hints on how to make the corrections.)

Provide any modifications to the instructions for this digital translinguaging
Space to fit the learners’ needs.

(Note: Stress to the students that in the beginning that they need to try to think in English as much as possible. Students also need to know that Google Translate is a tool to help them determine unknown vocabulary. Although Google Translate has improved at the sentential level, translating large chunks of text will result in machine errors. As they move into the second or third unit, gradually instruct students to move away from using Google Translate at the sentential level at this point in time of the intervention model. The second student sample work shows the gradual move away from using Google Translate and only recording his own bilingual work during the research brainstorming stage of the writing process.)

<table>
<thead>
<tr>
<th>STEP 7 – Writing – Outlining/Drafting/Ongoing Immediate Revision with teacher’s digital feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Students</strong></td>
</tr>
<tr>
<td>Organize all the ideas to the outline of the digital writing packet. You may choose to retype or copy/paste your work to the next step of the digital writing packet.</td>
</tr>
<tr>
<td>Retype and correct all the errors based on the corrective feedback provided by the teacher. Pay attention to the grammar points of the unit, as well as diction, sentence structure, paragraph structure, punctuation, and capitalization.</td>
</tr>
<tr>
<td>After correcting the errors for your sentences, reorganize all your sentences into paragraphs.</td>
</tr>
<tr>
<td>Retype and correct more errors based on the corrective feedback provided by the teacher.</td>
</tr>
<tr>
<td><strong>Teacher</strong></td>
</tr>
<tr>
<td>Model how to organize the ideas brainstormed in the outline. Instruct students to move what they have typed in their graphic organizers at the brainstorming stage and construct sentences in the outline.</td>
</tr>
<tr>
<td>Continue to provide ongoing immediate digital corrective feedback at the <strong>sentential level</strong> in students’ Googledoc digital writing packs.</td>
</tr>
<tr>
<td>Model how to organize all the corrected sentences into paragraphs.</td>
</tr>
<tr>
<td>Continue to provide ongoing immediate digital corrective feedback at the <strong>paragraph level</strong> in students’ Googledoc digital writing packs.</td>
</tr>
</tbody>
</table>
### STEP 8 – Writing – Revision with machine automated feedback

<table>
<thead>
<tr>
<th>Students</th>
<th>Teacher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copy/paste their work into Grammarly (full version) to further revise their work based on the automated writing feedback provided by the system.</td>
<td>Model how to utilize Grammarly automated writing feedback to make further revisions in students’ writing. Since Grammarly is also not perfect, instruct students to focus mainly on more salient aspects and repeated errors that most students make:</td>
</tr>
</tbody>
</table>
| Record a **before machine score** in your digital writing packet. | - Vocabulary usage  
- Basic grammar points, such as subject-verb agreement, verb tense, word order, sentence structure, etc…  
- Punctuation & capitalization  
- Spacing errors |
| Focus on correcting vocabulary, basic grammar points you understand, punctuation, capitalization, and spacing errors. Seek help from the teacher if you do not understand the machine’s feedback. | Have students record a before and after machine score generated by Grammarly in their digital writing pack. |
| Record an **after-machine score** in your digital writing packet. | |

### STEP 9 – Speaking – Baidu speaking exercises

<table>
<thead>
<tr>
<th>Students</th>
<th>Teacher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Download the <strong>Baidu Translate app</strong> to access the speech evaluation tool.</td>
<td>Model how to use the Baidu Translate app to access the speech evaluation tool.</td>
</tr>
<tr>
<td>Copy/paste your written text into Baidu Translate and tap “Read”. Follow the instructions in the app to practice speaking your writing. The app will produce a machine score to rate your speaking, as well as provide feedback on pronunciation errors. Tap on the words you mispronounced and practice speaking the words. Repeat the process until you have reached the highest score possible.</td>
<td>(Video screencasting of how to use the speech evaluation tool in Baidu Translate app: <a href="#">Click here</a>)</td>
</tr>
<tr>
<td>Record the three best machine scores produced by Baidu.</td>
<td>While students practice speaking, circulate around the classroom to provide differentiated instruction in what they need to focus on in terms of pronunciation feedback provided by the speech evaluation tool.</td>
</tr>
<tr>
<td></td>
<td>Have students record their three best machine scores in their digital writing pack.</td>
</tr>
</tbody>
</table>

### STEP 10 – Submit digital writing packet in Google Classroom for as Criterion C and Criterion D Summative
APPENDIX C: INTERNATIONAL BACCALAUREATE MIDDLE YEAR PROGRAMME SCORING RUBRICS FOR ALL FOUR LANGUAGE DOMAINS (LISTENING, READING, SPEAKING, WRITING)

**IB MYP Language Acquisition Task-Specific Clarifications**

Language Task Specific Clarification: Phase 3

Criterion A: Comprehending spoken and visual text

Maximum: 8

At the end of phase 2, students should be able to:

i. show understanding of messages, main ideas and supporting details

ii. recognize basic conventions

iii. engage with the spoken and visual text by identifying ideas, opinions and attitudes and by making a personal response to the text

<table>
<thead>
<tr>
<th>Achievement level</th>
<th>Task Specific Clarification</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>The student does not reach a standard described by any of the descriptors below.</td>
</tr>
<tr>
<td>1-2</td>
<td>i. ___ I show minimal understanding of the messages, main ideas, and supporting details presented in the video.</td>
</tr>
<tr>
<td></td>
<td>ii. ___ I cannot identify the purpose of the video.</td>
</tr>
<tr>
<td></td>
<td>___ I cannot identify the type of video.</td>
</tr>
<tr>
<td></td>
<td>___ I cannot deduce the meaning of words/phrases from the video.</td>
</tr>
<tr>
<td></td>
<td>iii. ___ I can minimally express my opinions about the video. (Wrote only 1 thoughtful sentence.)</td>
</tr>
<tr>
<td>3-4</td>
<td>i. ___ I show some understanding of the messages, main ideas, and supporting details presented in the video.</td>
</tr>
<tr>
<td></td>
<td>ii. ___ I can identify the purpose of the video, but I did not provide a reason.</td>
</tr>
<tr>
<td></td>
<td>___ I can identify the type of video, but I did not provide a reason.</td>
</tr>
<tr>
<td></td>
<td>___ I can deduce the meaning of the 1 word/phrase from the video but not very accurately.</td>
</tr>
<tr>
<td></td>
<td>iii. ___ I can express some of my opinions about the video. (Wrote 2-3 thoughtful sentences.)</td>
</tr>
<tr>
<td>5-6</td>
<td>i. ___ I understand most of the messages, main ideas, and supporting details presented in the video.</td>
</tr>
<tr>
<td></td>
<td>ii. ___ I can identify the purpose of the video and provided an adequate reason.</td>
</tr>
<tr>
<td></td>
<td>___ I can identify the type of video and provide an adequate reason.</td>
</tr>
<tr>
<td></td>
<td>___ I can deduce the meaning of 2-3 words/phrase from the video but not very accurately.</td>
</tr>
<tr>
<td></td>
<td>iii. ___ I can express most of my opinions about the video. (Wrote 4 thoughtful sentences.)</td>
</tr>
<tr>
<td>7-8</td>
<td>i. ___ I can understand the messages, main ideas, and supporting details presented in the video well.</td>
</tr>
<tr>
<td></td>
<td>ii. ___ I can identify the purpose of the video and provided a thorough and accurate reason.</td>
</tr>
<tr>
<td></td>
<td>___ I can identify the type of video and provide a thorough and accurate reason.</td>
</tr>
<tr>
<td></td>
<td>___ I can accurately deduce the meaning of 3 words/phrase in complete sentences.</td>
</tr>
<tr>
<td></td>
<td>iii. ___ I can express my opinions about the video well. (Wrote 5 or more thoughtful sentences.)</td>
</tr>
</tbody>
</table>
**READING COMPREHENSION/RESPONSE TO LITERATURE**

Criterion B: Comprehending written and visual text

Maximun: 8

At the end of phase 3, students should be able to:

i. show understanding of information, main ideas and supporting details, and draw conclusions

ii. understand basic conventions including aspects of format and style, and author’s purpose for writing

iii. engage with the written and visual text by identifying ideas, opinions and attitudes and by making a response to the text based on personal experiences and opinions

<table>
<thead>
<tr>
<th>Achievement level</th>
<th>Task Specific Clarification (Command Terms)</th>
<th>F1</th>
<th>F2</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>The student does not reach a standard described by any of the descriptors below.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 1–2               | I am able to:  
  | i. respond to the prompt with minimal understanding  
  |   _answer a limited number of the reading comprehension questions correctly.  
  |   _answer a limited number of the vocabulary questions used in context correctly.  
  | ii. explain the author’s purpose with minimal understanding  
  |   _demonstrates limited understanding of the intended audience and purpose of the quote passage from the novel.  
  | iii. respond to the prompt with my opinions minimally  
  |   _Focus and organization  
  |   _state 0–1 clear and opinions, with inconsistent ideas.  
  |   _write my opinions but they are unclear from the beginning through the middle to the conclusion  
  |   _Text evidence  
  |   _provide little to no support for my opinions.  
  |   _include a limited number of text references.  |    |    |   |
| 3–4               | I am able to:  
  | i. respond to the prompt with some understanding  
  |   _answer some of the reading comprehension questions correctly.  
  |   _answer some the vocabulary questions used in context correctly.  
  | ii. explain the author’s purpose with some understanding  
  |   _demonstrates some understanding of the intended audience and purpose of the quoted passage from the novel.  
  | iii. respond to the prompt with my some opinions  
  |   _Focus and organization  
  |   _state 2 clear and opinions, with a few inconsistent ideas.  
  |   _make my opinions somewhat clear from the beginning through the middle to the conclusion  
  |   _Text evidence  
  |   _provide adequate and accurate support.  
<p>|   _include relevant and good text references.  |    |    |   |</p>
<table>
<thead>
<tr>
<th>5-6</th>
<th>7-8</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am able to</td>
<td>I am able to</td>
</tr>
<tr>
<td>i. respond to the prompt with adequate understanding</td>
<td>i. respond to the prompt with thorough understanding</td>
</tr>
<tr>
<td>__answer most of the reading comprehension questions correctly.</td>
<td>__answer all of the reading comprehension questions correctly.</td>
</tr>
<tr>
<td>__answer most the vocabulary questions used in context correctly.</td>
<td></td>
</tr>
<tr>
<td>ii. explain the author's purpose with adequate understanding</td>
<td>ii. explain the author's purpose with thorough understanding</td>
</tr>
<tr>
<td>__demonstrate a good understanding of the intended audience and purpose of</td>
<td>__demonstrate thorough understanding of the intended audience and purpose of</td>
</tr>
<tr>
<td>the quote passage from the novel.</td>
<td>the quote passage from the novel.</td>
</tr>
<tr>
<td>iii. respond to the prompt with my adequate opinions</td>
<td>iii. respond to the prompt with my thoughtful opinions</td>
</tr>
<tr>
<td><strong>Focus and organization</strong></td>
<td><strong>Focus and organization</strong></td>
</tr>
<tr>
<td>__state 3 clear and consistent opinions</td>
<td>__state more than 3 clear opinions and elaborates well</td>
</tr>
<tr>
<td>__make my opinions clear from the beginning through the middle to the</td>
<td>__engage the reader from the beginning through the middle to the conclusion.</td>
</tr>
<tr>
<td>conclusion.</td>
<td></td>
</tr>
<tr>
<td><strong>Text evidence</strong></td>
<td><strong>Text evidence</strong></td>
</tr>
<tr>
<td>__provides adequate and accurate support.</td>
<td>__provide comprehensive and accurate support.</td>
</tr>
<tr>
<td>__includes relevant and good text references.</td>
<td>__include relevant and meaningful text references.</td>
</tr>
</tbody>
</table>
**WRITING/SPEAKING**
Criterion C: Communicating in response to spoken and/or written and/or visual text
Maximium: 8
At the end of phase 2, students should be able to:
- respond appropriately to spoken and/or written and/or visual text
- interact in basic structured exchanges
- use phrases to communicate ideas, feelings and information in familiar situations
- communicate with a sense of audience.

<table>
<thead>
<tr>
<th>Achievement Level</th>
<th>Task Specific Clarification (Command Terms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>The student does not reach a standard described by any of the descriptors below.</td>
</tr>
<tr>
<td>1-2</td>
<td><strong>written work</strong></td>
</tr>
<tr>
<td></td>
<td>i. I made a limited, often inappropriate response to the prompt of stating the 3 steps on how to survive Camp Green Lake.</td>
</tr>
<tr>
<td></td>
<td>ii. I do not demonstrate a good understanding of the novel <em>Holes</em> through my process analysis essay.</td>
</tr>
<tr>
<td></td>
<td>iii. I did not describe the process using any steps.</td>
</tr>
<tr>
<td></td>
<td>iv. My opinions are not supported by explanations.</td>
</tr>
<tr>
<td></td>
<td><strong>presentation</strong></td>
</tr>
<tr>
<td></td>
<td>i. I can speak briefly, with single words or short phrases.</td>
</tr>
<tr>
<td></td>
<td>ii. I can briefly explain the steps to survival at Camp Green Lake.</td>
</tr>
<tr>
<td></td>
<td>iv. I can briefly present formally.</td>
</tr>
<tr>
<td>3-4</td>
<td><strong>written work</strong></td>
</tr>
<tr>
<td></td>
<td>i. I responded to the prompt of stating the 3 steps on how to survive Camp Green Lake, but with some inaccurate statements.</td>
</tr>
<tr>
<td></td>
<td>ii. I demonstrate some understanding of the novel <em>Holes</em> through my process analysis essay.</td>
</tr>
<tr>
<td></td>
<td>iii. I described the process with less than three steps.</td>
</tr>
<tr>
<td></td>
<td>iv. My opinions are somewhat supported by explanations.</td>
</tr>
<tr>
<td></td>
<td><strong>presentation</strong></td>
</tr>
<tr>
<td></td>
<td>i. I can speak in simple and short complete sentences.</td>
</tr>
</tbody>
</table>
|                   | ii. I can explain the steps to survival at Camp Green Lake using short
244

5–6

i. iii. written work

i. I made a good and general response to the prompt of stating the 3 steps on how to survive Camp Green Lake.

ii. I demonstrate some understanding of the novel *Holes* through my process analysis essay.

iii. My steps show some connection to the setting, plot, and characters of the novel.

ii. iv. presentation

ii. I can speak in long complete sentences.

iii. I can explain the steps to survival at Camp Green Lake using good descriptions.

iv. I can present formally and clearly for the most part.

7–8

i. iii. written work

i. I made a detailed and accurate response to the prompt of stating the 3 steps on how to survive Camp Green Lake.

ii. I demonstrate a thorough understanding of the novel *Holes* through my process analysis essay.

iii. My steps show a thorough connection to the setting, plot, and characters of the novel.

ii. iv. presentation

ii. I can speak confidently in long complete and coherent sentences.

iii. I can explain the steps to survival at Camp Green Lake using detailed descriptions.

iv. I can present formally and clearly throughout my entire presentation with confidence.
**WRITING ONLY**

**Criterion D: Using language in spoken and/or written form**

- i. use language to suit the context.
- ii. use language to suit the context.
- iii. use language to suit the context.

