In 1961, the U. S. Office of Education (USOE) contracted with the Center for Documentation and Communication Research (CDCR) of the School of Library Science of Western Reserve University to develop a pilot information service of educational research materials. That this contract represented a new direction in information retrieval is illustrated by D. J. Foskett's preface to his Classification and Indexing in the Social Sciences:

... Enormous resources are devoted to the advancement of science and technology, and the dissemination of scientific information, without which these advances lose most of their significance, has been studied systematically for several years. This is not the case, however, in the field of the social sciences themselves. ... Yet hardly any studies have appeared of information of dissemination and retrieval in social science. New techniques of classification and indexing are only just beginning to make an impression, although they have already become commonplace in science.1

The Center therefore welcomed the opportunity to apply its experience in documentation and information retrieval to the field of education, since it was felt that what could be learned about information retrieval in education might be applicable, at least in part, to the whole social science field. The USOE, at the same time, was faced with very practical problems in retrieving and disseminating educational research information and realized the potential contribution of an information service.

The product of the merger of the interest of the Center and the need of the USOE is reported in this paper.

Some explication of the specific nature of information problems in educational research will be useful as background for explaining the objectives of the project.

Gordon C. Barhydt is Manager, Educational Research Information Projects, Center for Documentation and Communication Research, School of Library Science, Western Reserve University, Cleveland, Ohio.
Information Problems in Educational Research

Educational researchers are hampered by inadequate bibliographic control and infrequent and uncertain dissemination of educational research literature. They are further hampered by the absence of comprehensive and exhaustive collections of educational research. Bibliographic control is practically non-existent. The most frequently used index in education has employed more than 20,000 subject headings since it first appeared in print, and the number is rapidly increasing. Few indexes and fewer abstracting publications cautiously and randomly select a small sample of completed research from hundreds of journals regularly publishing research, and from the doctoral outpourings of innumerable colleges and universities. Almost totally ignored by standard indexes are written reports of sponsored research of foundations, of many agencies of the government, of state and local boards, and the unsponsored research of scores of individual researchers. In the educational media field alone it was demonstrated that much research of interest was going unabstracted, unindexed, and probably unnoticed. Tauber and Lilley in their Feasibility Study Regarding the Establishment of an Educational Media Research Information Service stated that "... reports of research relating to new educational media are not represented satisfactorily in the existing bibliographic controls..." They further reported, that within those controls, considerable duplication of coverage existed.2

Small collections of research are scattered among libraries, research organizations, and individuals; few attempts have been made to gather them into a comprehensive and exhaustive whole.

A search conducted for the Center by the Science Information Exchange (SIE) early in 1963 produced abstracts of 686 current research projects in education. If one conservatively estimates each project as receiving $20,000 of support, the total is over $1,370,000, and the real total, because of the limited coverage of SIE at that time, is probably much higher. The value of this research is obviously wasted unless results can be adequately disseminated to other researchers, and ultimately translated into practice.

Based on the Center's knowledge of the information problem in education, certain specific objectives were formulated for the pilot phase of the project, 1961-62:

a. Analysis of subject content significantly deeper, more detailed and more flexible than that provided by existing systems.

b. Control, or cross-referencing, of terminology more flexible and more interdisciplinary in nature than that provided by existing systems.
c. A mechanism for exploiting the body of literature indexed in the manner described above which will permit the system to function on both a centralized and decentralized basis.3

The Center’s work since the initiation of the project has been directed toward the furthering of those objectives. The balance of this paper reports our progress and is divided into three sections:

I. The CDCR Education Project.
   A. Orientation.
   B. Specifics of the System.

II. Current Research.

III. Future Research.

Since our current work is centered on a retrieval system for media and media-related educational research, most of the examples given are from this area.

