Information Trust
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An Integrated Approach to Instruction in Debugging Computer Programs

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Research Question

Can instruction in debugging help students improve their program debugging skills?

Background

- Debugging (trouble-shooting) is a time-consuming aspect of software development
- Testing reveals only presence of defects; debugging requires diagnosis
- Few computer science curricula include explicit instruction in debugging methods
- Code Inspection (Fagan): teams analyze code for defects before compilation
- Debugging tools: memory dumps, debuggers, program analyzers, etc.

ECE 291: Computer Engineering II

- 3 semester hours of credit
- Assembly language, real-time computing, device drivers, graphics
- Required for juniors in computer engineering, elective for majors in electrical engineering

Method

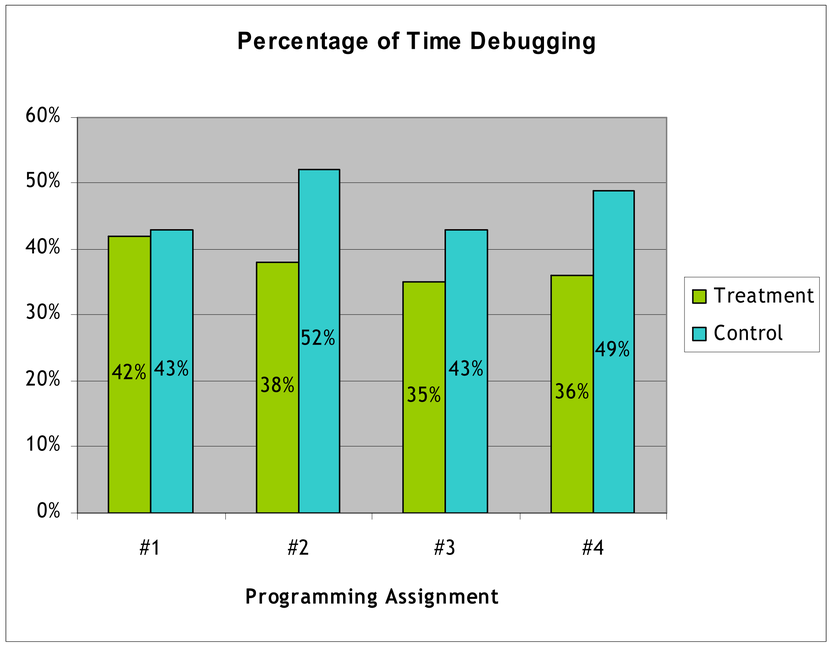
- Integrated several debugging activities into Spring 2003 offering of ECE 291
- Optional debugging exercises before programming assignments #2, #3, #4
- Of 116 students in the course, 27 participated in the debugging exercises, 89 did not
- No significant difference in aptitude between groups: average first exam scores were
  - 70.7% for Treatment group (*N* = 27)
  - 72.0% for Control group (*N* = 89)

Sample Debugging Exercise

```
; Factorial ()
; Factorial calculates the factorial of an input
; integer given in the AX register and returns the
; result in the AX register. Assumes input is
; nonnegative.
Factorial
    PUSHA           ; Save all registers on stack
    MOV  CX,AX      ; Initialize loop counter
    MOV  AX,0       ; Initialize result
    CMP  CX,0       ; Check for zero case
    JE   .Done
.Factorialloop:
    MUL  CX         ; AX = AX * CX
    LOOP Factorial  ; Decrement CX, jump if CX > 0
.Done:
    POPA            ; Restore all registers from stack
    RET
```

Defects:
- Should initialize result to 1, not 0
- Should loop back to `.Factorialloop` label
- `POPA` overwrites result in `AX`

Results



Differences in percentage of time debugging for assignments #2, #3, #4 are statistically significant at the $p < .002$ level

Conclusion

Students who are taught debugging skills will debug their programs more effectively

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