<table>
<thead>
<tr>
<th>Achievement Level</th>
<th>Task Specific Clarification (Command Terms)</th>
<th>F1 - W</th>
<th>F2 - W</th>
<th>F2 - W</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>The student does not reach a standard described by any of the descriptors below.</td>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>
| 1–2               | i. I have difficulty using vocabulary from the unit.  
          | i. I have trouble using progressive and perfect tenses correctly.  
          | i. I have difficulty maintaining consistent verb tense. | □     | □     | □     | □ |
|                   | ii. I wrote limited well-structured paragraphs.  
          | ii. I demonstrated limited sentence variety.  
          | ii. I demonstrated limited parallel structures.  
          | ii. I used limited transitions to communicate. | □     | □     | □     | □ |
|                   | iii. I minimally used appropriate register to communicate formally. | □     | □     | □     | □ |
| 3–4               | i. I used vocabulary from the unit, with some incorrect choices and/or usages.  
          | i. I have some progressive and perfect tenses errors in my writing.  
          | i. I have some difficulty maintaining consistent verb tense. | □     | □     | □     | □ |
|                   | ii. I made some attempt to write well-structured paragraphs.  
          | ii. I demonstrated some sentence variety.  
          | ii. I demonstrated some parallel structures.  
          | ii. I used some transitions to communicate. | □     | □     | □     | □ |
|                   | iii. I used appropriate register to communicate formally to some degree. | □     | □     | □     | □ |
| 5–6               | i. I used a good range of vocabulary from the unit.  
          | i. I have a limited number of progressive and perfect tenses errors. | □     | □     | □     | □ |
|                   | ii. All my paragraphs are well-structured.  
          | ii. I demonstrated a good amount of sentence variety.  
          | ii. I demonstrated parallel structures in my writing, with a few errors.  
          | ii. I used transitions to communicate well. | □     | □     | □     | □ |
|                   | iii. I usually used appropriate register to communicate formally. | □     | □     | □     | □ |
| 7–8               | i. I used a wide range of vocabulary from the unit.  
          | i. I effectively used progressive and perfect tenses correctly in my writing. | □     | □     | □     | □ |
|                   | ii. I effectively wrote well-structured paragraphs.  
          | ii. I demonstrated effective sentence variety.  
          | ii. I demonstrated effective parallel structures.  
          | ii. I used transitions to communicate clearly and effectively. (no errors - Level 8) | □     | □     | □     | □ |
|                   | iii. I effectively used appropriate register to communicate formally. | □     | □     | □     | □ |
APPENDIX D: A SAMPLE WRITING ACTIVITY THAT EXTENDS THE APPLICATION OF PEARL’S THREE-LAYER CAUSATION THEORY

Sensory Details

Video Clip - Using Sensory Language
Online Translation Tools - [Google Translate, Microsoft Translate, Baidu Translate],
Other Online Tools - [Google Image, Power Thesaurus, Describing words]

Write words (noun, adjective, verb) that describe the picture.

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sight</strong> - the visual sense used in writing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>color</strong></td>
<td><strong>shape</strong></td>
<td><strong>motion</strong> 労作</td>
<td><strong>brightness</strong></td>
<td><strong>scale</strong> 規模</td>
</tr>
<tr>
<td>Chinese text</td>
<td>Chinese text</td>
<td>Chinese text</td>
<td>Chinese text</td>
<td>Chinese text</td>
</tr>
<tr>
<td>太陽的金色光芒</td>
<td>鰲漪的水面</td>
<td>覓食的鳥類</td>
<td>黎明</td>
<td>大湖</td>
</tr>
<tr>
<td>English text</td>
<td>English text</td>
<td>English text</td>
<td>English text</td>
<td>English text</td>
</tr>
<tr>
<td>golden glow of the sun</td>
<td>rippling surface of the water</td>
<td>birds foraging for food</td>
<td>dawn</td>
<td>big lake</td>
</tr>
</tbody>
</table>
Write a sentence describing the situation of the picture. (Causality)

| 1) English text in your own words. If you cannot describe it in English, go to 2). | 2) Chinese text in your own words: 太陽的金色光芒照映下，在的漣漪的水面淺湖中，有7隻不知名的鳥，其中有的鳥在覓食水中物，或清潔自己，有的鳥是寂聊的站立在淺水湖中. | 3) GTranslate your Chinese text to English and compare with Step 1): Under the golden glow of the sun, there are 7 unknown birds in the shallow lake of the rippled water, some of them are foraging for food or cleaning themselves, and some are standing in shallow water. In the lake. | 4) Revised English text: Under the golden glow of the sun, there are seven unknown birds bathing in the rippling surface of the shallow lake. Some are foraging for food or cleaning themselves. Some are quietly standing in the shallow water of the lake. | 5) GTranslate back to Chinese: 在金色的陽光下，淺湖蕩漾著七隻未知的鳥兒。有些人正在覓食或清潔自己。有些人靜靜地站在湖的淺水區。 |

**Shortened text for machine learning:**

**CLASS 1**

Seven birds are bathing in the shallow lake.

**CLASS 1**

淺湖蕩漾著七隻未知的鳥兒正在清潔自己。
Write a sentence describing the situation of the picture. (Causality)

1) English text in your own words. If you cannot describe it in English, go to 2).

2) Chinese text in your own words:
十幾隻看起來像是侯鳥，橫屍在湖邊

3) GTranslate your Chinese text to English and compare with Step 1):
A dozen of them look like migratory birds. Their dead bodies are by the lake.

4) Revised English text:
A dozen of them look like migratory birds. Their dead bodies are by the lake.

Shortened text for machine learning:

CLASS 2
Among them, twelve migratory birds look dead.
Follow teacher’s instructions and input both translated texts into Google’s Teachable Machine Training platform to train a model to detect the accuracy of the text in both languages. Link: [https://teachablemachine.withgoogle.com/](https://teachablemachine.withgoogle.com/)

English
Teachable Machine Data Model Link:
[https://teachablemachine.withgoogle.com/models/latr2gRPO/](https://teachablemachine.withgoogle.com/models/latr2gRPO/)
Teachable Machine Data Model Link:
https://teachablemachine.withgoogle.com/models/FvGCp9SNH/
<table>
<thead>
<tr>
<th>student instructions</th>
<th>teacher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watch the video of how to use Baidu Translate’s <strong>Read</strong> function</td>
<td>As students engage in active and metacognitive learning via using Baidu Translate’s <strong>Read</strong> function, provide one-to-one differentiated/ubiquitous instruction.</td>
</tr>
<tr>
<td>Click here to view <a href="#">video</a></td>
<td>Strategies human teaching and learning-machine interaction:</td>
</tr>
<tr>
<td></td>
<td><strong>In the classroom</strong></td>
</tr>
<tr>
<td></td>
<td>provide live human one-to-one feedback</td>
</tr>
<tr>
<td></td>
<td><strong>Beyond classroom walls</strong></td>
</tr>
<tr>
<td>Using your final story writing draft, type a sentence in Baidu Translate and follow the steps in the video.</td>
<td>have students screen record, upload, and send a video of the Read voice recording process to provide one-to-one digital feedback in a learning management system, such as Google Classroom.</td>
</tr>
<tr>
<td>Practice 3-5 times.</td>
<td></td>
</tr>
<tr>
<td>Record your highest score next to each sentence in your writing packet.</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX F: TIMELINE OF DATA COLLECTION

Academic school year 2020-2021

Grade 7 – 3 thematic units – September 2020 ~ April 2021

What is your Story?
Building Character
Revive: Our Mother Earth

Grade 8 – 3 thematic units – December 2020 ~ June 2021

Respect
People and Languages
Limitations

September
causal comparative design data collection instruments - pretest scores for Northwest Evaluation Association Measures of Academic Progress reading/language use scores, Achieve3000 reading scores

October
causal comparative design data collection instruments - Term 1 International Baccalaureate Middle Year Programme English language acquisition criterion scores for all language domains

October - June
computation design - data will be collected during the unit for any related machine learning activities

May - June
causal comparative design data collection instruments - post-test scores for Northwest Evaluation Association Measures of Academic Progress reading/language use scores, Achieve3000 reading scores
causal comparative design data collection instruments - Term 3 (Grade 7) and Term 4 (Grade 8) International Baccalaureate Middle Year Programme English language acquisition criterion-related scores for all language domains

June-July
analyze findings
# APPENDIX G: SUMMARY OF GRADES 7 AND 8 QUANTITATIVE DATA

| GRADE 7 SAMPLE | | GRADE 8 SAMPLE |
|----------------|------------------|
| **Grade** | **Student Number** | **Gender** | **Grade** | **Student Number** | **Gender** |
| 7 | 1 | female | 8 | 21 | male |
| 7 | 2 | female | 8 | 22 | male |
| 7 | 3 | female | 8 | 23 | male |
| 7 | 4 | female | 8 | 24 | female |
| 7 | 5 | male | 8 | 25 | male |
| 7 | 6 | female | 8 | 26 | male |
| 7 | 7 | male | 8 | 27 | female |
| 7 | 8 | male | 8 | 28 | female |
| 7 | 9 | male | 8 | 29 | male |
| 7 | 10 | male | 8 | 30 | male |
| 7 | 11 | female | 8 | 31 | male |
| 7 | 12 | male | 8 | 32 | female |
| 7 | 13 | female | 8 | 33 | male |
| 7 | 14 | female | 8 | 34 | female |
| 7 | 15 | female | 8 | 35 | female |
| 7 | 16 | male | 8 | 36 | female |
| 7 | 17 | male | 8 | 37 | male |
| 7 | 18 | male | 8 | 38 | female |
| 7 | 19 | female | 8 | 39 | female |
| 7 | 20 | male | 8 | 40 | female |
APPENDIX H: UNIT 1 GRADE 7 STUDENT SAMPLE

Work by Student 5 and 8

“Amigo Brothers” Increasing Background Knowledge

Image related to the story
Online Translation Tools - [Google Translate], [Microsoft Translate], [Baidu Translate],
Other Online Tools - [Google Image], [Power Thesaurus], [Describing words]

Write words (noun, adjective, verb) that describe the picture.

<table>
<thead>
<tr>
<th>Sensory Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>What do you see?</td>
</tr>
<tr>
<td>Chinese text</td>
</tr>
<tr>
<td>兩個人在打拳擊</td>
</tr>
<tr>
<td>English text</td>
</tr>
<tr>
<td>Two people are fighting (boxing) in a race</td>
</tr>
</tbody>
</table>
Write a sentence describing the situation of the picture.

1) English text in your own words. If you cannot describe it in English, go to 2).

There are two people fighting in a matchrace. They are gasping and shouting. They are persistent in the matchrace. Their sweat is salty and smelly.

2) Chinese text in your own words:

那裡有兩個人，他們正在一場格鬥比賽中，他們發出了喘氣聲和大喊聲，他們在比賽中持續堅持著，他們的汗是鹹的跟充滿痛苦的，非常的臭

3) GTranslate your Chinese text to English and compare with Step 1):

There were two people there. They were in a fighting match. They gasped and shouted. They Persist in the game, their sweat is salty and painful, very smelly.

4) Revised English text:

There are two people fighting in a match. They are gasping and shouting. They are persistent in the match. Their sweat is salty it's smelly.

5) GTranslate back to Chinese:

一場比賽有兩個人打架，他們正在喘著粗氣大喊，他們堅持比賽，他們的汗水很咸，很臭

Search for two more images that best match your description.

Write words (noun, adjective, verb) that describe the picture.

Search for another image that shows a different situation in a boxing match.

Sensory Details
<table>
<thead>
<tr>
<th>What do you see?</th>
<th>What do you hear?</th>
<th>What physical feeling does the picture give you?</th>
<th>If you were one of the boxers, what would the sweat taste like?</th>
<th>What are the smells?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chinese text</td>
<td>Chinese text</td>
<td>Chinese text</td>
<td>Chinese text</td>
<td>Chinese text</td>
</tr>
<tr>
<td>兩個拳擊手在比賽然後一個拳擊手贏了</td>
<td>觀眾歡呼,一個拳擊手贏了,另一個被擊倒</td>
<td>非常痛因為他被另一位拳擊手擊倒</td>
<td>臭,苦,酸,鹹</td>
<td>臭,鹹</td>
</tr>
<tr>
<td>English text</td>
<td>English text</td>
<td>English text</td>
<td>English text</td>
<td>English text</td>
</tr>
<tr>
<td>Two boxers are a match and a boxer win</td>
<td>Audience cheer, once boxer win, another one knocked out.</td>
<td>Very pain because he knocks out by another boxer</td>
<td>Smelly, bitter, sour, salty</td>
<td>Smelly, salty</td>
</tr>
</tbody>
</table>

Write a sentence describing the situation of the picture.

1) English text in your own words. If you cannot describe it in English, go to 2).

Two boxers are having a match and one boxer wins.

2) Chinese text in your own words:

兩個拳擊手在比賽然後一個拳擊手贏了.

3) GTranslate your Chinese text to English and compare with Step 1):

Two boxers are in a match and one boxer wins.

4) Revised English text:

Two boxers are having a match and one boxer wins.

5) GTranslate back to Chinese:

兩名拳擊手進行比賽，一名拳擊手獲勝。

Search for two more images that best match your description.
Screen capture the text score

Teachable Machine

There are two people fighting in a match.

Two boxers are having a match and one boxer wins.

Teachable Machine

There are two people fighting in a match.

Two boxers are having a match and one boxer wins.
### GRADING PROCEDURE

<table>
<thead>
<tr>
<th>Exceeding Expectations</th>
<th>Meeting Expectations</th>
<th>Approaching Expectations</th>
<th>Below Expectations</th>
</tr>
</thead>
</table>

Some of the images are not very matched to the sentence, so I think we need to find a new picture that more matches the sentence. *Student 8*

We need to find a better picture for the sentence, and the sentence needs to be better. *Student 5*
## APPENDIX I: UNIT 1 GRADE 8 STUDENT SAMPLE

**Work by Student 34**

**Making predictions about what will happen in the story**

Video Clip - Using Sensory Language

Online Translation Tools - [Google Translate](https://translate.google.com), [Microsoft Translate](https://vecta.microsoft.com), [Baidu Translate](https://trans.baidu.com),

Other Online Tools - [Google Image](https://images.google.com), [Power Thesaurus](https://powerthesaurus.com), [Describing words](https://www.describingwords.com)

Write words (noun, adjective, verb) that **describe** the picture.

<table>
<thead>
<tr>
<th>ATL Activity 8 (Chapters 38-49)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PICTURE 1</td>
</tr>
<tr>
<td>Mom’s red shoes were under Crash’s bed.</td>
</tr>
<tr>
<td><img src="image1.png" alt="Picture 1" /></td>
</tr>
<tr>
<td>PICTURE 5</td>
</tr>
<tr>
<td>Crash returns turtle to Penn because _________________ _____.</td>
</tr>
<tr>
<td><img src="image5.png" alt="Picture 5" /></td>
</tr>
</tbody>
</table>
### Use the sentence template to describe the picture.

