RESEARCH TITLE

Jigsaw co-operative learning strategy integrated with GeoGebra: a tool for content knowledge development of intermediate Calculus for first year undergraduate learners of two public universities in Ethiopia

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ABSTRACT

Intermediate calculus bridges secondary school and advanced university mathematics courses. Most mathematics education research literatures indicated that the conceptual knowledge in intermediate calculus has challenged first year undergraduate mathematics and science learners to a great extent through the lecture method. The content knowledge attained by them has been tremendously decreasing. Negative attitude exhibited by students toward calculus was highly influenced by the lecture method used. Generally, students have not looked at the learning of all mathematics courses offered in universities as normal as other courses. Due to this lack of background conceptual knowledge in learners, they have been highly frustrated by the learning of advanced mathematics courses. Taking the understanding of teaching and learning challenge of conceptual knowledge of calculus into consideration, Ethiopian public universities have been encouraging instructors to devise and implement active learning methods through any professional development training opportunity. The training was aimed to enhance learners' content knowledge and attitude towards calculus. This is one of the main reasons for the motivation of this study that experimental group learners were allowed to be nurtured by the lecture method in their mainstream class, and then also the active learning intervention method integrated with GeoGebra in the mathematics laboratory class. Only conventional lecture method was used to teach the comparison group in both the mainstream and mathematics laboratory class. The purpose of the study was to explore the Gambari and Yusuf (2016) stimulus of the jigsaw co-operative learning method combined with GeoGebra (JCLGS) on statistics and chemistry learners' content knowledge improvement and change of their attitude towards calculus. The post-positivism mixed methods tactic was used in a non-equivalent pre- and post-test comparison group quasi-experimental design. The population of the study was the whole freshman mathematics and science degree program learners of two public universities in Ethiopia in 2017. Samples of the size 150 in both the experimental and comparison groups were drawn utilizing two-stage random sampling technique. A questionnaire using a Likert-scale on attitudes and an achievement test were sources used for data collection. Data analysis employed descriptive statistics conducting an independent samples t-test and a Two Way ANOVA for repeated measures using SPSS23. Each of the findings on content

knowledge, conceptual knowledge, and procedural knowledge development produced through the TWO-Way ANOVA, respectively as F(1,148)=80.917; η2=.353; p<.01, F(1,148)=106.913; η2=.419; p<.01, and F(1,148)=7.328; η2=.047; p<.01, revealed a statistically significant difference between the treatment and comparison groups from pre-test to post-test. These findings show that the experimental group participants were highly beneficial in developing their content knowledge and conceptual knowledge through the active learning approach and technology-based learning strategy using Vygotsky's socio-cultural learning theory. The JCLGS learning environment representing Vygotsky's socio-cultural learning theory modestly influenced the procedural knowledge learning of the experimental group learners'. Although the lecture method affected the comparison group students' knowledge development in calculus during the academic semester, the impact was not comparable to that of the active learning approach and technology-based learning strategy. The major reason for this was the attention and care given to the active learning intervention integrated with GeoGebra by the researcher, data collectors, and research participants. Overall findings showed that the active learning intervention allowed the experimental group students to considerably enhance their conceptual knowledge and content knowledge in calculus. Learners also positively changed their opinion towards calculus and GeoGebra. The intervention was a group interactive environment that allowed students' to be reflective, share prior experience and knowledge, and independent learners. As a matter of fact, educators are advised to model such a combination of active learning approach and technology-based learning strategy in their classroom instructional setting and practices. Consequently, their learners will adequately benefit to understand the subject matter and positively change their opinion towards university mathematics.

Keywords: active learning strategy; attitude, computer-assisted learning, conceptual knowledge, content knowledge, first-year undergraduate university learners, GeoGebra, intermediate calculus achievement, jigsaw co-operative method, knowledge development, procedural knowledge

The full thesis can be found at http://hdl.handle.net/10500/26355