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Students' proof schemes for mathematical proving and disproving of propositions.

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Summary: Classification of students' proof schemes offers insights into students' mathematical proving. However, previous studies revealed little about finer progressions in students' proving and barely examined their proof schemes involving counterexamples. This study examined students' proof schemes through their considerations of examples and counterexamples and reasoning in Proof Constructions. From 480 proofs constructed by 60 Singapore secondary three (14–15 years old) students, classifications of schemes for Deductive-proof Construction and Proof-by-counterexample Construction were established as a progression through four phases. The former consisted of seven levels, spanning from irrelevant inferences to deductive proofs using formal representations. The latter consisted of six levels, spanning from irrelevant inferences to construction of a general set of counterexamples. The refined classifications revealed students' progression through their sophisticated use of examples, counterexamples, and deductive inferences and that Proof Construction was knowledge-driven. Comparisons to previous classifications and the role of counterexamples in Proof Construction were discussed.

Classification: E53

Keywords: proof; proof schemes; mathematical reasoning; counterexamples; examples; mathematical proving
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