<table>
<thead>
<tr>
<th>1) English text in your own words. (If you do not know a word in English, you may type it in Chinese with the English words you know.)</th>
<th>2) Chinese text in your own words:</th>
<th>3) Google Translate your Chinese text to check your English mistakes in Step 1):</th>
<th>4) Fix your English text using Google Translate and the teacher’s help: (ten words)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mom’s red shoes were under Crash’s bed.</td>
<td>媽媽尋找紅鞋 子在 Crash 的床底下.</td>
<td>The mom’s red shoes are under Crash’s bed.</td>
<td>Mom tries to find red shoes were under the bed.</td>
</tr>
</tbody>
</table>

Search for at least three similar images. (You may need to search for two or more)
Train bilingual texts with images

Follow teacher’s instructions and input both translated texts into Google’s Teachable Machine Training platform to train a model to detect the accuracy of the text in both languages.

English text

Teachable Machine Data Model Link:
Teachable Machine Data Model Link:
APPENDIX J: UNIT 2 GRADE 7 STUDENT SAMPLE

Work by Student 13

Making predictions about what will happen in the story

Video Clip - Using Sensory Language

Online Translation Tools - Google Translate, Microsoft Translate, Baidu Translate,

Other Online Tools - Google Image, Power Thesaurus, Describing words

Write words (noun, adjective, verb) that describe the picture.

---

<table>
<thead>
<tr>
<th>ATL Group Activity 1 (Chapters 1-7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Picture 1</td>
</tr>
<tr>
<td><img src="image1.png" alt="Picture 1" /></td>
</tr>
<tr>
<td>Picture 4</td>
</tr>
<tr>
<td><img src="image4.png" alt="Picture 4" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What do you see? (color, lighting, shapes)</th>
<th>How does it make you feel?</th>
<th>What is the image trying to tell us?</th>
<th>How are the characters related? What is communicated by the</th>
<th>Is there any symbolic meaning in the picture?</th>
</tr>
</thead>
</table>

284
<table>
<thead>
<tr>
<th>character's gestures?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write a sentence describing the situation of the pictures. (Causality)</td>
</tr>
</tbody>
</table>

1) English text in your own words. If you cannot describe it in English, go to 2).

Two people were digging something in the desert.

2) Chinese text in your own words:

兩個人在沙漠挖東西。

3) Translate your Chinese text to English and compare with Step 1):

Two people were digging in the desert.

4) Revised English text:

Two people are digging many holes in the desert.

5) Translate back to Chinese:

Search for two similar images.
Reflection about your learning of English with the support of your first language and images.

When I typed in English, the machine gave me a very low present. I think it's because I wrote "many holes" but in the picture I just have one hole about 95% and for Chinese, 88%. I think my English is better than my Chinese. I should choose better pictures next time. I would like to try write harder sentences.
**APPENDIX K: UNIT 2 GRADE 8 STUDENT SAMPLE**

*Holt Readings Increasing Background Knowledge*

**Student work by Student 32**

Image related to the story

Online Translation Tools - [Google Translate], [Microsoft Translate], [Baidu Translate],

Other Online Tools -  [Google Image], [Power Thesaurus], [Describing words]

Write words (noun, adjective, verb) that **describe** the picture.

ATL Activity 1 - “A Shot At It”

<table>
<thead>
<tr>
<th>Sensory Details</th>
<th>Going to college in America is excited. (How does it make you feel?)</th>
</tr>
</thead>
</table>

| Use the sentence frame to write a sentence describing the situation of the picture. |
|---|---|---|---|
| 1) **English text in your own words.** (If you do not know a word in English you may type it in Chinese with the English words you know.) | 2) **Chinese text in your own words:** | 3) **Google Translate your Chinese text to check your English mistakes in Step 1:** | 4) **Fix your English text using Google Translate and the teacher’s help:** (ten words) |
| After four years of studying in an American university, I finally graduated. I am very happy. | 在美國的大學讀了四年終於畢業了，十分的開心。 | After four years of studying in the United States, I finally graduate I am very happy. | After four years of studying at a colleg in the USA, I feel really happy. |

Search for three similar images that best match your description.
### ATL Activity 2 - “How I Learned English”

**Sensory Details**

Playing sports _______________ English.

Write a sentence describing the situation of the picture.

<table>
<thead>
<tr>
<th>1) English text in your own words. (If you do not know a word in English, you may type it in Chinese with the English words you know.)</th>
<th>2) Chinese text in your own words:</th>
<th>3) Google Translate your Chinese text to check your English mistakes in Step 1:</th>
<th>4) Fix your English text using Google Translate and the teacher's help: (ten words)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I learned English by playing baseball.</td>
<td>我藉由打棒球學會了英文。</td>
<td>I learned English by playing baseball.</td>
<td>I studied English by playing baseball.</td>
</tr>
</tbody>
</table>

Search for three similar images that best match your description.
ATL Activity 3 - “Ed McMahon is Iranian”

Sensory Details

_____ was born in ______ (preposition) ______________ parents.

I not only speak Chinese but also English. (parallel structure)

Write a sentence describing the situation of the picture.

<table>
<thead>
<tr>
<th>1) English text in your own words. (If you do not know a word in English, you may type it in Chinese with the English words you know.)</th>
<th>2) Chinese text in your own words:</th>
<th>3) Google Translate your Chinese text to check your English mistakes in Step 1):</th>
<th>4) Fix your English text using Google Translate and the teacher’s help: (ten words)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I not only speak Chinese but also English.</td>
<td>我不僅會說中文，我也會說英文。</td>
<td>Not only can I speak Chinese, but I can also speak English.</td>
<td>Not only can I speak Chinese, but I can also speak English.</td>
</tr>
</tbody>
</table>
Search for three similar images that best match your description.

Train bilingual texts with images

Follow the teacher’s instructions and input both translated texts into Google’s Teachable Machine Training platform to train a model to detect the accuracy of the text in both languages. Link: [https://teachablemachine.withgoogle.com/](https://teachablemachine.withgoogle.com/)

**English text**

Teachable Machine Data Model Link:

**ATL Activity 1**

![Teachable Machine](attachment:image.png)
## APPENDIX L: UNIT 3 GRADE 7 STUDENT SAMPLE

**Work by Student 14**

### Sensory Details
- Video Clip - Using Sensory Language
- Online Translation Tools - [Google Translate](https://translate.google.com), [Microsoft Translate](https://translate.microsoft.com), [Baidu Translate](https://pan.baidu.com/)
- Other Online Tools - [Google Image](https://images.google.com), [Power Thesaurus](https://www.powerthesaurus.com), [Describing words](https://www.describingwords.com)

Write words (noun, adjective, verb) that **describe** the picture.

<table>
<thead>
<tr>
<th>ATL Activity 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Image of soil with buildings and trees in the background." /></td>
</tr>
</tbody>
</table>

### CAUSE --- EFFECT
- **SIMPLE SENTENCE** - _____ [EFFECT 影響] ________ due to ____ [Cause 原因] ________.
- **COMPOUND SENTENCE** - _______ [Cause 原因] ________, so _____ [EFFECT 影響] ________.
- **COMPLEX SENTENCE** - Because _________ [Cause 原因] ________, ___ [EFFECT 影響] ________.

Write a sentence describing the situation of the picture. (Causality)

<table>
<thead>
<tr>
<th>1) English text in your own words. (If you do not know a word in English, you may type it in Chinese with the English words you know.)</th>
<th>2) Chinese text in your own words:</th>
<th>3) Google Translate your Chinese text to check your English mistakes in Step 1):</th>
<th>4) Fix your English text using Google Translate and the teacher’s help: (ten words)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Now the soil is very unhealthy due to we always throw the waste on the ground.</strong></td>
<td>現在的土非常的不健康由於我們總是把垃圾亂丟在地上。</td>
<td><strong>The soil today is very unhealthy because we always throw rubbish on the ground.</strong></td>
<td><strong>The soil today is very unhealthy due to people always throwing rubbish on the ground.</strong></td>
</tr>
</tbody>
</table>

Search for at least three similar images. (You may need to search for two or more images per box to complete the meaning of the sentence.)
### ATL Activity 2

**CAUSE --- EFFECT**

- **SIMPLE SENTENCE** - ______ [EFFECT 影響] due to ____ [Cause 原因] _____.
- **COMPOUND SENTENCE** - ______ [Cause 原因] ______, so _____ [EFFECT 影響] ______.
- **COMPLEX SENTENCE** - Because ______ [Cause 原因] _______, _____ [EFFECT 影響] ______.

Write a sentence describing the situation of the picture. (Causality)

<table>
<thead>
<tr>
<th>1) English text in your own words. (If you do not know a word in English, you may type it in Chinese with the English words you know.)</th>
<th>2) Chinese text in your own words:</th>
<th>3) Google Translate your Chinese text to check your English mistakes in Step 1):</th>
<th>4) Fix your English text using Google Translate and the teacher’s help: (ten words)</th>
</tr>
</thead>
<tbody>
<tr>
<td>We coal mining to many, so now the soil are pollution.</td>
<td>我們一直採煤過度，所以現在的土地被污染了。</td>
<td>We have been over-mining coal, so the land is now polluted.</td>
<td>We have been over-mining coal, so the soil is polluted.</td>
</tr>
</tbody>
</table>

Search for at least three similar images. (You may need to search for two or more images per box to complete the meaning of the sentence.)
Because we always cut down trees, we need to plant more plants.

Because 我們總是砍樹，我們需要去種更多植物。

Because we always cut down the trees, we need to plant more plants.

Because we cut trees, we need to plant more tree.

Search for at least three similar images. (You may need to search for two or more images per box to complete the meaning of the sentence.)
Train bilingual texts with images

Follow the teacher’s instructions and input both translated texts into Google’s Teachable Machine Training platform to train a model to detect the accuracy of the text in both languages. Link: https://teachablemachine.withgoogle.com/

**English text**

Teachable Machine Data Model Link:

**ATL Activity 1**

**ATL Activity 2**
Chinese text
Teachable Machine Data Model Link:

**ATL Activity 1**

![Teachable Machine Activity 1](image1.jpg)

**ATL Activity 2**

![Teachable Machine Activity 2](image2.jpg)
ATL Activity 3

現在的土非常的不健康由於我們總是把垃圾亂丟在地上。

我們一直採用過度，所以現在的土地被污染了。

因為我們總是砍樹，我們需要去種更多植物。
APPENDIX M: UNIT 3 GRADE 8 STUDENT SAMPLE

Work by Student 32

Making predictions about what will happen in the story

Video Clip - Using Sensory Language
Online Translation Tools - Google Translate, Microsoft Translate, Baidu Translate,
Other Online Tools - Google Image, Power Thesaurus, Describing words

Write words (noun, adjective, verb) that describe the picture.

ATL Activity 3 (Chapters 13 - 17)

<table>
<thead>
<tr>
<th>PICTURE 1 (Chapter 13)</th>
<th>PICTURE 2 (Chapter 14)</th>
<th>PICTURE 3 (Chapter 15/16)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A package</td>
<td>Dogs _______ by soldiers.</td>
<td></td>
</tr>
<tr>
<td>_________</td>
<td>Dogs are near the soldiers.</td>
<td></td>
</tr>
<tr>
<td>A package has something important</td>
<td>Annemarie is running to the boat and delivering the package.</td>
<td></td>
</tr>
<tr>
<td>Mom hurt her ankle while coming back.</td>
<td>Annemarie remembers the story of a little red riding hood.</td>
<td></td>
</tr>
<tr>
<td>Found Peter’s package and was supposed to give it to Uncle Henrik.</td>
<td>Suddenly Annemarie sees four soldiers and two large dogs.</td>
<td></td>
</tr>
<tr>
<td>Mom told Annemarie to place the package in the basket and put food on top.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>____________ is used for __________.</td>
<td>____________ is used for __________.</td>
<td></td>
</tr>
<tr>
<td>The handkerchief is used to wipe away tears</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Annemarie was stopped by soldiers and soldiers found the package in the bottom.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. The soldiers opened the package and found a white handkerchief inside</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Annemarie safely gives the package to Uncle Henrick.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CH.16 Uncle Henrik was able to safely deliver the Jews</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The handkerchief was to numb the dog’s smell</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

301
The war has ended.
Lise was hit by a truck
Peter was caught and later executed
This symbol represents has an important meaning
Annemarie asked dad to fix the gold star necklace.

<table>
<thead>
<tr>
<th>PICTURE 4 (Chapter 17)</th>
<th>PICTURE 5 (Chapter 17)</th>
<th>PICTURE 6</th>
</tr>
</thead>
</table>
| The war \______________.
The war has ended.
Lise was hit by a truck
Peter was caught and later executed | This symbol represents \______________.
This symbol represents has an important meaning | This symbol represents has an important meaning |

Use the sentence template to describe the picture.

<table>
<thead>
<tr>
<th>1) English text in your own words. (If you do not know a word in English, you may type it in Chinese with the English words you know.)</th>
<th>2) Chinese text in your own words:</th>
<th>3) Google Translate your Chinese text to check your English mistakes in Step 1):</th>
<th>4) Fix your English text using Google Translate and the teacher's help: (ten words)</th>
</tr>
</thead>
</table>
| 1. A package has something important
2. Dogs are nearby the soldiers
3. The handkerchief is used to wipe away the tear
4. The war was end
5. This symbol represents has an important meaning | 1.一個包裹有重要的東西
2. 狗在士兵附近
3. 手帕是用來擦眼淚的
4. 戰爭結束
5. 這個符號代表重要的意義 | 1. A package has something important
2. Dogs are nearby the soldiers
3. The handkerchief is used to wipe away the tear
4. The war was end
5. This symbol represents has an important meaning | 1. A package has something important
2. Dogs are nearby the soldiers
3. The handkerchief is used to wipe away the tear
4. The war was end
5. This symbol represents has an important meaning |

Search for at least three similar images. (You may need to search for two or more images per box to complete the meaning of the sentence.)
Train bilingual texts with images

Follow teacher’s instructions and input both translated texts into Google’s Teachable Machine Training platform to train a model to detect the accuracy of the text in both languages.
Teachable Machine Data Model Link:
APPENDIX N: TEACHER REFLECTION QUESTIONS

Teacher Reflection Questions

Questions designed based on extending Tashior et al.’s (2011) transtheoretical framework for hybrid learning

Extent of potentiality in learning outcomes

What difficulties did you encounter while completing the units?

What difficulties did you encounter with the formative and summative assessment task(s)?

What resources are proving useful?

What student inquiries are emerging?

What is the level of student engagement?

How can we scaffold learning for students who need more guidance?

Are the integrated technologies effective and efficient in determining student learning evidence? And to what extent?

What are some trends in learning outcomes in all the units taught?

Did the machine learning interventions via the use of machine translation software support student’s learning?

Did the scaffolded approaches that combine human teaching/learning and AI-powered technologies and/or other combination of technologies allow students to reach the highest achievement levels? For each question below, describe in detail for each of the following language domains: listening, reading, speaking, and writing.

