The Impact of Using the IBL Approach and the 5E Framework in Mathematics Classrooms on Students' Motivation and Engagement

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Many academic fields such as engineering and economics, rely on mathematics as a fundamental discipline (D'Ambrosio, 1995; Diego-Mantecon et al., 2021). One essential goal for mathematics educators should therefore be graduating students who can address real life challenges. This requires an education system that emphasizes practical problem-solving skills. In traditional educational systems memorization is prioritized over real-world applications. As a result, students perceive mathematics as a challenging subject with no practical applications (Diego-Mantecon et al., 2021; Gravemeijer et al., 2017), causing a decline in students' motivation and engagement to learn mathematics (Grootenboer, 2013). For this reason, more and more academics are adopting a mathematics curriculum that emphasizes the relevance of the subject to society. While engagement is active participation, motivation is the willingness to engage in an activity (Fredricks et al., 2004; Singh et al., 2002). In mathematics, engagement is fostered by challenging problems and group learning, whereas motivation is the result of factors such as curiosity, perceived relevance, or outside incentives (Skinner et al., 2008).

In this study, the Inquiry-Based Learning (IBL) approach and the 5E framework were employed to teach a mathematics lesson on logarithms. The subjects of the study were grade 12 students (equivalent to the college Freshman year) in a school situated in a remote area of Lebanon. In this intervention, we aimed at investigating the impact of IBL on students' motivation and engagement. The research was guided by two questions: (1) *How does the IBL approach impact students' motivation to learn mathematics?* (2) *How does the IBL approach impact students' engagement in learning mathematics?* A variety of tools were used to examine the research questions. Those included two questionnaires and an interview. The freely available surveys were the *Mathematics Motivation questionnaire* (Fiorella et al., 2021), and the *Mathematics Learner Engagement Scale* (Rimm-Kaufman, 2010). Interviews were conducted with 6 students after the intervention. Interviews were semi-structured and included 10 questions divided into five domains: Background information, perception of Mathematics in real life, application of mathematical skills, individual needs, suggestions, and feedback. A semi-structured interview was also conducted with the class teacher, and it was employed to elicit information on the educator's perspective and experience with the application of the IBL approach.

The class teacher and the researcher collaborated to design the intervention on the topic of logarithms. To increase students' intrinsic motivation and actively engage them in the classroom, the design incorporated an activity on earthquake intensity, a timely and relevant topic since Lebanon had experienced prior to the intervention a series of rather intense earthquakes. The study findings showed that the implementation of the earthquake activity heightened students' intrinsic motivation. Results also showed that using student-centered pedagogical techniques and building a cooperative learning environment significantly impacted student engagement. Results of the teacher's interview highlighted the shortcomings of traditional teaching approaches and the importance of creative pedagogical approaches such as IBL alongside the 5E framework to pique students' interest in learning.

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