The CDCR Educational Research Project

Orientation

The educational research project at the Center has three unique advantages:

1. Because it is only one of many research activities at the Center, it benefits from a substantial research effort in many fields and from the extensive work in information retrieval theory.
2. Because of the Center’s contact with the research activities of other documentation centers in the U. S. and Europe, it is in close touch with many related efforts.
3. Because of the establishment of a pilot user group in October 1963, it benefits from the advice and experience of twenty key educational researchers.

Of the Center’s varied research activities, the comparative systems laboratory, established by a grant from the National Institute of Health in June 1963, has perhaps most significance to the education project. Here components of several information retrieval systems are being isolated and compared under experimental conditions. Included in these comparative tests are system components applicable to a system for educational research literature.4

Complexities of system development demand involvement with every facet of documentation research, and two research activities outside the Center are of particular importance. The first is the work of the Classification Research Group in England, in particular
the faceted classification for education developed by D. J. Foskett, librarian of the University of London’s Institute of Education.\(^5\)

We are fortunate that Foskett will be in the United States in the summer of 1964 and will act as consultant to the project at the Center during a portion of his stay. Of equal interest is the work of the Centre Nationale de la Recherche Scientifique in Paris, in the application of SYNTOL (Syntagmatic Organization Language) to social science literature.\(^6\)

Although advisory groups in information retrieval are not new, the Center’s pilot user group provides the advantage of critical evaluation of experts based on their specific knowledge and use of the system. A conference was held in Cleveland in October 1963 to familiarize this group with the system and to seek their advice on several important problems, among these, criteria for the inclusion of material in the file. During the next eighteen months, they will submit questions and provide evaluations of the relevance of the responses.

These three advantages have proved to be invaluable supplements to the research activities in the project and have contributed substantially to the development of the system described below.

Specifics of the System

These can be grouped into eight divisions or processing steps: (1) acquisitions and selection, (2) analysis, (3) terminological control, (4) recording of results of analysis on a searchable medium, (5) storage of records or source documents, (6) question analysis and development of search strategy, (7) conducting of search, and (8) delivery of results of search.

Acquisitions and selection,—The base point for acquiring media and media-related research was William Allen’s bibliography for his summary of audio-visual communication in the Encyclopedia of Educational Research.\(^7\) A “citation index” search was conducted restricting selection where the material did not appear to be within the loosely defined limits specified by Title VII of the NDEA. Preliminary criteria for inclusion were then developed. Since this area is one of direct concern to educators and possibly one of only peripheral concern to librarians, a complete discussion may be found in the final report for Title VII Project B-170a.\(^8\) Basically the criteria are as follows. “Research,” as we have defined it, means controlled experiment, the reporting of which is accompanied by quantified data. Included are research reviews if they make a contribution to the analysis or synthesis of a particular area. The file of “research” includes studies of and related to the utilization of the newer educational media (those made possible by technological advances, e.g., educational television (ETV), motion pictures, teaching machines, etc.) within intentional, human learning situations employing meaningful materials.
At this point in the development of criteria for inclusion we are in the role of judge; a judge, as defined by H. L. Mencken, is "A law student who marks his own examination-papers." We do have what can be considered preliminary criteria: a base for extension or reduction of the contents of the file.

Analysis and terminological control.—The Western Reserve University semantic-coded telegraphic abstract approach has been applied to the research studies in the file. In view of our present and past work in other fields and our current work in other techniques, the Center feels that this approach is a reasonable one. It offers the capability of providing specific, generic, and other relationships necessary in dealing with educational research literature. We are prepared to modify the system if it seems advisable, and to incorporate, where appropriate, the results of our own research and the research of others.

The first step in analysis is to prepare a telegraphic abstract (TA) (see Fig. 1). The TA is designed to provide a detailed machine-readable index to a research study. An abstracter selects those words from a document which have a high indexing value. Although the abstracter is free to select any indexable term from the document, freedom of selection is limited by well-defined rules governing the inclusion of certain types of information for a particular kind of study. These terms appear in the right hand column of the TA form.