What evidence of learning can you identify?

What artifacts (formatives, summatives, other activities) of learning can you
document?
Which specific machine-learner teaching strategies were effective? Why?
What specific computer-assisted technologies of the intervention were helpful?
What student-initiated action did you notice?
How effectively did the bilingual/L2 hybrid intervention model assist with differentiated learning in this unit?

**Extent of connectivity**

*Teacher self-perception*
How do you perceive your role as a teacher when engaging learners in this bilingual/L2 hybrid learning environment with machine-learner teaching and learning at its core?

*Teacher-student interaction*
What were some initial difficulties encountered while teaching the students how to use the technologies deployed?
Were you able to overcome these difficulties easily?
Are you able to identify student learning outcomes at a more effective level compared to a traditional non-hybrid course?
Are you able to detect higher rate of learning compared to a traditional non-hybrid course?

*Collaborating teachers-subject group coordinator*
During moderation, were you and other teachers, including the subject group coordinator able to reach an agreement in terms of assigning assessment scores?

**Extent of resilience**
What were some setbacks of the technologies deployed?
APPENDIX O: STUDENT REFLECTION QUESTIONS

Student Reflection Questions

Questions designed based on extending Tashior et al’s (2011) transtheoretical framework for hybrid learning

Extent of potentiality in learning outcomes

What difficulties did you have with the formative and/or summative assessment task(s)?

What activities are helping you learn in the following areas:

   Listening:
   Reading:
   Speaking:
   Writing:

What technologies are helping you learn?

What teaching strategies and/or technologies are helping you learn at your own pace and English ability level?

Extent of connectivity

Student self-perception

How do you perceive your role as a student learning in a bilingual/L2 hybrid learning environment?

Did you find yourself transferring the skills of translingualism in machine translation and/or machine learning in your other subject areas? If you answered yes, please describe.

Teacher-student interaction
What were some initial difficulties encountered while learning the technologies?

Were you able to overcome these difficulties easily via teacher facilitation?

Were you able to learn better when the machine and the teacher can provide you immediate feedback? If so, describe how you were able to learn better?

**Extent of resilience**

What are some problems with the technologies used? Describe.
APPENDIX P: TEACHER REFLECTION WRITTEN RESPONSES

Teacher Reflection Questions

Questions designed based on extending Tashior et al.’s (2011) transtheoretical framework for hybrid learning

Extent of potentiality in learning outcomes

What difficulties did you encounter while completing the units?

Teacher Participant 1: Overall, the beginning of implementing the units was the most difficult, as the learners were not completely accustomed to computer learning or the basic tools, such as Google Classroom, Google Suite apps, Google Meet, Goformative, and the teaching material organized into website module units. Every unit differs, so there will be slight variations with every module for the learners to navigate the information. To move into the operation of the three core pieces of AI-powered technologies effectively, students needed to be first immersed into a digital hybrid environment. Keeping the instructions simple for students to understand and follow was another challenge.

Teacher Participant 2: Time issue — both teacher and students were unfamiliar with using the tools, so it was difficult to complete the tasks on time.
Teaching materials — although all the units were already prepared and ready to go, it still took some time understanding the instructions and getting used to the format and procedures on how to implement them in class. Though after being more familiar with the designer’s purpose and logic behind each unit, I was able to implement the lessons with ease.

What difficulties did you encounter with the formative and summative assessment task(s)?

Teacher Participant 1: For the listening and reading formatives and summatives, students continued with traditional paper-based pencil testing. Students had the most trouble with answering higher-level test questions that required them to write a full paragraph response. For the writing assignments, the process of providing on-screen one-to-one feedback at the sentential level with GoogleDocs was time-consuming and requires the teacher to think quickly to provide human support for differentiated learning. It took time to be able to develop the skill of providing immediate feedback similar to what machine feedback, such as Grammarly, does.

Teacher Participant 2: For the majority of my students, they found the videos too fast and struggled even more when the CC [captions] was taken away. For example, for formatives the CC [captions] is turned on but during the summative it’s not. Result, most students that were able to answer 70~80% of the questions with the assistance of the CC [captions], were only able to answer 40~60% w/o CC [captions]. And their answers weren’t as complete. Meaning their answers weren’t as complete and with more grammar mistakes.
Planning — It is always a challenge to predict accurately where the students’ levels are, if the formative and summative are too difficult for the students.
Unit 5 Online Assessments — Since the classroom was drawn to the internet due to Covid. One immediate problem when assessing the formatives online, students were directly searching the questions online and copying the answers. Solution: If students were to copy any materials via online or open book, they must convert the sentence into their own words. This is to teach students how to translate the original meaning into their own and also teach the importance of not plagiarizing.

What resources are proving useful?

Teacher Participant 1: Organizing all the lessons into a module unit using Googlesites with a combination of technology tools provided an efficient and organized way of giving students easier navigation of the content taught. These resources also provided ubiquitous access anytime, anywhere.

The machine learning resources provided various affordances, especially with allowing students to think metacognitively about their learning and actively constructing the skill of thinking bilingually to support their English language development via various multimodal learning designs. These include engaging students to describe the causal effects of images, while tactfully using Google translate to borrow their vocabulary in Chinese and transferring the words over to their English vocabulary bank, in various contextual learning environments (eg. Prediction of what will happen in the chapters of a story.)

Teacher Participant 2: Using Google Classrooms was most useful. Especially when transferring to fully online classes. With a click of the ‘Meet’ button, and poof we are back in the classroom. Whether it’s announcing an upcoming test, or assigning an in-class activity Google Classroom makes it easy to use and organizes everything in a folder. Another big advantage is when other apps are linked to Google Classroom, such as GoFormatives. So after creating a quiz on GoFormatives, it gives the option to directly link and publish in your Google Classroom. But things aren’t perfect, the biggest complaint is Google grades are not linked to our school’s grading platform. So the grades accumulated in Google are “virtually” useless.

GoFormatives was most useful when answering reading comprehension problems. The first few students would receive extra points if their answer turned ‘green’. And immediately once someone got a green, everyone suddenly became your best friend. At this point, the rule is you could speak out, spell out if you have to, but can’t leave your seat, and can’t text message. This is in hopes to have more verbal practices.

Speaking of GoFormatives, the app Quizizz proved to be most entertaining and the students enjoyed playing those quizizz. Students said things like, “It was faster and more exciting.” “I like to wait till later to kick people down the scoreboard.” I would pick this over Kahoot, because it’s live but relatively at their own pace. And keeps the kids engaged longer than Kahoot.

The activities using the Baidu apps were proven most effective. Students automatically would aim for a high 80-90 score. And for those who are competitive, when seeing a student get a higher score, they would want to top that score.
What student inquiries are emerging?

Teacher Participant 1: Most student inquiries occurred when implementing the three AI-powered tools. After engaging in several bilingual image-text machine learning activities, students began to inquire more about unfamiliar vocabulary, as well as the accuracy of their sentences after checking with Google Translate. Most were noticing the imperfections of Google Translate. Then, students were asking what some of the automated machine feedback Grammarly provided meant, and how they could further improve their machine scores. As for Baidu, when they had trouble improving their scores, they sought help from the teacher. As for other technologies, Goformative was a common tool used to boost students’ vocabulary development. Students mainly questioned about how to change the word form to fit the blank for cloze sentences. Students were also asking about unfamiliar vocabulary on exams.

Teacher Participant 2: There was one student who did ask how to raise the machine learning score in Teachable Machine. Similar reaction was more prevalent when using the Baidu app. Few students would huddle together and trade notes/tips on how to better their scores. I also noticed that instant gratification plays an important role. The faster and more accurate the app responses, the greater the willingness of the student is willing to try again. Take Gofomatives for example, if the students sense that the program takes a bit longer to respond, or if there is one inaccuracy in the answer key, then they immediately lose interest and make comments like “oh this is too much trouble” or “this is too hard” and so on. This also affects the teacher’s credibility, meaning the students begin to question the teacher’s ability or knowledge on the subject. And add doubts to future Goformative activities.

What is the level of student engagement?
Teacher Participant 1: With the use of computers for 90% of the activities, students were actively engaged though close monitoring of off-tasks activities required new classroom management strategies. With the teacher’s ongoing facilitation and immediate feedback combined with machine feedback, students were able to redress their errors more quickly.

Teacher Participant 2: Depending on which class the levels of engagement for certain tools is better accepted than the other. For example, Class 1 likes (more like loves) to use the Baidu app, and some of the boys would haze the other boys how high their score was. So immediately, they would have to raise their scores or be ridiculed for the rest of the day. Whereas Class 2 was more into GoFormatives or sometimes Kahoot, because few of the students were exceptionally fast (7-10 mins) in completing the tasks and that caused the class as a whole to compete.

How can we scaffold learning for students who need more guidance?
Teacher Participant 1: Peer to peer support and intrinsic rewards for small accomplishments have proven effective to motivate struggling learners. Also, using writing assistants and speech automated scoring software have also made these learners curious as to how the tools will help them improve their English faster.

Teacher Participant 2: Ideally having peer to peer support and giving intrinsic rewards while using writing assistants or speech automated scoring software has proven useful. Although when extrinsic rewards are added, then student motivation is heightened. And if a physical challenge is
added to the equation, then student response is taken to the next level. For example, after a student completes a task an automated score is given (ex.88%) then the student is rewarded with a star. A star = to a chance to throw the ball and win a prize (ex.candy). Setbacks are very time consuming and whenever extrinsic rewards are given, human greed follows.

Are the integrated technologies effective and efficient in determining student learning evidence? And to what extent?

Teacher Participant 1: For the first unit, it took more time and scaffolding, as the combination of technologies have their own distinct features. However, the same technologies used in each unit became more second nature for the students, as we moved through more units. As machine automated scoring gave learners immediate feedback of their performances their English language development, learners developed the autonomy to do better.

Teacher Participant 2: After students worked out the kinks and were familiarized with the technologies, learning was most effective and at a more efficient pace. For example, in one of my classes there was heavy (yet friendly) competition as to who got the highest audio-automated score (Baidu). So much that they were waiting on the same device due to fairness and authenticity. Because of this, it had forced the weakest student to learn, adapt and improve exponentially.

What are some trends in learning outcomes in all the units taught?

Teacher Participant 1: Participants who exhibited higher learning motivation engaged in more constructive thinking. These learners tend to have higher performances in all testing instruments, as well as machine learning activities (image-bilingual text translation models, Grammarly and Baidu writing/speaking scoring).

Teacher Participant 2: As mentioned in the situation above, the trend could also turn south and students lose interest due to the difficulty of using the technology tool or there are inaccuracies to the system.

A trend I noticed was certain classes, or individual students tend to excel in using one app while others excel in another app. And through time one class (or student) would improve in efficiency and accuracy, but never surpass the predecessor.

Did the machine learning interventions via the use of machine translation software support student’s learning?

Teacher Participant 1: Overall, the machine learning interventions that involve the use of machine translation software had moderate support on students’ learning. After several practices, students realized that when they write more complex sentences in either English or Chinese, the machine translator produces more errors. When they kept their sentences simple, near perfect to perfect Chinese-English translations were generated. Some also realized that translators could be used like a calculator to check their basic sentence structures and diction. However, students with lower English abilities have not developed ample metalinguistic background of specific grammar structures, so they cannot tell whether the machine translators are giving them accurate translations. Teacher intervention in correcting further errors is needed.
When students moved into machine training of image and bilingual text models, they initially thought that high scores meant that their sentences were well-written in both languages, while low scores meant poorly written sentences. As they moved into the third unit, they realized that they needed to find similar images to build these models more accurately and produce higher percentage scores. Then, a few were able to realize that if they were writing ungrammatical sentences in either language with corresponding images, then they would be training models with errors, which is similar to training machine translators. Hence, the idea of image-bilingual sentential texts began to make more sense to them. In engaging in these activities using a variety of topics, students were able to develop a deeper metacognitive awareness about the affordance machine translators can offer in activating their translilingual skills when writing in both languages, mainly to bridge over to their English language acquisition.

Teacher Participant 2: When working on the machine learning interventions at the beginning of the first semester, minimal translation was used, because students were not taught how to properly use the translation tools. And even after they knew how to use the translation tools, they still had difficulty differentiating which word(s) was correct and appropriate for their use. This was because their English level was still too low. But as the semester went on, students were building up a habit of using the translator not only for machine learning exercises, but also in other activities as well. Only a few students were able to accurately use the translators independently. Whereas the rest of the students had to still rely on the teacher to give the correct suggestion.

Did the scaffolded approaches that combine human teaching/learning and AI-powered technologies and/or other combination of technologies allow students to reach the highest achievement levels? For each question below, describe in detail for each of the following language domains: listening, reading, speaking, and writing.

Teacher Participant 1: Yes, the intent of key AI-powered tools used is to give these learners more opportunities to achieve the highest score possible after multiple tries.
Teacher Participant 2: Yes, when using the scaffolding approach combined with human teaching, AI technologies and an interesting factor (something fun that triggers student’s interest in learning) will allow students to reach the highest achievement levels.

What evidence of learning can you identify?
Teacher Participant 1:
Listening – Most of the listening tests were completed using video formative and summative. The videos are segmented by listening questions and repeated until students understood each section of the video. By the third unit, the number of repeats for each segment of the videos decreased. Students are probably able to listen and comprehend after half a year of practice.
Reading – Students were more inquisitive about unfamiliar vocabulary while engaging in on-screen reading and used Google images to support their translilingual thinking rather than relying on online translators.
Writing – The students’ vocabulary knowledge increased, and they are becoming more aware of writing complete sentences with proper punctuation, varying sentence structures, longer and more thoughtful paragraphs.
Speaking – Students still have the tendency to speak in Chinese, but when they are made aware of speaking in English, they can produce their thoughts somewhat clearly. Perhaps, there needs to be more interactive activities using the Baidu app to practice their speaking.

Teacher Participant 2:
Listening — when listening to audiobooks, then followed by some discussions, and then reading question activities. More students are able to answer the questions quicker and with a bit more accuracy.
Reading — whether its completing a vocabulary task, or writing a sentence for ML-predictions, students often need to inquire about different synonyms, hence their vocabulary skills are sharpened.
Writing — some students were becoming more confident in making mistakes. When writing essays, some students were able to write out their sentences first, then use Grammarly to assist them in grammatical corrections. Of course another problem emerges when they don’t understand Grammarly’s suggestions.
Speaking — using tools like Baidu was most helpful in allowing students to practice their speaking skills. The goal was to have the students practice speaking English as many times as possible, while keeping them interested and engaged in their learning. Baidu was perfect for the task because each time the student finishes a reading, their reading is recorded and analyzed by the app. The students found the analyzed date to be broken down into useful information. For example, not only would their recording be written out in text form, but their mistakes would be highlighted in red. Furthermore if you tap on the red mispronunciated words a correct pronunciation with a breakdown of the mouth formation is shown. So the student could listen to the correct pronunciation over and over at his own leisure. With this a noticeable trend shows that if the students could read and learn to correct their mispronunciations repeatedly, then not only is their English pronunciation improved, but simultaneously their confidence in speaking English is enhanced.
A slight issue occurred with some students when using the microphone. Students quickly noticed that using the microphone on earphones was easier than speaking into the phone, because you don’t have to be loud in order for the app to pick up. Hence the student could just whisper into their phone and still receive a high score. This resulted in the very shy and quiet students not improving as much as a normal student would.

