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Translating Productive Failure in the Singapore A-level Statistics Curriculum

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KEY IMPLICATIONS

- Constructivist learning designs, such as Productive Failure (PF), could be viably incorporated in the Junior Colleges (JCs) mathematics classrooms.
- Teachers' consolidation quality seemed to be linked to students' conceptual understanding.
- Effective professional development (PD), in-site and collegial support, and professional learning communities are important in changing practice.

BACKGROUND

The PF learning design (Kapur, 2012; Kapur & Bielaczyc, 2012) was translated across key concepts in the Singapore Advanced-level (A-level) statistics curriculum. This was to support the learning experiences advocated in the revised A-level mathematics curriculum, which emphasises the use of constructivist pedagogies to effect deep learning of concepts and develop relevant 21st century competencies.

FOCUS OF STUDY

The main objectives of the three-year project were to: (1) develop, implement, and refine curricular units that targeted six key statistical topics using PF principles; (2) build teachers' capacity in implementing PF; and (3) impact student learning.

KEY FINDINGS

Results revealed that highly rated consolidation lessons were significantly related to better performance on conceptual understanding items on the post assessments, showing the important roles that teachers play in ensuring the deep learning of concepts. For teachers who conducted more than one PF unit, lessons that were conducted in the second year of implementation were significantly better rated than those in their first. This could be due to better revised PD materials, and in-site collegial and research team's support, providing insights into the support factors that affect teachers' enactment of new learning designs. At least 8 JCs indicated their interest to continue to use PF beyond the project, and 12 JC mathematics teachers also formed a Networked Learning Committee (NLC) to design PF units for topics of their interest. This attests to the possible sustainability of alternative learning methods in the JC mathematics classes.

SIGNIFICANCE OF FINDINGS

Implications for practice

Given a possible link between consolidation quality and deep understanding in the results, mathematics instruction should emphasize the building upon students' ideas when leveraging constructivist learning designs in developing deeper learning of concepts.

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Learning gains, and implications for policy, research

Teachers play important roles in implementing and sustaining constructivist learning designs in practice, and the study shows possible PD interventions that policy makers can consider in addressing policy practice gaps.

Proposed Follow-up Activities

Future research could look into the sustainability of such constructivist designs in practice, such that teachers could design such units themselves.

PARTICIPANTS

Six PF units were developed, implemented to 1191 students and 61 mathematics teachers from 14 JCs, and were successfully incorporated to the statistics lessons of different instructional formats. The PD reached out to 144 JC mathematics teachers.

RESEARCH DESIGN

For each PF unit, students were first engaged to solve a complex problem that targeted a concept not taught formally, and were then taught the targeted concept via the consolidation of their ideas by the teacher. To build teachers' capacity in enacting PF, PD workshops, one that introduced PF to teachers and another for teachers championing PF in their schools, were designed. Measures of students' learning, ratings of teachers' consolidation lessons, and surveys of schools' perception of PF were collected.

REFERENCES

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