The abstracter then establishes several kinds of relationships among these terms by the use of role indicators. Role indicators indicate logical relationships between terms,

<table>
<thead>
<tr>
<th>Role Indicator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>KEJ</td>
<td>population</td>
</tr>
<tr>
<td>KAM</td>
<td>process</td>
</tr>
<tr>
<td>KQJ</td>
<td>agent of process (by means of)</td>
</tr>
<tr>
<td>KWJ</td>
<td>device or material prepared</td>
</tr>
</tbody>
</table>

or facets of the study,

<table>
<thead>
<tr>
<th>Role Indicator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>KEC</td>
<td>subject matter taught</td>
</tr>
<tr>
<td>KAP</td>
<td>dependent variable(s)</td>
</tr>
<tr>
<td>KAL</td>
<td>independent variable(s)</td>
</tr>
</tbody>
</table>

or provide descriptive information.

<table>
<thead>
<tr>
<th>Role Indicator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>KAB</td>
<td>type of material or study</td>
</tr>
<tr>
<td>KIT</td>
<td>date of study</td>
</tr>
</tbody>
</table>

Punctuation or level indicators are also incorporated into the TA. These symbols (.,.), (,), (,) are signals of the closeness of association between the elements of a TA: role indicators, words, etc., preventing cross-talk between separate portions of the TA during the searching operation. The level indicators underlined, separate
<table>
<thead>
<tr>
<th>Col. 6-8</th>
<th>Role Indicator (Col. 28-80)</th>
<th>Col. 6-8</th>
<th>Description (Col. 9-27)</th>
</tr>
</thead>
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<tr>
<td>1</td>
<td>..KAB,</td>
<td>2</td>
<td>Research</td>
</tr>
<tr>
<td>3</td>
<td>.KIT,</td>
<td>4</td>
<td>1962</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>..KEJ,</td>
<td>8</td>
<td>Experimental Group</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>..KEJ,</td>
<td>12</td>
<td>Control Group</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>..KAM,</td>
<td>16</td>
<td>Matching</td>
</tr>
<tr>
<td>17</td>
<td>.KQJ,</td>
<td>18</td>
<td>Mathematics</td>
</tr>
<tr>
<td>19</td>
<td></td>
<td>20</td>
<td>Aptitude</td>
</tr>
<tr>
<td>21</td>
<td></td>
<td>22</td>
<td></td>
</tr>
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<td>..KEC,</td>
<td>24</td>
<td>Electronics</td>
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<tr>
<td>25</td>
<td>.KQJ,</td>
<td>26</td>
<td>Filmed</td>
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<td>28</td>
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<tr>
<td>29</td>
<td></td>
<td>30</td>
<td>Instruction</td>
</tr>
<tr>
<td>31</td>
<td>.KQJ,</td>
<td>32</td>
<td>Lecture</td>
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<td>34</td>
<td>Demonstration</td>
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<tr>
<td>35</td>
<td>.KQJ,</td>
<td>36</td>
<td>Textbook</td>
</tr>
<tr>
<td>37</td>
<td></td>
<td>38</td>
<td></td>
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<td>39</td>
<td>..KAM,</td>
<td>40</td>
<td>Testing</td>
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<td>41</td>
<td>.KQJ,</td>
<td>42</td>
<td>Psych Corp EPSAT</td>
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<td>43</td>
<td>.KQJ,</td>
<td>44</td>
<td>Achievement</td>
</tr>
<tr>
<td>45</td>
<td></td>
<td>46</td>
<td>Test</td>
</tr>
<tr>
<td>47</td>
<td>.KQJ,</td>
<td>48</td>
<td>Mathematics</td>
</tr>
<tr>
<td>49</td>
<td></td>
<td>50</td>
<td>Test</td>
</tr>
</tbody>
</table>

Abstracter

Fig. 1
.KAP, (dependent variable)  Experimental Group
  Reading
  Listening

.KAL, (independent variable)  Language Laboratory
  I.Q.

from

.KAP,

Control Group
  Reading
  Listening
  Lecture
  Demonstration
  I.Q.