What artifacts (formatives, summatives, other activities) of learning can you document?
Teacher Participant 1:
Unit Telling Stories
A salient finding in the first unit of the intervention is students’ making connections of the bilingual image-text training activity with the story writing task. Three students’ works have been randomly selected to examine this natural occurrence. Student 6, Student 5, and Student 1’s machine learning activities and writing samples show the connection of how the bilingual image-text activities supported their translingual thinking when drafting a short story as the summative. An interesting occurrence is their transferring the idea of the bilingual image-text activity to the drafting of their story. The
students searched for similar images with different actions and described the images, while thinking bilingually and utilizing Google translate to help her with vocabulary words she did not know in English. Overall, all students depended heavily on tactful use of Google translate to help them with vocabulary words, as this was the first writing assignment. There was still a need for teacher facilitation in identifying and correcting grammatical errors for more complex sentence structures.

Student 6
https://docs.google.com/document/d/1q0NgLOuz0qPYUSIH1dmoyxds_mlHUsYf5A/edit

Student 5
https://docs.google.com/document/d/1tWzeQbaFeGCgHs1NTsWvEM03jXcdjBD4lUiTaB5HA/edit

Student 1
https://docs.google.com/document/d/10ruiElEImKUm9Y5T_wRYhqvgyCFhP7GU3bUH_LGk/edit

Unit Building Character
A notable finding in the unit building character also stems from the bilingual image-text activities. Students were able to carry over the knowledge they have acquired from the predicting story events via the bilingual image-text activities to produce an essay with similar descriptions. Most sentences were written coherently although more complex sentence structures still required teacher support.

Unit Revive-Our Mother Earth
After two extensive units of scaffolding, students are increasingly becoming more independent in completing the bilingual image-text activities. Upon completion of these activities, students have been able to quickly make connections to the listening and writing formatives and summatives. Students were able to complete the listening activities more easily after associating each video topic to images for casual-effect interpretations. However, this unit also required extensive research, so there was still extensive usage of online translators at the beginning of the unit when reading more complex text online. Students’ bilingual thinking processes with the use of online translators have been documented in their essay packets. Most were able to carry over similar thinking processes acquired from the bilingual image-text activities. For instance, in Step 1 of three randomly selected students (Student 14, 13, and 12’s research), tactful usage of the online translator can be identified, in which Student 14 and Student 13 first read the online text and identified the information they needed to answer the guiding research question. Then, they used Google Translate to helped them with a small chunk of text and reworded to their own understanding in Chinese. Then, they put everything in their own words to the best of their ability with occasional guidance of key words from the original text. Interestingly, Student 12 was able to write in his own words in English after understanding the original text in Chinese with the help of Google Translate. After Step 1, no online translators were allowed and most students were able to follow through on writing their works in their own understanding. There were a few students who still
needed extensive guidance from the instructor, which probably suggests that they have not completely acquired the metacognitive bilingual skill as a support to help them write in English.

Student 14
https://docs.google.com/document/d/10MGTH30luX6dAGe891vzENdHeRSLZye-TthxW1kjak/edit

Student 13
https://docs.google.com/document/d/10e8czoz38Ukh9bG_Dqu61JZksVQF1WKf8Zii3Kn2kBE/edit

Student 12
https://docs.google.com/document/d/1gi0gJfIPKpTF25JlbPJUPXE2lakpqcwW4FFY77OW8I/edit

Teacher#2:
Probably the most useful and resourceful formative activity was the ML-Predictions. Within just one formative, students need to analyse a picture, relate it to the novel, then translate their answer in Chinese to English. In the example the same ML-Prediction activity is done at two different time periods (in Unit.3 and Unit.5). The students chosen are at different English levels (high / med / low). The activities chosen are all closer towards the end of the units, so the students had plenty of time to practice and get acquainted with the task. In Unit.3 student_A started off as being the strongest of the three; whereas student_B and student_C were both considered low in their English levels.

Unit.3 — ML: Crash (Ch.31-37)
Student A — High (Student 34) [Student_A-high]
Student B — Low (Student 40) [Student_B-low]
Student C — Low (Student 39) [Student_C-low]

Later on in Unit.5 of the 2nd semester student_A still showed improvements and remained the strongest, although student_C showed visible improvements and resulted in surpassing I_B.

Unit.5 - ML: Number the Stars (Ch.13-17)
Student A — High (Student 34) [Student_A-High]
Student C — Med (Student 40) [Student_C-med]
Student B — Low (Student 39) [Student_B-low]

Conclusion, the ML Prediction activity proved useful because all three students were able to learn and complete their tasks by the end of Unit.5, therefore all showing relative improvements in their works.

Which specific machine-learner teaching strategies were effective? Why?

Teacher Participant 1: The bilingual image-text machine learning activity helped students think metacognitively. The automated writing assistant and automated speech scoring supported students’ output of the English language, both in written and spoken texts.

Teacher Participant 2: Students tend to write the same way as they speak. Hence by improving their writing through listening and reading, their speaking will follow. Take the ML-Prediction activities for example, a student looks at a picture and guesses what is depicted in the picture. Then the student is asked to write a sentence in mostly English
(with some Chinese). Next student has to translate a complete English sentence (using any translator app). Lastly the student has to form a sentence using his own words. From this exercise the student has a chance to ‘read’ and ‘listen’ to the translator’s sentence; decide which word(s) best fits his intended meaning; take that sentence and change it into his own words. So when he finally reads out the newly formed sentence it more or less becomes a part of him.

What specific computer-assisted technologies of the intervention were helpful?

Teacher Participant 1: Aside from the automated feedback features of Google Translate/Teachable Machine, Grammarly, and Baidu, the shared screen feature with speech-to-text output using Google Meet to scaffold on-screen audiobook reading, digital text annotation in modeling how to read and write notes, and the real-time feedback and tracking features by Goformative helped increase engagement of the learners.

Teacher Participant 2: Whenever there is an essay due, after their final draft, students are asked to read their own essays and record their score using Baidu. The goal of this is for students to practice their pronunciations over and over using their own writing and at their own pace. The rules are 1st and 2nd recordings must be documented and scores can not change. The 3rd score is progressive, so students can try as many times as possible. But the catch is, the student has to report the latest score, not the highest score. This encourages students to try at least 3 or more times.

Projecting the Kindle audio book on the white board was a leap of improvement. Instead of the old fashion way of playing a downloaded audio book clip from YouTube. Not only was Kindle’s recording quality vastly superior, also the note taking functions were convenient and useful for discussions.

What student-initiated action did you notice?

Teacher Participant 1: Students helping each other with the machine learning activities.

Teacher Participant 2: Those who finish their Goformatives first have free-time on their computers, but if you take away that free-time, then students are more likely to help assist others with completing their task.

How effectively did the bilingual/L2 hybrid intervention model assist with differentiated learning in this unit?

Teacher Participant 1: The model allows the teacher to instruct each learner in real-time/in person both online and offline and provide comments continuously. Also, the use of AI-powered technologies allowed students to move at their own pace and recognize the types of errors they tend to make on an individual level.

Teacher Participant 2: In class B, I have separated the students into groups of 2 and 4. The groups of 2, pairs one strong and one weak. This is more of an intimate one-on-one set up. Reason being most of the teacher’s instructions needs to be translated, and also less distractions.
The groups of 4 are mostly in the middle range, so they should be independent enough to complete the task themselves. And if not, they could help each other out as a group.

Another rule for seating that is designed for motivating students to work hard is every time we finish a formative or summative, the students are relocated depending on their scores. And special privilege to those who get 6 or above, they get to pick where to sit for that week. Also a warning to those too talkative, the teacher reserves the right to move the student if being disruptive.

**Extent of connectivity**

**Teacher self-perception**

How do you perceive your role as a teacher when engaging learners in this bilingual/L2 hybrid learning environment with machine-learner teaching and learning at its core?

Teacher Participant 1: Teaching and learning have become more student-centered rather than teacher-centered. I was mostly acting as a facilitator.

Teacher Participant 2: As a bilingual learner, I tend to see myself as the perfect role model for my students, but when adding these new tools with machine-learning and all, I am not so sure anymore. At times I pause and think what goes through my students mind? How does this new generation of students think? What makes them tic? How much should a teacher facilitate and how much should be modeled? I honestly don’t know.

**Teacher-student interaction**

What were some initial difficulties encountered while teaching the students how to use the technologies deployed?

Teacher Participant 1: Language difficulties, students’ lack of knowledge in the tools

Teacher Participant 2: Language barrier is usually the first hurdle. Far too often at the end of an explanation the teacher would ask “Any questions?”, the class would automatically say “No.” And if a student repeats the instructions in Chinese, then immediately half of the class would have more questions to ask. After language, the next hurdle would be the lack of knowledge in the tools or their own devices.

Were you able to overcome these difficulties easily?

Teacher Participant 1: Coming up with a simple set of classroom management instructions regarding the use of computer-mediated instruction helped with overcoming these difficulties.

Teacher Participant 2: Yes, after getting used to the class dynamics and knowing my students better, I would usually ask certain student(s) to help translate my instructions.

Are you able to identify student learning outcomes at a more effective level compared to a traditional non-hybrid course?
Teacher Participant 1: Yes, I was able to track student learning not only with computation scores but also use the combination of technologies to follow the effect of student learning almost instantaneously. With traditional teaching, reaching every learner takes more time, especially with paper and pencil-based assessments.

Teacher Participant 2: Yes, with certain programs such as Grammarly, the outcome is almost instantaneous. And by taking that score and the specific errors the student had made, the teacher was able to give a relatively appropriate assessment grade to the student.

Are you able to detect higher rate of learning compared to a traditional non-hybrid course?

Teacher Participant 1: Overall, I was able to provide more differentiated instruction for all the students compared to a traditional non-hybrid course. I was able to provide more scaffolded instruction with the instantaneous machine learning scores and tailor learning to individual language learning needs for every language domain at a faster pace. With the tactful usage of translators through the bilingual text-image writing activities with Teachable Machine, I was able to teach the students the skill of not only recognizing their own errors but also identifying how Google translate could help or not help them and how they can use the tool to their advantage more effectively. As we moved into the second unit, less time was spent on fixing students writing at the morphological and sentential level. I was able to spend more time teaching higher-level linguistic skills, such as attending to more advanced syntactical features, semantics and pragmatics of writing longer paragraphs, or essays.

Teacher Participant 2: Yes there is an overall level-up in student’s rate of learning compared to the traditional non-hybrid way. Take summative B for example, looking at the data in Term 1 the class average is at 4.4, then in Term 3 a large increase at 4.8 and lastly in Term 4 slight increase at 4.9. Also bear in mind the level of difficulty from terms 1-4 has increased significantly, making the last unit the most difficult. And even with that, the average of both classes combined still shows an increase. This is mainly due to the attribution of ML-Prediction activities. Possibly the predicting of the pictures and relating to the novel, then consciously or subconsciously translating their thoughts into a readable sentence creates a link between the two languages and allows for the student to gain faster access from both sides.

Collaborating teachers-subject group coordinator
During moderation, were you and other teachers, including the subject group coordinator able to reach an agreement in terms of assigning assessment scores?

Teacher Participant 1: Yes, most of the time, we agreed with giving similar scores. There were a few occasions when re-assessments needed to be done.

Teacher Participant 2: During moderations, the vast majority of the scores given are always usually fairly close (0.5~1.0). But on some rare occasions, when there is a difference of 1.5 or more, teachers would take turns explaining their reasoning(s) and then all come to a full agreement.
**Extent of resilience**
What were some setbacks of the technologies deployed?

Teacher #1: Sometimes, the tools lag in speed due to poor internet connection. It would be great to have offline capabilities just in case there is no internet. Otherwise, everything cannot proceed, as there is not much paper/pencil-based learning. Also, the bilingual text-image writing activities with Teachable Machine, initially, took a lot of time for students to understand the steps, as this part of the intervention required manual uploading of images. Later, these activities were broken down into separate mini lessons so students would not be so overwhelmed with the amount of technology they needed to learn. Also, the training of images sometimes produced strange machine scores, as in one high image recognition score for one language and one low image recognition score for another language. Therefore, this required retraining of the models to make the numbers make more sense.

Teacher#2: When using programs such as Goformatives and using the automatic correction function, it is troublesome when setting up an answer key that fits all possible answers. When using Teachable Machine, there were some inconsistencies when testing out the same sentences, but different pictures. Maybe a ‘kink’ in the program that needs to be updated. Sometimes the incompatibility of certain devices (eg.iPad) causes delays in the lesson, or worse case student unable to participate with their devices and miss hands-on learning opportunity. When lessons are conducted online, monitoring student’s progress is difficult. Often they are off task or multi-tasking and miss out on the lesson at hand. Or when there is a technical problem, it is difficult to talk through the problem due to language barriers. Also when taking a test online, there is always the question of authenticity. How much of it is truly the student’s work?

[Note – All teacher feedback were typed and provided in digital format. For easier reading, the researcher has reorganized the typed responses of both teachers into one feedback form.]
APPENDIX Q: STUDENT REFLECTION WRITTEN RESPONSES

Student Reflection Questions

Questions designed based on extending Tashior et al.’s (2011) transtheoretical framework for hybrid learning

Extent of potentiality in learning outcomes

What difficulties did you have with the formative and/or summative assessment task(s)?

Student 1 (female, 13): There are some words that don’t know the meaning and some of the words I don’t know the spelling of [referring to the formatives and summatives].

Student 2 (female, 13): There are some words I can’t understand.

Student 3 (female, 13): Sometimes I want to write and describe something, but I don’t have the vocabulary to describe it.

Student 4 (female, 13): I think the only question is I don’t know a lot of vocab for tests, so I need to keep asking the teacher.

Student 5 (male, 13): Some English I can’t understand and the reading, it is very difficult.

Student 6 (female, 13): Can not understand what the questions asking about on the test.

Student 7 (male, 13): In the test, I usually have some problem reading the questions.

Student 8 (male, 13): I have some problem reading long English sentences, and that will cause I can’t know what is the question means.

Student 9 (male, 13): I had difficulties with the reading test because sometimes I don’t know what the question means.

Student 10 (male, 13): In the formative or summative, sometimes the vocabulary that I don’t know will affect the reading test, such as the “Avocado tree”, that summative is very difficult. When I take the listening test, the teacher will tell us what video we will test, it can let me prepare more in the listening summative.

Student 11 (female, 13): I had difficulty with the test because sometimes in the test there will have some word I don’t know. Summative, because at the beginning we need to listen and write down the answer on the paper, so I think maybe my writing has improved a little.

Student 12 (male, 13): There is some vocab I can’t read [referring to exams].
Student 13 (female, 13): It [referring to exams] is not that hard, and you don’t need to spend too much time, but still need some preparation. We just need to spend some time and more concentrate on it, then we can get a good score.

