The Effect of Explicit Instruction and Self-regulation on Problem-solving Performance of At-risk Pre-university Students

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1. Introduction

In general, explicit instruction has a series of instructional supports that elevates learners' knowledge base to a next level. However, this model of learning would not help at-risk students to achieve their full potential. Once scaffolding is lifted, at-risk students fall back to initial mode of learning, which is true when they learn a new topic in mathematics. In this case, self-regulation plays an important role to let learners aware about importance of self-direction and how self-regulation could help them achieve mastery in a mathematical content and beyond.

The aim of the study is to employ explicit instruction together with self-regulation activities on at-risk pre-university students in problem solving given that this kind of intervention has produced successful results among primary and secondary students in single-subject experiments (e.g., Case, Harris, & Graham, 1992).

Students at risk in mathematics reached a plateau after 7th grade in their mathematics ability and made an average of 1 year's growth during grades 7 through 12. (Warner, Alley, Schumaker, Deshler, & Clark, 1980)

5 to 8% of school-age children exhibit some forms of deficits in arithmetical competencies. (Geary, 2003)

The top ranked mathematics difficulties among students at risk in mathematics in grades 8 through 12 are:
(a) has difficulty with word problems;
(b) has difficulty with multi-step problems;
(c) has difficulty with the language in mathematics;
(d) fails to verify answers and settles for first answer;
(e) unable to perform simple calculations;
(f) takes a long time to complete calculations.
(Bryant, Bryant, & Hammill, 2000)

2. Methods

a. Experimental design

- A multiple-probe-across subjects design was used with phases of baseline and instruction, and generalization and maintenance.

b. Dependent variables

- Two dependent variables in mathematics, which are word problems in: (1) arithmetic sequence; (2) geometric sequences. Probes consist of word/story problems.

c. Instructions

- The intervention strategy is adapted from Case, Harris, and Graham (1992). The intervention phase included:

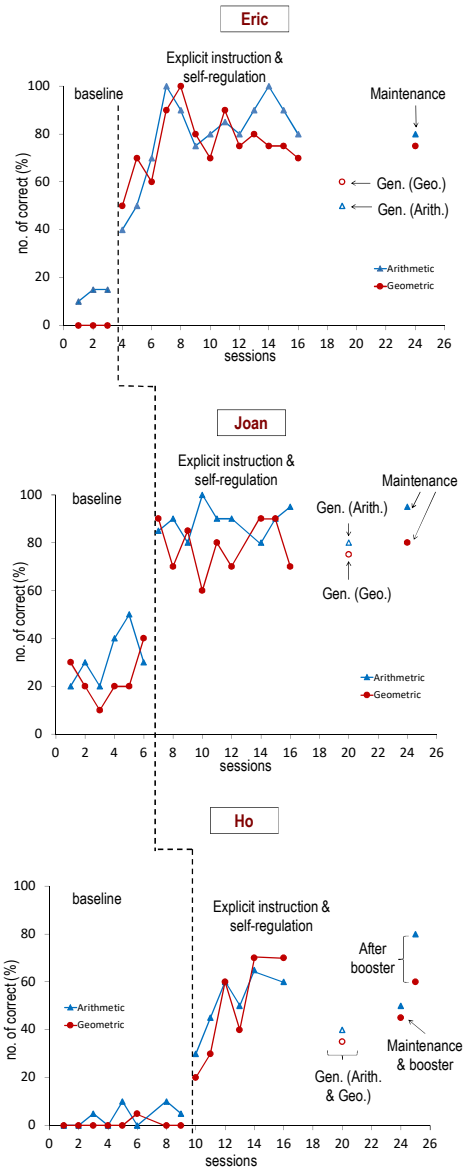
i. Activation of prerequisite knowledge mainly algebra.
ii. Discussion on their performance and strategy use.
iii. Discussion of the five-step strategy of problem solving and three-component self-regulation procedures. The five-step strategy: (1) read the problem loudly; (2) look for key words and circle them; (3) use of diagrams to unlock the problem; (4) write down the mathematics sentence; (5) write down the answer. The self-regulated activities are self-instruction, self-recording, and self-evaluation.
iv. Modeling of the strategy and self-instructions through think aloud.
v. Mastery of the strategy.
vi. Guided practice of the strategy and self-instructions.
vii. Independent practice/performance.

d. Procedures and data collection

- The process is shown as follows.

1. All three subjects enter the baseline, and probes are administered to all.
2. When stability of performance of a subject is observed, the instructions are introduced to the subject.
3. Instructions are continued until mastery of the strategy is achieved.
4. Probes are continued in the instruction phase.
5. Once the stability of performance was achieved, another subject enters the instruction phrase.
6. Performance is measured during generalization and maintenance (2 weeks later).

3. Results



4. Discussion

Eric. Performance in both types of word problems is low at baseline phase. Upon the application of instructions and self-regulation, some improvement in both performances are observed. Both move to the top and decline towards the end. Generalization of the strategy to financial mathematics is evident to a certain degree. Maintain performances 2 weeks after the last probe.

Joan. Initial performances are rather poor. Arithmetic performance is declined while geometric performance is improved prior to the intervention. Significant and immediate improvement can be seen both performances. She is able to generalize the strategy to financial mathematics and to maintain performances 2 weeks after the last probe. Arithmetic performance is better than geometric performance during maintenance.

Ho. Both performances are very low during baseline. After the intervention, performances are improved but at unsatisfactory level. Performances climb to a slightly-above-average level at the end. Generalization of the strategy seems to be poor. Both performances at maintenance drop below the level of last few probes. Hence, the strategy is reintroduced. Improvement is observed, particularly arithmetic score.

5. Conclusion

Improvement in problem-solving performance is clearly evident after the introduction of explicit instruction and self-regulation activities. One participant is able to generalize the strategy to a new context. Maintenance is observed 2 weeks after the end of the instruction phase. Although unsatisfactory improvement is observed in one of the participants, overall effectiveness of the intervention on both performances is satisfactory.

6. References

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