.KAL,

Where in this example the independent variables (.KAL,) are associated with their appropriate groups . .KAP, experimental group or . .KAP, control group) and can be so specified in the search program. (A complete list of role indicators and punctuation levels is given in Appendix A.)

The next step is the encoding of the TA by the application of the semantic code to each word listed. If the word has previously appeared in a TA and been coded, this may be accomplished by mechanical means. If not, the process is as follows.

The semantic code is comprised of semantic factors—three letter combinations representing concepts; alphabetical infixes, which show the relationship of the factor to the word being coded; numerical infixes, which delimit a concept; and numerical suffixes, which establish the uniqueness of each code. For example, the code for the Minnesota Multiphasic Personality Inventory (MMPI) is

DACM MUSR MYMT 1017 3102.

Breaking this down we have the semantic factors

D—CM = printed document
M—SR = measurement
M—MT = emotion

and adding the alphabetical infixes appropriate for each factor, we have

A = categorical infix
U = productive infix
Y = attributive infix

The code tells us that the MMPI

is a document = DACM
is used for measurement = MUSR and that
the concept emotion is an important characteristic of the word(s) coded - MYMT.

Since there are many aspects of the concept emotion, a numerical infix has been assigned to the factor M-MT to designate, in this instance, the concept of personality.

MYMT 1017 - Personality

Thus far we have DACM MUSR MYMT 1017. Since other closely related tests may be coded in the same way, e.g., The Rorschach Ink-blot Test (RIT), a numerical suffix is added to the end of each complete code to establish the code as unique.

\[
\text{MMPI} = \text{DACM MUSR MYMT 1017 3102} \\
\text{RIT} = \text{DACM MUSR MYMT 1017 3304}
\]

A search, therefore, can be made on any generic to specific level retrieving all tests of this type (by programming for DACM, MUSR, MYMT 1017) or by specifying the unique code for a specific test. Utilizing the semantic code and combining it with the relationships established by the TA, a very powerful searching tool can be constructed.

Concurrent with the preparation of the TA, the abstracter prepares a conventional abstract of the original document (see Fig. 2).

Figure 2

Conventional Abstract


The Keesler Mathematics Test and the Psychological Corporation Electronic and Physical Sciences Aptitude Test are used to match three groups of Air Force trainees during six weeks of a course on the principles of electronic communication. The experimental group consists of a randomly selected set of 14 students with scores in the middle 60 per cent of the distribution. The control group is a matched set of 14 students who are aware of their participation in a research project, but who are taught by lecture-demonstration. The blind control group, another matched set of 14 airmen, is also taught by
lecture-demonstration, but is wholly unaware that its performance is under experimental consideration. The experimental group receives all of its instruction from 35 mm film projected with the AutoTutor Mark I. The film is organized along the principles of intrinsic programming. Three progress tests are administered at two week intervals and scores are analyzed by F ratio, analysis of variance and t-test. No significant differences are found between control and blind control groups. While examination scores for control groups are somewhat higher than scores for the experimental groups, the differences are not great. A replication of the original study produces results which are not significantly different.

Recording of results of analysis on a searchable medium.—Each role indicator along with its punctuation, and each word on the TA are punched on separate Hollerith cards. The words are matched with a card reproduction of the code dictionary and where a word has previously been encoded the proper code is gang-punched from the dictionary card into the word card. Codes are assigned by an individual to new words entering the system, and these new words and their codes are added to the code dictionary. All cards for role indicators and coded words are then sorted in the order in which they appear in the TA. Processing in blocks of 100 abstracts, the detailed index (TA) is transferred from the cards to storage on magnetic tape.

Storage of records or source documents.—The original document is shelved by accession number. It is hoped that hard-to-get documents will be available on demand, although the cost is somewhat prohibitive. Conventional abstracts are filed according to accession number and await the results of a search.