Student 14 (female, 13): In the first semester, I don’t know anything very well on formative and summative. For every question I don’t know how to write the answer will be correct and perfect, I need to think a lot to write my answer down. But I think this teacher is not the same, when we have formative or summative [The teacher] will explain what the question is about and that I understand what the question is talking about, so that I know how to write that maybe will be correct.

Student 16 (male, 13): I have difficulties in reading tasks, because i’m not understand what the question means.

Student 17 (male, 13): I will have some words or how to read that I don’t know, need to waste any time to search or ask other people [referring to exams].

Student 18 (male, 13): Some sentences and vocabulary are difficult to understand, and I have to learn for a long time. Also, the test time is very short, and I don’t have enough time to finish it.

Student 19 (female, 13): Maybe I get terrible in tests because I don’t know what the words mean, and I can’t use the words to make a long sentence, when I see the test I am afraid about it. I think the test is so difficult for me, but maybe it is a good way to improve English.

Student 20 (male, 13): I think there are so many difficulties because I think there are so many exams that I can’t read or write. I have difficulty on the summative because the test has a lot of thinking problems so I don’t know how to get it.

Student 21 (male, 14): I have difficulty with criterion A because the sound is very not clear.

Student 22 (male, 14): Say the ture, I don’t have any quaction.

Student 23 (male, 14): Sometimes I can not very well understanding what the question [referring to questions on formatives and summatives] is asking.

Student 24 (female, 14): I had difficulty with reading because the computer tools can play how to read the word, so I can improve by it.

Student 25 (male, 14): I had difficulties with the essay test because sometimes I couldn’t catch the reading main idea so I didn’t know how to write.

Student 26 (male, 14): I had difficulties with the listening test because some of the words are too long or he/she speaks too fast so it is hard to understand.
Student 27 (female, 14): I had difficulty with summative C, D, because you need to think a lot of things by yourself/, When I use google translate sometimes it will not translate correctly.

Student 28 (female, 14): During the formative Summative one of the problems that I have is sometimes there is the word that I type wrong and also there is some grammar mistake.

Student 29 (male, 14): The difficulties during the formative that I have is that it’s a bit hard to concentrate, because there are some classmates talking while I’m doing the formative.

Student 30 (male, 14): I have difficulty with criterion a because I can’t hear the sound clearly.

Student 31 (male, 14): I had difficulty with summative assessment B. Because I can’t read.

Student 32 (female, 14): There are some difficult to understand words, so answering questions will be a bit difficult

Student 33 (male, 14): ”A”, because the people in the video’s sound is strange.

Student 34 (female, 14): I think the most difficult and I had difficulties with is summative A Because I think no CC is so difficult.

Student 35 (female, 14): There are some words I don’t know in the questions.

Student 36 (female, 14): I had difficulty with the writing test because I forgot what is in the story.

Student 38 (female, 14): There are some words I don’t understand [on the test].

Student 39 (female, 14): For me, the difficulties of all formative and summative have many words I can’t understand. I can use the translation after the test and remember it.

Student 40 (female, 14): I had difficulty with part B because the content is already in my mind but I just can’t translate it into English.

What activities are helping you learn in the following areas:

Listening:
Reading:
Speaking:
Writing:

What technologies are helping you learn?
What teaching strategies and/or technologies are helping you learn at your own pace and English ability level?

Student 1 (female, 13): Cutting the video into a little place and listening to the stories on screen then writing down the note is easier to understand the story. Listening to the story as reading the story is clearer. Using the [Baidu] translation can improve our speaking more because we want to beat the higher score. Writing the thought question (for the Achieve reading platform). Teachable Machine can help we describe the picture better. It can let us know the grammarly problem that is common. Helping us speak clearly [referring to Baidu].

Student 2 (female, 13): I think I can listen to the article machine talk. Read more book. Talk English in class. We can write essays because it can help us read more articles and improve on writing. This machine can put pictures and sentences in and see how the picture matches your picture. Now, pictures are easier than english and can help us understand faster. Grammarly tells me my grammar mistakes, and I can fix them. Vocabulary words can help me learn.

Student 3 (female, 13): The online reading apps, Achieve3000, and Baidu speaking activity have helped me learn. The Teachable Machine translation activity can let me learn about using pictures with words. Grammarly scoring can help me fix and teach my grammar. Baidu scoring that can fix my grammar, also when I speak something wrong, Baidu will help me fix it and teach us the correct one. I think grammarly and Baidu can fix my problem.

Student 4 (female, 13): Teachable Machine activity can help me to quickly translate chinese to english, and using photos to tell an english story. Grammarly scoring can help me to know what grammar I need to improve. I think Achieve 3000 can help me to learn a lot, and I can also know if I am improving or not.

Student 5 (male, 13): For listening, videos cut into pieces to let we understand the meaning. On screen reading and [Baidu] help me. Teachable Machine activity can let me learn more vocabulary and pictures connect to some sentences to let me understand more and some translators will have some pictures when we type some words in the translation. Grammarly scoring let me know my grammar mistakes. Baidu scoring, It helps me to promote my speaking. Reading the book [referring to digital books] and watching videos also help me learn.

Student 6 (female, 13): Teachable Machine, translators, and bilingual text writing help me know that my picture and the sentences are connect or not. Translators can help me fix grammar mistakes, but we can not always use the translators because it is dangerous. Grammarly scoring helps me know where need to improve. Baidu helps me know how to read the sentences. Grammarly and Baidu are helping me learn at my own pace and English ability level.
Student 7 (male, 13): More listening can help me more understand what someone saying in a conversation. Reading can help me to improve my writing skill and my amount of vocabulary. More speaking will help me to improve my speaking skill and grammar. Write can let me remember more vocabulary and know how to use it. Teachable Machine activity, translators bilingual text writing, Grammarly scoring, Baidu scoring help me learn. Using video can help me to understand what the teacher wants to tell us. The image will help me to understand what are the sentences talking about [referring to Teachable Machine].

Student 8 (male, 13):
Listening - let the video go into small pieces can help me easily to know what does the video means.
Reading - type the note of each chapter can let me know what is the main point of each chapter.
Speaking - use the Baidu app to test my speak is helps me very much because I can know what word I am speaking wrong.
Writing - writing class can make me more understand what is the grammar I use wrong in the paragraph. Teachable machine helps me know how good is my sentence, and how to fix it.

Student 9 (male, 13): Listening: formative
Reading: english book and achieve 3000 can help us read more articles.
Speaking: Baidu scoring can help us read sentences more nicely
Writing: Grammarly scoring can help us correct our grammar mistakes.
Teachable Machine/Translators/bilingual text: We use let to set up our translate
Use more computer to teach, I can learn myself sometimes.

Student 10 (male, 13): The teacher will choose an achieve 3000 article and explain it, and sometimes will explain some reading questions that help me to get a higher, even 100% score. We use Baidu to practise speaking, if I have some mistake that I don’t know, the teacher will explain clearly, such as give an example to let me know. After I finish my writing, the teacher will check and get some advice to help me write more currently and clearly.
I think teachable machine is a very helpful website, it helps me to fix the writing for more describing. It uses images and my words that I type to give a score. For Google translate, it has images for a word, it can help people learn English more faster; Also, Google translate has grammar fix for the sentence, it can help people to learn English, too. The grammarly has some examples to explain why my grammar is wrong, it will make my grammar faster. A little bit of a bad part is sometimes grammarly gives me a wrong answer. The Baidu scoring is good because it uses some pronunciation examples to show why my English pronunciation is wrong, it can practice more time to get a more than 90 score. The biggest weak point is this software is from China, I hope that Google or Microsoft can have pronunciation scoring. Teachable machine, Achieve 3000, grammarly both can help me with English.
Student 11 (female, 13): Achieve3000, it have many different stories and the storys help my reading get better. Baidu, I think baidu help me some about the reading. Industry waste helps me with writing because we need to use our words to write. Google translate can help me translate Chinese to the English. Grammarly can correct my vocab. Baidu can help me about the reading my writing. Teachable Machine activity text tells me that my words and the picture are related or not, so this helps me I, and also I can lend that the picture I find is related to the words.

Student 12 (male, 13): Listening: videos cut into pieces. I can’t understand what the video maker talks about, need to repeat the video to let me understand the video better. Reading: On-screen reading. Some of the vocab I can’t understand very well, I need translator to understand vocab better. 百度 My pronunciation of English is terrible, it tells me how to pronounce the word correctly. My grammar is bad need Grammarly to help correct me. The Teachable Machine activity doesn’t help me very much, because I can picture a sentence without machine. Translators: It helps me learn more vocabulary and understand the article better. Grammarly scoring: Improve my grammar, but sometimes I won’t understand all of the grammar I’m wrong, and sometimes I will make the same mistake. Baidu scoring: Improve my pronunciation, but takes a lot of time, also everyone’s has a different amount of word in an essay, someones is longer, I think the person has longer essay can just read some of their essays, this can save a lot of time. I think the translator helps me most because there’s not a lot of vocabulary in my brain.

Student 13 (female, 13): There will be some tests about listening. On the test, the teacher will play a video, and the narrator will talk when it reaches a point, it will stop and give us a question about what it says in front. If we don’t understand what the narrator says, we can use what we have just seen and describe the picture. The teacher changes the way to let us read. Like when we are reading the book hole, the teacher will let us open google meet, and the teacher will put her screen on our screen so we can see it. Then she will open the book on the screen. There will be a person reading the story, and the word will follow the person and move to that word. When the reader finishes reading one to two paragraphs, the teacher will stop it, and start writing the setting, character, and plot about those paragraphs. After we finish our own essay, the teacher will let us bring our phones to class, and we need to download Baidu translate. First, we copy and paste our essay to the translation and then listen to the machine talk, after that, we need to read and record our sound. Last, we type our score into the essay. The teacher will make it into many parts, and eerie class we will do some of it. The teacher will check each part and until the end, we will make all of them into an essay. Yes, Grammarly helps us to fix the grammar in our essay, Baidu helps us speaking. So each machine can make us better in different places. Translators, when I have some words that I don’t know, I can use it to let me know what the word means. I think the picture translators can let us write better by looking the picture and tell. But when I use
the picture translators I must find a picture that is very similar to my sentence, or my score will be low.

Student 14 (female, 13): We have the listening test, and I need to concentrate very well so I can write something down. And now I am listening to the people who said English I can quickly understand. (formative & summative). The reading at the class we do some of the reading we read on the book, frequently we read on the computer. I think reading on the computer is better because when I don’t understand the word I can use the dictionary to help me to know what the word means and explain it in English. We use the app to help us speak, and the app gives us the score. We have written 3 the story. At first, I wrote the essay I cannot think very well, I thought about Chinese and translated it on my own. At that time I even I don’t know I am writing about. The technologies that help me are computer and phone when having computer typing; in my opinion, I think typing can let me think very carefully when I need to change but I am not at the class. The teacher is not beside me, I can take out my computer. When it comes to paper writing I need to change something. I need to go to find that teacher and take the paper to change something. I think [the teacher] has very good teaching strategies to let me have very fast improved my English, she uses many technologies to help us improve our English. In class, [the teacher’s] teaching strategies are very happy and don’t have many pressures, she helps the students to improve very fast... Teachable Machine activity is very well to me because the thing let me learn about “use complete sentence to describe the image” and the machine will give me the score so I know my sentences are good or bad. So I think this technologies are very helping me learn.

Student 15 (female, 13): I think the hardest part in this Summative is a book, because I really don’t like to read books, so if I get a large book, I will don’t want to read and also can not understand what the book is saying about. The book changed to computer listening, it is fun to listen to because I just listen. I don’t need to see a large book. Reading the Achieve 3000 helps me I, because it has some questions to test you if you really understand the story, it is a better way to help me to improve my score. We speak the vocabulary to speak again let us heat my memory. Summative test can improve my writing. It is a little bit hard, but I can understand some things. Google translate because it helps me to translate the word I do not understand. Baidu can also let your Chinese and English both improve will. Grammarly scoring will let your mistakes be right and give you a score. Teaching machine is better that other, because I think I use that can help me to have more word in my sentence.

Student 16 (male, 13): I don’t have problems with using computer to read books. The computer helped me with the translate for the words that I don’t understand. In baidu translation, if I get a bad score, I will listen again to the correct one and mine. I do achieve3000 activity and thought questions and improve my English skills after 1 years I improve very fast. I prefer on screen reading than reading the book because on screen-reading makes me understand faster. I use baidu to translate and study my speaking and listening. I think handwriting is faster than typing. I can write faster, but the teacher can give me feedback faster by using typing.
Teachable Machine activity — The teacher’s teaching strategies helped me to better understand the meaning of the sentence or the word. Grammarly scoring: Grammarly scoring teaches me about the mistakes I made and gave. Baidu scoring: Baidu scoring gave me motivation to learn to read and learn to how to pronounce the word.

Student 17 (male, 13): For listening, the teacher speaks or google classroom vocab or the story. I have no problem because the teacher will repeat the question to help the student know what the question is asking. Reading: The story will tell me how the word read. I think the old way is better because the new way, you read from the screen I will don’t where is the word in the book. Speaking: The translator will help me speak right. I speak to the Baidu will that I speak faster, but the spelling still the quite same. Writing: The google classroom vocab will help writing. It becomes easier when the machine checks it, it is easier to type on the computer than writing on paper. Teachable Machine/Translators/bilingual text -the technologies help me to learn the word of English, the picture that I know what the story is talking about. Grammarly scoring — if the score improves that I know I am doing better. Baidu scoring — every time I read the word trouble is getting lesser. Teachable Machine, translators/bilingual text, Grammarly scoring, Baidu scoring can help me to learn how to read. For some topics I know about I can write faster, and the topic is new I will write slower.

Student 18 (male, 13): I use google translate to listen and search for vocabulary and sentences that I don’t know. This semester my teacher taught us how to write an essay about environmental pollution. When we finished the essay, she used a teachable machine to summarize my essay and pictures. It lets me understand more clearly what I wrote.

Student 19 (male, 13): We do summative in class and we have listening summative. Teacher finds the video on the internet, and we listen to the words in the video so that we can answer the question. We use Achieve 3000 to help reading, and we also have reading summative, we have to read the article and answer the questions or write a short essay about what you feel after you read this article. We use Baidu to practice speaking, we say the sentence we write. We write the ATL in google docs, teachers use common help to change the words or retype. It is a good idea to use Grammarly to learn, I think it is the way to help me learn. It shows the words or sentences wrong, and it could explain it, it could let you know why you are wrong. Baidu scoring is a new technology to translate to translate, it can let me know when I say what words are wrong, and will give me a score, but some I will think it is broken because sometimes I finish saying it, and it doesn’t record my voice, so I read it again it.
Student 20 (male, 13):
Listening - The soil pollution video
Reading - English novel
Speaking - The Baidu scoring
Writing - GoFormative practice
Teachable Machine/Translators/bilingual text. Grammarly scoring, Baidu scoring: The technologies can help me to learn more about the class work. This things help my english grammar and words.

Student 21 (male, 14):
Listening - Not help
Reading: That me read well
Speaking: Let me know the word how to read
Writing: It help me be better
Yes ,because it [the bilingual text-image activity] can show the picture to you easily to know the meaning.

Student 22 (male, 14):
It [the bilingual text-image activity] can give me more suggestions.
I think if I ask teacher by my self is the bast.

Student 23 (male, 14):
the reading lessons help me the most and the other one is listening.
Listening - I can listen more
Reading - let you can read the book
Speaking - help me can talk to people
Writing - can write more better
Yes, we can learn more about use machine to help

Student 24 (female, 14):
Listening - help us when talking to people
Reading - helps us to read better and when we don’t know what does it mean we can just search online and that is easy to learn more.Speaking: baidu help us not only speaking it also help us at reading and listening
Writing - it helps us with chicking if there are any wrongs
Yes, it [bilingual text-image activity with Teachable Machine] helped me with knowing where are the wrongs or what does the word means.
I think is Grammarly because my grammar is really poor so it helped me a lot with grammar.

Student 25 (male, 14):
Listening - TEDed videos can help me for listening.
Reading - Achieve can help me to read faster.
Speaking - Know how to pronounce the word.
Writing - Grammarly can help me to correct my essay.
Yes, those teachable can help me write essays.
I think using more computer tools can help me to learn new things.

Student 26 (male, 14):
Speaking and reading can help the most [referring to the tools used for these language domains].
Yes, a teachable machine and translators help me learn.
Teachable machines and translators both are helping me learn at my own pace and help my English ability level.

Student 27 (female, 14):
Listening: So I don’t need to think too many questions.
Reading: On-screen reading with Kindle is the same in class and on my computer.
Speaking: Can speak with Baidu so I can speak more clearly.
Writing: Know how to use Grammarly to do the writing.
Grammarly help me to learn, it will help my grammar and explain why my grammar is wrong, but it is also bad about is that sometimes it will give me a wrong answer.
And teachable machine help me learn, it use image to let me know more.
Achieve 3000 and Grammarly can help me with English at my own pace.

Student 28 (female, 14):
The technologies can help me change my wrong mistakes to be right.
Listening - Watch more videos to help improve our listening skills.
Reading - Give us more time to do Achieve [on-screen reading practice].
Speaking - Let us talk and debate something to improve our speaking skills.
Writing - Let us try to do the writing by ourselves.
Yes, it [bilingual text-image writing activity with Teachable Machine] can help me a lot in learning in english and also when I’m doing the essay and learning the vocabulary.
Translation and grammar can help us when we are doing the vocabulary and also doing the essay.

Student 29 (male, 14): Yes! These things helped me I. For example, Baidu helps me speak more fluently, not making my tongue tied, Grammarly lets me know more about the grammar mistakes etc. Listening increases my concentration of listening and…
Yes, because if the text… English and Chinese, everytime we see the book we will deepen our impression of the meaning of these words [referring to Teachable Machine].
I think grammarly and Baidu help me the most my own pace. To me it helps the most important things in English, Baidu helps me communicating, help me speak more clearly, to express the thing I want to say, at future, like persuading our products, you have to speak clearly to let the people can trust you. Through this they can tell your attitude, if you not speak clearly, they will think you are not trust to your product, automatically they will not trust you either. But if you speak clearly, they might think that you have so much confidence in the product, it should be good. Grammarly is helping me on the grammar part, it’s important is because…
Student 30 (male, 14):
Reading - It can help me reading without a book.
Speaking - It can help me practice my speaking skill and if there’s a mistake, I can fix it. Yes, if I don’t know some of the words in Chinese, I can use google translate. I can do more achieve 3000 questions by myself.

Student 31 (male, 14):
Listening - these things can help improve my watching videos to learn grammar.
Reading - Reading can help my reading ability.
Speaking - Baidu can help me translate.
Writing - teacher+GoogleDoc+ Grammarly can help correct my wrong grammar and sentences.
Yes, it [bilingual text-image writing activity with Teachable Machine] can help. It can tell me the words I don’t know.

Student 32 (female, 14):
Listening - I think this test can help me if I hear foreigners in the future so that I can understand it more easily because the way that video speak is the same as the normal people.
Reading - I think it helps me to improve my reading because my reading wasn’t really good at all.
Speaking - I think this is a useful test because it can help us to good at speaking.
Writing: I think this can also help me writing articles in the future without too much difficulty.
I think these [referring to bilingual text-image activities] are helpful to me, because sometimes when I read English articles, it would be great if there is a machine that can help me do translations.
I think a machine that can translate is what I need most at this time.

Student 33 (male, 14):
Listening - listen different people say English
Reading - help read
Speaking - help speak
Writing - help write
These website and app [Teachable Machine] does help from learn, but it’s already good, but it can be better I think the reading part (baidu translate) can help the level of reading.

Student 34 (female, 14):
Listening: audiobooks can learn in the shortest time
Reading: reading novel can help us read fast
Speaking: Baidu can help me want to do better
Writing: Grammarly can help me to check my grammar
I think Teachable Machine will help me learn because I think using that can help me to know some words I don’t know and some words I don’t know how to write in English.
I think we can read more and we can learn more words.
Student 35 (female, 14):
Listening - nothing, I think it only helps my listening, because I only find the word I didn’t listen to.
Reading - learn more words, because
Speaking - better pronunciation of using 百度
Writing - use more words because I can learn words just on pictures so I won’t forget.
[Teachable] Machine helps me about the writing and reading the Machine province a lot of my times, because I can just learn from the picture, and...
I can understand words I don’t know from pictures better than the only words describing.
I think the pictures help me to remember vocabularies and also understand those words faster.

Student 36 (female, 14):
Listening - I can understand more words
Reading - I can learn more words
Speaking - It can make me do better in my speaking.
Writing - They make me know more about grammarly.
Yes they [referring to bilingual text-image activity with Teachable Machine] does help me learn because they can make me understand more about the class.
Learning more vocabulary can help me.

Student 37 (male, 14):
My sentence grammar is wrong.
Teachable machine can help me connect the picture and sentence.
Have more listening classes, like video or audiobook.

Student 38 (female, 14):
Listening - nothing
Reading - earn more words
Speaking - better pronunciation, because using baidu can make me know how to pronounce words.
Writing - better grammar
Yes, translators help me. When I write an essay, sometimes I know how to write in Chinese so I will use the translators to help me.
I think focusing on finishing the novel helps me because when I want to find something in the book I can find it faster.

Student 39 (female, 14):
Listening - Teachers play the novel on Kindle.
Reading - The Number The Stars novel.
Speaking - Baidu can correct my pronunciation.
Writing - I like writing essays with the computer more than paper and pen because computers can correct my words and grammar.
Yes, those three things [Teachable Machine, translators, bilingual text writing] can help me when I’m confused about something.
Different levels learn different difficult English.
Student 40 (female, 14):
Listening - Improve my listening
Reading - Can learn more words
Speaking - Make me speak more fluently
Writing - use more words
These things make me progress
It [referring to bilingual text-image writing activity] allows me to better understand the meaning in the text.
Many things can help me to improve English such as “Achieve”.

Extent of connectivity

Student self-perception
How do you perceive your role as a student learning in a bilingual/L2 hybrid learning environment?
Student 2 (female, 13): Nontraditional because the computer can teach more faster it correct our grammar mistake and spelling mistake.
Student 3 (female, 13): I think sometimes I will be confused about it. I was confused about the teachable machine. But I will ask teacher or classmates to figure out and learn things from the machine.
Student 5 (male, 13): I need to work very hard.
Student 6 (female, 13): Nontraditional.
Student 7 (male, 13): Need to study harder.
Student 8 (male, 13): Try hard to learn the language I don’t unfamiliar.
Student 9 (male, 13): I think I just follow teacher’s rule.
Student 10 (male, 13): I think that I still have lots of places for learning English, because my mother language is Chinese, therefore, my Chinese is better than English.
Student 11 (female, 13): Before we won't use computers, but now we will use computers to learn many different things. And the computer tools help a lot like translate, to translate the words, Achieve 3000, help reading.
Student 12 (male, 13): I think I’m very lucky in an L2 hybrid learning environment, I
learn a lot in this class, I handling this class very seriously.

Student 14 (female, 13): I am in the international part and in almost every class I need to use English, that I do not feel very well because when I am at the elementary school we steal we have to say English but not so many. And now I need to say English for almost class, sometimes I said in a low voice I am very scared about other people will hear I said English. But now I feel it is ok to speak English very loud because there are people with me at the same level, so I think I can do better than giving me confidence. In our English class, the teacher has given us the robot to help us with speaking so we will have the score. My score sometimes is high and I know I improve my speaking.

Student 16 (male, 13): I see myself as a very good student for learning english. I think the teachers is more important than the computer itself because the teacher teaching me is better than the selflearning by using translators.

Student 19 (female, 13): I have a good English environment and teacher now, so I think my English will be very good before I graduate from this school.

Student 20 (male, 13): I perceive the role of the student to study hard.

Student 21 (male, 14): I like the technology teacher because we can learn more things on the internet.

Student 22 (male, 14): I think mix two [referring to traditional and non-traditional teaching] cound of way, is a good idea, it make me be easter to understand.

Student 23 (male, 14): I think 科技教學 [learning with technology] is better

Student 24 (female, 14): I think i prefer more with Traditional teaching because it is really hard to be undisturbed by the video or game etc.

Student 25 (male, 14): I think student learning in a bilingual is better.
Student 26 (male, 14): I feel that my role as a student is a bit lazy and not very active. Sometimes I will not hand in my homework, but if I am active, I will hand in my homework early or on time and finish the classwork early.

Student 30 (male, 14): I think learning in a bilingual environment can help you have more language skills.

Student 33 (male, 14): It should be said that each has its own advantages. Just like traditional learning has better stability, it is more convenient to learn science and technology, and it is much more convenient. Almost only one device can complete many aspects of learning, but it can be further improved. A variety of devices can be used

Student 34 (female, 14): I perceive my role as a student learning in a bilingual because we can learn both Chinese and English in a bilingual.

Student 36 (female, 14): I think it is very great, because that makes me not just listen to the teacher to learn. We use technology and we can have some online quizzes or games. It's very helpful.

Student 37 (male, 14): Learn everything I can.

Student 38 (female, 14): English is important in now so I think learning in a bilingual [environment] is help for future.

Student 39 (female, 14): In kcis, English class uses technology to study, but other classes still use traditional teaching, and i think in the future we will fully change to technology teaching, we need to adapt to this shift.

Student 40 (female, 14): Sometimes I get confused, and suddenly I don’t know what language to use.
Did you find yourself transferring the skills of translingualism in machine translation and/or machine learning in your other subject areas? If you answered yes, please describe.

Student 1 (female, 13): Trying hard and using Chinese to help me learn English. I think when I am translating the Chinese into English in my brain faster than before.

Student 2 (female, 13): Yes, now I don't use translations that offer [translators], i can think in my mind.

Student 3 (female, 13): Yes, I will know how to use machines properly. And related to Chinese can let me understand more, and make my English improve a lot, also the other subjects.

Student 4 (female, 13): I think the English can decrease a little, because sometimes I will forget the Chinese and I use English to translate it. Sometimes forgets the Chinese vocab so I translate it from English to Chinese.

Student 5 (male, 13): Yes. Because when I just started school, I can’t type a sentence very well but using the machine I think that I can type more and better sentences.

Student 6 (female, 13): Yes, I can transfer the language between Chinese and English faster, sometimes can thinking about English in my brain easily.

Student 7 (male, 13): Yes, because these things can help me learn more and know what is the class tell me

Student 8 (male, 13): Yes, because I can transfer this skill [translingualism with machine support] to other classes.

Student 9 (male, 13): Yes [referring to transferring the skills of translingualism to other subject areas], now I can know what other teachers are talking about. If they use Chinese I can change to English.

Student 10 (male, 13): Yes, in design and drama class, I use machine translation, such as
Google translate to help me finish my homework and my summative.

Student 12 (male, 13): Yes, in many classes, such as science class, when I doing the science project, some of the scientific words I don’t know will use the translator to help me.

Student 13 (female, 13): In this environment, I use Chinese and English to learn and speak. I wish I can learn more, in future, I want to go abroad. Yes, because of the things that we learn in class, I improve in every part of English, so when I am doing work on the other subject, I can write the word more difficult in it, also when I am speaking I won’t be stuck.

Student 14 (female, 13): Yes, in English class we learned how to write a good sentence, when I have another class I will try to use some words to make my sentence get better. So that I can get a higher score.

Student 15 (female, 13): In two bilingual learning I think it is good for us to learn another language. In another class I will also use Google translate to help me with my English. In google translate if you don’t understand some word, you can go translate and you also can find another language word.

Student 16 (male, 13): I sometimes can translate the words by using my brain if I remember the meaning of the word.

Student 17 (male, 13): Yes, we can put Chinese to google translate to help English. Some words I can translate to English, but the harder word I cannot transfer to English.

Student 18 (male, 13): Yes, we use Chinese language to help English in google translate. Then, use a teachable machine to train picture models to get a score. They help me learn how to write essays and formatives/summatives.
Student 19 (female, 13): When I use google translate or the other machine I can remember the words or the things I learned, so I use it in other subjects.

Student 20 (male, 13): I will try to use the translingualism in other classes. I will try the translingualism English to change Chinese to make better learning.

Student 21 (male, 14): When I use the transfer [Teachable] machine that can help me to improve my English.

Student 23 (male, 14): Yes, I can learn more [referring to translingualism]

Student 24 (female, 14): Yes, now when i don’t know something in English i can just translate it or just google search it and look at the picture of it and i can learn more stuff.

Student 25 (male, 14): I think transferring is good for learning english.

Student 26 (male, 14): Yes, in my other subjects, if I don’t know what those words mean, I will use translators.

Student 27 (female, 14): Yes, in Design class, I will use Google translate to help me finish my work.

Student 28 (female, 14): No I think I still need to be understand more about the skills of translingualism.

Student 34 (female, 14): I find myself transferring the skills of translingualism in machine translation and it can help me by learning words that I don’t know or check my spelling in the writing. Yes, my science uses some experiment computer.

Student 35 (female, 14): I think the translations are used for one word, not for a sentence so I like the new way, and it fixes my problem and rites away so I think it is faster than teachers in class, because there are too many students in class.
**Teacher-student interaction**

What were some initial difficulties encountered while learning the technologies?

Student 1 (female, 13): At the beginning our typing speed is not fast. Yes, I was able to get better.

Student 3 (female, 13): I can not use the apps properly. Teacher will help me when I need, like last time I had a problem with essay writing, and the teacher gives me options and gives me some professional websites that can help me out. The machines can fix me more quickly.

Student 6 (female, 13): My typing speed is too slow. Yes, I can overcome these difficulties easily via teacher facilitation.

Student 7 (male, 13): Can’t understand the word.

Student 8 (male, 13): Still don’t understand some paragraph mean. Yes [referring to overcoming his literacy skills].