Question analysis and development of search strategy.—Allan Rees, assistant director of the Center, in a paper for the American Documentation Institute conference in October 1963, makes some illuminating observations on the real problems of question analysis. He points out that there is frequently a distinction between:

1. What the questioner needs...
2. What he thinks he needs...
3. What he wants...
4. What he is prepared to read...
5. How much of what he gets he is prepared to read...
6. How much time he is willing to devote to it all...
7. In what sequence he would like to read what he gets...
8. What value he will attach to what he gets...  

The best method for determining the answers to the questions raised above is as yet unknown; no research has been done relating to the nature of the question-asking process, although increasing attention is being devoted by Rees and others at the Center to precise
identification of the areas of investigation. It is obvious though, in
the light of our experience, that question analysis must be approached
with a great deal of care.\textsuperscript{11}

The education project at the Center asks each questioner to:
(1) state his question on three levels—specific, more generic, most
generic; (2) define the terms in the question, (3) list those terms he
associates with the question terms, and (4) describe the purpose of
his research.

In instances where this outline is followed rigorously and com-
pletely, the Center's question analysts have a good beginning. The
real problem is whether the questioner can define his research need
so precisely. To further the more complete analysis of a question,
television contact with the questioner is very desirable, and frequently
used.

Once the analyst has what appears to be a complete statement
of the question, the question is analyzed for searchable concepts;
these are translated into the indexing language of the system and are
organized so that they correspond to the logic of the question. Identif-
ication of searchable concepts involves the isolation of question con-
cepts which correspond to the indexing concepts used by the system,
and the addition of generic, specific, and associated concepts derived
from the analyst's knowledge of the file or from conversations with
specialists. One of the computer listings of the semantic code diction-
ary is arranged alphabetically by code so that the thesaural relations-
ships established by the code are apparent.

The concepts thus identified are translated into the semantic
code, and further structured by the application of appropriate role
and level indicators.

In formulating the logical structure of the question program, the
following connectives can be used.

\begin{align*}
A \cdot B & = A \text{ and } B \\
A + B & = A \text{ or } B \\
A - B & = A \text{ but not } B
\end{align*}

Any question therefore can be expressed as an algebraic polynomial
of logical sums, products, and differences of semantic codes.

Let me briefly illustrate the search structuring by providing an
example. The question submitted by a researcher is "Give me ab-
stracts of all studies dealing with the use of educational media in
teaching biology at the below college level." The concepts identified
as "searchable" are media, biology, educational institution, and
college.

\begin{align*}
\text{Let } A & = \text{ media} \\
B & = \text{ biology} \\
C & = \text{ educational institution} \\
C^1 & = \text{ college}
\end{align*}
Using the logical connectives we have,

\[ A \land B \land (C \land C^1) \]

Applying the appropriate role indicators,

\begin{align*}
\text{KQJ} &= \text{agent of process (by means of)} \\
\text{KEC} &= \text{subject taught} \\
\text{KIS} &= \text{location of population}
\end{align*}

the program becomes

\[ \text{KQJ} \land \text{KEC} \land \text{KIS} \land (C \land C^1) \]

Since KQJ.A must be associated with KEC.B and not with any other word of the telegraphic abstract, the level indicators must be added. Additional level indicators are then included to designate for the computer the precise grouping of all the terms to be searched.

1. 4 level - a role indicator and the word to which it applies
2. 5 level - a group of terms closely associated within the study
3. 6 level - all words relating to the same study

Our complete program is:

\[
6 \left[ 5 \left[ 4 \left( \text{KQJ.A} \right) \right] \left( \text{KEC.B} \right) \right] \left( \text{KIS.(C-C^1)} \right) ^{4/6}
\]

Conducting of search.—The question program is keypunched and the question transferred to computer memory. The computer, a GE-225, compares the analytics of each document on tape with the analytics of the question and where they match prints out the document accession number.

Delivery of results of search.—Conventional abstracts corresponding to the accession numbers identified by the computer are pulled manually from the file and mailed to the questioner.