Student 9 (male, 13): Don’t know what teachers say.

Student 10 (male, 13): The biggest problem is sometimes the machine translations are still incorrect, or the machine gives me suggestions that are unnecessary.

Student 11 (female, 13): Don’t understand what is the thacher talking about [referring to learning technologies].

Student 12 (male, 13): My typing speed is very slow at first. No, but my typing speed is getting faster now.

Student 13 (female, 13): At first, the hardest thing for me is always using English, this is new for me.

Student 14 (female, 13): When I first use the technologies everything for me is new. So that is little difficulties to lead me to and I learn from other people what did they solve the
difficult thing. I came to [the school] this is my first contact with technology. On the first day of school, I observe everyone in our class typing very fast, and ask one classmate “Why do you type very fast and she tells me typing can learn from google.” At that time I know I need to do it, I need to improve very fast so that I can catch up at their speed. If I have the time I go online and practice, at the class time [Teacher Participant 1] types very fast, she remembers all the keyboard places, so that I practice and practice, now I can easily remember the keyboard location.

Student 15 (female, 13): I think write a packet is hard too. Because it need to think what there do many things and how did they survive in that place. Now it also have some poem we learn, I like to read poem, because it is fun, you can find some rhyme and some fun word in the poem. It is fun to read.

Student 16 (male, 13): Some of the difficulties while learning English with the technologies is remembering the meaning of the words.

Student 17 (male, 13): Don’t know how to write.

Student 18 (male, 13): Don’t know how to use it at first [referring to technologies].

Student 20 (male, 13): I think I have trouble at the beginning of the baidu or the other helping tool because the first is hard so I don’t know how to do it.

Student 21 (male, 14): Some words I did not know how to read!

Student 23 (male, 14): When I was writing I will write some words wrong and I think I need to be more carrefour

Student 24 (female, 14): It is hard to understand the instructions because we are new to use the technologies thingy.

Student 25 (male, 14): Don’t know how to spell the word.
Student 26 (male, 14): The words are hard to understand and some words are hard to use in essays or sentences.

Student 27 (female, 14): While learning these technologies, I found it difficult with google translate, because google translate can not translate something right.

Student 28 (female, 14): Somehow the technologies sometimes will have some problems such as the internet and the bugs, also we can’t fix the problem so it’s a problem.

Student 29 (male, 14): Some initial difficulties encountered while learning the technologies is that I might not know how to use them.

Student 30 (male, 14): Sometimes google translate has some grammar mistakes, but not that often.

Student 32 (female, 14): I had difficulty with summative A because If you are a little distracted while watching the movie, you won’t know the answer, and the movie is fast and has no subtitles. It is quite difficult for me, and there will be a few words in the middle that I don’t understand in English, and I don’t know how to spell them.

Student 33 (male, 14): The device can’t use baidu (It would be better if that application/website can be completed on a computer)

Student 34 (female, 14): Sometimes when I do Baidu the machine doesn’t know what I am talking about and it will make me wrong. I think the teacher can’t help with this because the machine is china’s and some pronunciation is not the same as in Taiwan.

Student 35 (female, 14): A can’t find out the picture that really matches the first time, and I can’t understand how to use the machine.

Student 36 (female, 14): I’m not really sure about how to use the technologies.

Student 37 (male, 14): I don’t know how to use English write what I’m thinking.
Student 38 (female, 14): There are some words I don’t understand. When I write an Essay sometime I will have some words I don’t know how to explain.

Student 39 (female, 14): When I just coming to kcis, lots of things that needs to use laptop I don’t know how to use.

Student 40 (female, 14): I used to not understand the teacher in class, but there will be kind classmates to help me explain.

Were you able to overcome these difficulties easily via teacher facilitation?

Student 3 (female, 13): Teacher will help me when I need, like last time I had a problem with essay writing, and the teacher gives me options and gives me some professional websites that can help me out.

Student 5 (male, 13): English is not understood. My English is better and better with teacher help, too. My grammar is better and my vocabulary has more than before. Yes, Because when I have things I don't understand I will ask the teacher and sometimes go to google translate, these can let me have more impressions and will not make mistakes other times and I will work harder.

Student 7 (male, 13): Yes, the teacher patiently teaches us how to use it.

Student 9 (male, 13): Yes,because the teacher will explain again and use the easy word.

Student 10 (male, 13): Yes, the teacher will come and check what suggestions that I don’t need, just close it.

Student 11 (female, 13): Yes, because the teacher will tell me in detail or she will change a way to explain the meaning. Yes, because if I am wrong the teacher can tell me writaway

Student 13 (female, 13): Yes, if I have any questions, Then I can ask the teacher to help.

Student 14 (female, 14): Yes, the teacher has to help me with the school thing and more
explain it to me so I can understand more. The teacher will not just tell me the answer I need to do it myself so that I can learn something before I don’t know. If something happens the teacher will always teach us how to do it so that in the future you have the same thing happens you know how to do it.

Student 15 (female, 13): Yes, teacher will help me if I do not understand, if I have some question that can not be asked at class, teacher will let me go to her class to be clear to do some things and help me will. I think teacher is a great and nice teacher.

Student 16 (male, 13): Yes, I am able to over the difficulties with teacher’s help.

Student 18 (male, 13): Yes, [Teacher Participant 1] helps us to overcome [referring to technologies].

Student 21 (male, 14): Teacher can help me to know how to read.

Student 22 (male, 14): You, I can ask about the world I don’t know.

Student 23 (male, 14): Yes, the teacher will help me to correct the words and tell me how to write the sentence better.

Student 24 (female, 14): Yes, because the teachers really know what they are doing.

Student 25 (male, 14): Yes, the teacher will correct my work.

Student 26 (male, 14): Yes, the teacher can spell the words out for me and teach me what the words mean, and they can teach me by giving me examples.

Student 27 (female, 14): Maybe, if there is something I don’t know and google translate does not translate it correctly, then I can ask the teacher to help.

Student 28 (female, 14): Yes, mostly teachers will teach me and explain more details for me if I don’t know how to do it.

Student 29 (male, 14): Yes, because the teacher should know to use the thing they tell us
to do.

Student 32 (female, 14): Yes, because he [Teacher Participant 2] something will tell us words meaning, but just sometimes.

Student 35 (female, 14): No, because the teacher can tell us how to solve the problem, but they need to think at the first time so I can’t get the support at the first time.

Student 36 (female, 14): Yes, the teacher knows better than us about these things.

Student 37 (male, 14): Yes, the teacher will help me to make the sentence become more complete.

Student 38 (female, 14): I think maybe not because I usually use translate to solve the problem.

Student 39 (female, 14): Yes, by the teacher's teaching, I can use these things skillfully.

Were you able to learn better when the machine and the teacher can provide you immediate feedback? If so, describe how you were able to learn better?

Student 1 (female, 13): Yes, because when we make a mistake we can know it and fix it immediately.

Student 2 (female, 13): There are many words that I don't understand. Teachers always teach us vocabulary words. Sometimes machines will tell me my grammar and spelling mistakes to remember them and won’t that this mistake happen again.

Student 3 (female, 13): The machines can fix me more quickly.

Student 4 (female, 13): I don’t understand how to use the technologies. Yes, the teacher tells me many ways to use it because the more ways to learn better, the faster time to improve.

Student 6 (female, 13): Yes, because the machine will tell me where I have wrong for the
grammar and the spelling, I can remember and I won’t make the same mistake for the same place.

Student 7 (male, 13): Through the machine and the teacher’s advice, I have a better understanding of how to learn.

Student 8 (male, 13): YES, I can, because I can know the answer faster. when reading the book this way can make me more understand with machine and teacher helping.

Student 9 (male, 13): Yes, because they [referring to teacher and machine learning technologies] know what I need to improve it.

Student 10 (male, 13): Yes, the machine and the teacher will let me learn better because sometimes the machine will give me wrong things, the teacher will tell me why the machine is wrong, it helps me for my thinking skills.

Student 12 (male, 13): Yes, I have more time to correct my homework [with both machine and teacher support].

Student 13 (female, 13): Yes, but I wish the machine can change something if the machine can add the things that can make students better, I think it can help students more.

Student 14 (female, 13): I think teachers and machines will help me get better. Because when I use the machine there might be words I don't know so I can translate. When the time teacher or machine gives me something that I improve at, I will be thinking about where I can improve and try it again.

Student 15 (female, 13): I think the machine and teacher teach me is a better way to help me in my homework and class, in before I did do will in class, Because it can not use much machine help and it just teacher saying the important things, and also not use too
many computer teaching in class. But now teacher let us use computer teaching and machine learning, it let me understand more. But if I always rely the google translate my head will be not thinks so it have a good ways and the bad ways. But I like the computer learning more.

Student 16 (male, 13): Yes, it helped me to better understanding the word and the sentence.

Student 17 (male, 13): Yes, because don’t need to wait for the teacher to check.

Student 18 (male, 13): Yes, I can know right now and continue to do so [referring to machine and teacher support].

Student 20 (male, 13): Yes, I’m able to learn better with machine and teacher, I will move my score up if I improve my English with machine and teacher.

Student 21 (male, 14): Teacher, because machine is not better than people

Student 22 (male, 14): Yes ofcouse, I can get two different explantion.

Student 23 (male, 14): Yes, I will do the work more seriously [referring to both human and machine feedback]

Student 24 (female, 14): Maybe yes maybe no, because using technologies may make me distract but the traditional teaching will make sure we stay attentive.

Student 25 (male, 14): Grammarly can teach which word is better, so I think grammarly is a fantastic app.

Student 26 (male, 14): Yes, I can learn better when the machine and the teacher provide me feedback. I can listen to teacher’s feedback and machine’s feedback and I can mix teacher’s feedback and machine’s feedback together and learn better and better.

Student 27 (female, 14): I think when I am able to learn better when the machine and the
teacher, I can learn it better because if the teacher and the machine helps, I can know things that I don’t know.

Student 29 (male, 14): Yes, because every teacher is different, naturally the standards required will be different, and the teacher has to teach other things and there is no time to determine whether they are right one by one. So if everyone has a machine to help them learn, I think it will be more helpful in learning.

Student 30 (male, 14): Some machines help teachers to answer or correct student sentences. The machines really help the teacher a lot. Teachers can spend less time correcting or answering students' words, and do more meaningful things.

Student 32 (female, 14): Yes, because when I get my score and I see my friends are higher than me I will want to be better, and I will keep on trying, just to make sure that my score was not too low.

Student 33 (male, 14): I think the machine is useless because it is very inefficient.

Student 34 (female, 14): I think yes because the teacher will use some games to help us learn and it will make it fun. I think using a machine to learn is great because I think using some Grammarly can help us to check grammar.

Student 35 (female, 14): The computers are able to tell me rite away, because it just needs to be easier to use it the way that is used is too hard for me.

Student 36 (female, 14): They can fix my problem at the right time and the right way.

Student 37 (male, 14): Yes, the machine can let me connect the world to pictures.

Teachable Machine

Grammarly

Baidu
Student 38 (female, 14): Yes, because I can know the words and I can finish an essay.

Student 39 (female, 14): Yes, the teacher and machine can help me learn better, the teacher can answer my questions, and the machine can help me memorize more profound memories.

Student 40 (female, 14): I can ask the teacher at any time and I can use the machine to help myself.

**Extent of resilience**

What are some problems with the technologies used? Describe.

**Benefits and limitations with using digital tool used.**

**Limitations of tools**

Student 1 (female, 13): I think some of the translator’s final answers that have been translated are strange.

Student 8 (male, 13): the problems I got is the translator of machine some time is not correctly, so I can’t get what the problems mean

Student 10 (male, 13): The biggest problem is what I say on the top, sometimes the machine will give me wrong translations or wrong suggestions. Therefore, the machine cannot replace humans at now, we need to use technologies also humans to learn, however, maybe in the future, the technology will get better and better, the machine can replace humans for learning.

Student 11 (female, 14): Sometimes it’s not your words that are the machine.

Student 15 (female, 13): If I use a machine to learn I have some problems. Machine translation is hard and many people use that word ,so I need to think of an easy word to help me in my story in some paragraph.Because if u use translate world teacher will know that was not my word.
Student 18 (male, 13): Sometimes the machine translation is different from the original meaning.

Student 27 (female, 14): Problems are sometimes the Google translate will not give me the right things, and Grammarly too.

Student 38 (female, 14): If I use google translate, maybe the words are not suitable for the sentence.

Student 26 (male, 14): Baidu-problem is sometimes the machine doesn’t record it properly, the first time I use my earphone, it don’t record properly, and next I use my phone, but it doesn’t record properly too.

Student 34 (female, 14): Sometimes when I do Baidu the machine doesn’t know what I am talking about and it will make me wrong.

Student 32 (female, 14): I think the technologies have a part that wasn’t really good because There is no way to find a suitable photo to describe the current situation, so the score given by the system will be very low.

Student 33 (male, 14): High barriers to use, impractical. (Not all pictures can be found)

[Referring to Teachable Machine]

Student 36 (female, 14): Sometimes the technologies can’t know what I mean.

Student 17 (male, 13): Something machines can’t do only people can do.

Student 7 (male, 13): 會過度依賴機器 Over-reliance on machines

Student 13 (female, 13): The machine can help us to improve the English, but it also can’t let us be focus on our work, and after we started to use the machine to help our English, we will be too dependent on it.
Student 20 (male, 13): The baidu reading will lag or crash. I think the technology needs to be better, the grammarly scoring is bad because the tool if you want to get a better grade you need to buy the premium to continue, has a lot of problems.

**Difficulties in learning the different tools**

Student 3 (female, 13): It’s quick but sometimes I will be confused by the apps. Sometimes I will be confused by how to use it, but I will ask my teacher or classmates to figure it out and learn how to use it.

Student 24 (female, 14): It is hard to understand the process of how to use it.

Student 35 (female, 14): It takes too much time for me to learn. It takes a lot of time to understand how to use it.

Student 40 (female, 14): It’s a little troublesome if you don’t know how to use this machine.

**Positive and negative reactions**

Student 9 (male, 13): sometime have student will not very concentrate and they play games

Student 12 (male, 13): I can’t really concentrate sometimes.

Student 19 (female, 13): Many people use computers to watch youtube or play games.

Student 6 (female, 13): No, because some of the words that I don’t understand can go to research, and it can take notes faster than handwriting.

Student 14 (female, 13): At first, I am very not used to technologies because I think “we use the computer to learn?” I am very not understanding why we need computers to learn. And now I think using a computer is better. In the future we all use the computer to do everything, the test might be on the screen, and now we need to get with the computer.
Student 31 (male, 14): We use technologies, inside have software can help us

Broader issues of the tools used

Student 25 (male, 14): We can’t always use the computer any time.

Student 28 (female, 14): The internet and bug will influence when we using it.

Student 29 (male, 14): It just depends on whether your classmates can use it.

Student 39 (female, 14): I’m curious about how it works?

[Note – All student feedback were typed and provided in digital format. For easier reading, the researcher has reorganized the typed responses by all the student participants into one feedback form. Grammar errors are not corrected to reflect authenticity.]