The above is intended as an elementary summary of the structure of the system. For a detailed explanation and analysis I refer you to the various Center reports listed in the references.

Current Research

A study recently completed for Cooperative Research has indicated several fruitful areas for research.\(^{12}\) The purpose of the first part of the study was to compare the relative effectiveness, in terms of relevancy and recall, of three different approaches to searching the file. The second part attempted to determine what differences,
if any, existed in the assignment of relevance by different evaluators of the same question. For Part I, twenty-four questions, selected from the more than 400 submitted during the initial year of the project, were used as the sample. The questions were programmed using three searching strategies: (1) narrow semantic code programs, using the maximum discriminatory features of the system, (2) broad semantic code programs, derived from the narrow programs by eliminating role indicators, by omitting conjuncts, by adding disjuncts, etc., and (3) faceted classification programs. Number 3 requires some explanation. Along with the semantic-coded telegraphic abstract approach, a machine searchable faceted classification, developed at the Center and based on the Tauber-Lilley faceted classification for media literature, was applied to all of the documents used for this investigation. It was felt that comparative testing would benefit from the application of a classification scheme different in concept from the semantic-coded, telegraphic abstract approach.

Responses to the questions were evaluated as relevant or peripheral by CDCR staff members and as relevant, peripheral, or nonrelevant by the questioner.

Although any conclusions about the comparative effect of the three searching strategies would be unwise because of the inadequate size of the sample, the first part of the study made several important recommendations.

1. The structure and application of the semantic code should be examined in more detail, to determine the desirability of modification.
2. Greater terminological control should be exercised in the telegraphic abstract and more attention should be devoted to the consistency of its preparation.
3. Intensive investigation should be made of the nature of question formulation and analysis.
4. An attempt should be made to establish more precisely the appropriate level of information content of conventional abstracts.
5. The faceted classification should be further developed to provide a suitable tool for researchers wishing to organize their own collections.

In Part II of the study, answers to fourteen questions were evaluated as relevant or peripheral by CDCR staff members and as relevant, peripheral, or nonrelevant by the questioner. Four of the fourteen questions were given two outside evaluations (by two questioners who posed the same question). The results of these evaluations indicated a wide variation in the assignment of relevance for a particular question between CDCR evaluators and the questioner, and a wide variation between two questioners who posed the same question.
Included in Part II was a preliminary investigation to determine whether relevant answers are characterized by some objective properties of relevance and whether those properties can be isolated. One very interesting aspect of this portion of the study was the application of probability theory to the problems of relevance. I refer you to the final report, since only a complete reporting of the method and the results would be of value.

Current research activities are based on the experience of the Center during the last three years and on the recommendations made by the effectiveness study outlined above. Key to the conduct of current research is the pilot user group. They will analyze and evaluate the system in four areas: (1) coverage (within the user’s own subject area or field of interest), (2) usefulness (in relation to the user’s own research needs), (3) relevance (of abstracts received in response to questions), and (4) recall (missed known answers).

On the basis of the questions submitted by the user group, the Center will analyze the system objectively in four areas: (1) further development of the techniques of question analysis, (2) revision and testing of telegraphic abstracting techniques, (3) comparison of relevance assessment by different evaluators (questioner, staff member, and expert), and (4) development of operational administrative procedures. As contact with the field of education has increased, most importantly through representatives of the USOE and the present user group, so has the necessity for expanded investigation. Plans are now being made for the expansion and extension of current research activities.

**Future Research**

From our current research we have selected three areas which we feel could contribute most, at this time, to the refinement and development of the system: coding, development of inclusion criteria, and conventional abstract preparation. Our experience in question programming and searching has revealed that some of the present codes are either incorrect (through human or machine error) or do not establish the desired thesaural relationships among terms. These codes must be corrected or revised. In addition, we wish to determine whether the development of additional semantic factors, elimination of some of the existing factors, or changes in conceptual meaning of existing factors, would have any appreciable effect on relevance and recall. Any code revision or modification will be tested under operational conditions.

Development of criteria for the inclusion of material in the file has been approached pragmatically by establishing a pilot user group,
by analyzing the needs of this group as expressed by their pilot questions, by scanning thousands of research studies, and by analyzing the citation patterns in well-known studies. As I indicated earlier, our current work is focused on the establishment of a comprehensive media and media-related research file. Although criteria must eventually be established for the total field of educational research, much will be gained by concentrating at this time on the media field. The Center is enlisting the help of an experienced media researcher to examine the problems of inclusion from a theoretical point of view, hopefully providing a rationale for the inclusion of media and media-related research. The practical experience of the Center will then be merged with the rationale to provide inclusion criteria for an operational file.

The preparation of conventional abstracts poses some as yet unexplored questions.

1. What level of information content of conventional abstracts is most appropriate to the needs of educational researchers?
2. What kinds of data should be included in abstracts and at what degree of specificity?
3. What is the effect of various levels of information content on the users' assessment of relevance?

A tentative experimental design has been worked out for an investigation of the above. The results of this experiment will contribute to the establishment of precise rules governing the amount and type of information to be included in a conventional abstract.

Conclusions

The fact that we have made and are continuing to make progress in no way implies that the system is ready for operation. Sufficient evidence of our realization that many tasks remain is given in the outline of current and future research. We are, however, confident that the system can be developed to an operational level.

Our experience tells us that we must proceed slowly, so that any operational service will have the full benefit of a concerted research effort. Research is extremely difficult when one is faced with the many day-to-day problems of operating a large information system.

The interest and criticism of educational researchers have been invaluable. Currently the most interested and most critical of these are the twenty members of the pilot user group. Without their help as users, critics, and advisors, our work in the education project would be much more difficult.
We have also benefited from the advice and counsel of representatives of the USOE. Without the support (both moral and financial) of the U. S. Office of Education, the project would have been impossible.

REFERENCES


Additional References


APPENDIX A: ROLE INDICATORS AND LEVEL INDICATORS

Role Indicators

<table>
<thead>
<tr>
<th>Role Indicator</th>
<th>Functional Meaning</th>
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<tr>
<td>KAB</td>
<td>Type of study</td>
</tr>
<tr>
<td>KIT</td>
<td>Date of study</td>
</tr>
<tr>
<td>KIS</td>
<td>Geographical or environmental location</td>
</tr>
<tr>
<td>KEJ</td>
<td>Population acted upon or studied</td>
</tr>
<tr>
<td>KAM</td>
<td>Process carried out on, by, or in relation to KEJ</td>
</tr>
<tr>
<td>KEC</td>
<td>Subject taught</td>
</tr>
<tr>
<td>KQJ</td>
<td>Agent of process (of KAM or KEC)</td>
</tr>
<tr>
<td>KWV</td>
<td>Attribute given</td>
</tr>
<tr>
<td>KAH</td>
<td>Condition of process</td>
</tr>
<tr>
<td>KUP</td>
<td>Attribute or behavior determined</td>
</tr>
<tr>
<td>KAP</td>
<td>Dependent variable; attribute or behavior influenced</td>
</tr>
<tr>
<td>KAL</td>
<td>Independent variable; influencing factor</td>
</tr>
<tr>
<td>KEW</td>
<td>Person interviewed or answering questionnaire</td>
</tr>
<tr>
<td>KWC</td>
<td>That toward which an attitude is noted</td>
</tr>
<tr>
<td>KWJ</td>
<td>Device or material prepared</td>
</tr>
</tbody>
</table>

This list comprises all the role indicators used in the TA. Their sequence and use in a TA are dependent on the characteristics of the individual document.

Level Indicators

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space ( )</td>
<td>To separate two or more role indicators on a single line of the TA.</td>
</tr>
<tr>
<td>(,)</td>
<td>To separate a role indicator from the word or words to which it applies.</td>
</tr>
</tbody>
</table>
I have been asked to react to the usefulness to the field of educational research of the project which Barhydt describes. His purpose is laudable, and the general idea is clearly stated. A tremendous amount of careful work is evident. Barhydt shows proper restraint and modesty in describing the project. He states that the system is not operational, but he expresses confidence that it can be developed to this stage.

In such an early stage of research and development, one can only speculate on the usefulness of this system. I am sure Barhydt would agree that now we can apply primarily the tests of logic and common sense to the probable usefulness. As I read the paper I feel a recurring desire to talk with some of the members of the pilot user group. One of them and not I perhaps should be making this reaction. I am sure that as the project develops the experience of the user group will be evaluated constantly for feedback into the system.

While Barhydt's paper quite properly concentrates on the technical aspects of the information retrieval (IR) system, the ultimate test will be its usefulness. It must meet certain needs of the user so well that its expense and operation are justified.

My bias is strongly hopeful that a useful system can be developed. Comprehensive services of bibliographic control and abstracting would be invaluable in the field of educational research to both

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producers and consumers. But these are only steps to aid in the identification of materials. What ultimate goal is contemplated? Barhydt alludes to the problem of "uncertain dissemination" of educational research literature and to absence of comprehensive collections. Does he envisage a system of reproduction of materials in the original form? Can the system, however, comprehensive, be made available to the thousands of centers for use, such as college and university libraries, public school libraries, public libraries, and others?

It seems to me, therefore, that the ultimate test of the system is its value to the user not only to identify materials but to make careful discriminations. I am concerned about two groups of users, the researcher or producer and the general consumer. The former is also a consumer but a special one. These two groups have different needs. Indeed within each one there is a wide range of needs.

Is the approach to the development of the IR system grounded in theory of learning and human behavior? Or is it dominated by criteria which satisfy theories of mathematics and electronics primarily and only secondarily those of learning and behavior? For example, how much knowledge of the system does the researcher, and the general consumer, need in order to use it effectively? To what extent are his intellectual processes structured in the use of the system?

I am particularly concerned about the researcher and the demands of the system on him to state or to define his research need in the earliest stage when he is attempting to create or to formulate an idea into researchable form. At this time he is engaged in the act of structuring something out of nebulous thought. How much does the system demand of him in this situation? In this connection, the role of the analyst needs to be elaborated. It seems that this person may have a key role in assisting the questioner and perhaps in making judgment about selections.

If my inference is correct, is it not true then that this system may lead to further development or modification of the role of the librarian? I get the impression that this project is of necessity centered at the moment on the warehousing and transportation function of librarianship. But the performance of the system must facilitate the higher functions of interpretation, consultation, advisement, guidance, and specialized forms of teaching. If this is true, my earlier assumption that the development of this system must proceed over bridges of research on use is correct. I am wondering, therefore, to what extent research with the use is made an indigenous part of the process of development of the system? For example, the statement is made "Development of criteria for the inclusion of material in the file has been approached pragmatically by establishing a pilot use group, ..." What does the term "pragmatically" mean? Does it mean that the approach is limited to a priori knowledge of the group of users? Or is research being done on the experience of users with
the system? If so, then, I should like to know what is being built into the system and what results are being obtained from the experience of users.

I am sure that Barhydt and his colleagues face many puzzling problems in this venture. For example, in the preparation of abstracts, it is not clear whether he is selecting a narrow field and concentrating on it, sampling from a broad range of materials, or taking everything available to him. The three questions in the paper suggest that he is assuming a big responsibility of deciding what is “appropriate,” “how specific,” and “relevant.”

I cannot see how the problem of choice or selection can be avoided, given the volume and range of material. Much of the literature on research, for example, as in other fields, reflects the advancement of people as well as of knowledge. What may be new to the neophyte may not be new to a field of knowledge. Each may have ample justification for publication but differential demands for use. Thus it seems that the IR system should make it possible to improve the rationality of choice which now exists in the selection of materials.