Experiential Learning as a Catalyst for Student Engagement in Mathematics Classrooms

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***Abstract*—The concept of "Student Engagement" is based on the belief that learning improves when students are inquisitive, interested, inspired and the same learning tends to suffer when students are bored, dispassionate, disaffected or otherwise "disengaged". This study examined the effectiveness of the Experiential Learning Approach on three types of Engagement in mathematics among middle-stage students. The researcher conducted quantitative research on 80 students (40 experimental and 40 control) of middle stage students in a private school. While the experimental group was taught using Experiential Learning strategies, the control group received instruction through traditional methods. Both the groups were then given a student engagement scale which had 57 questionnaires based on Likert's scale which covered cognitive, behavioural and affective. The descriptive analysis revealed that students in the experimental group demonstrated higher engagement across all dimensions compared to the control group. Inferential analysis using independent samples t-tests showed statistically significant differences ($p < 0.001$) between the experimental and control groups across cognitive, affective and behavioural engagement, with large effect sizes ($\Omega^2 = 0.16–0.53$), confirming the strong impact of the Experiential Learning Approach on student engagement in mathematics.**

***Index Terms*—Experiential Learning, Kolb Cycle, Engagement, Mathematics, middle stage students**

I. INTRODUCTION

Student Engagement is a term used to describe an individual's interest and enthusiasm for school, which impacts their academic performance and behaviour (Gallup, 2013). It is a combination of many positive behaviours, such as attendance, paying attention and participation in class, as well as the psychological experience of identification with school and feeling that one is cared for, respected, and part of the school environment" (Anderson, Christenson, Sinclair, & Lehr, 2004, p.97). Engagement is a phenomenon that includes both academic and non-academic elements in the school along with social aspects. (Krause and Coates 2008).

William (2003) considers it two-dimensional including behavioural and psychological engagement. Fredricks et al. (2004) mentions that it is three dimensional which includes behavioural, emotional, and cognitive engagement and (Christenson et al., 2008) consider it as four-dimensional labelled as behavioural, cognitive, social, and academic engagement. (Reeve, 2012) labelled as behavioural, emotional, cognitive, and agentic engagement. (Wang et al., 2016), labelled as cognitive, emotional, behavioural, and social engagement. Cognitive engagement is conceptualized as the psychological investment students make towards learning that ranges from memorization to the use of self-regulatory strategies to facilitate deep understanding (Fredricks et al., 2004) in the learning and instruction. Deep cognitive engagement is directly related to better achievement (Greene, 2015). (Craik & Lockhart, 1972) specified that if students move shallow cognitive processing to meaningful cognitive processing it will lead to better cognitive engagement, Cognitive engagement involves internal motivation for learning strategies (Bingham & Okagaki, 2012; Fredricks et al., 2004), making efforts to learn within the framework of activities offered and participation in classes and activities (Skinner & Pitzer, 2012). We propose that emotional engagement is very important for learning and that it has received very little attention, although many studies have pointed out the importance of emotions in learning. Taylor and Statler (2014) argue that neuroscience has shown that students who are emotionally engaged learn more effectively. To date most studies have tended more toward description than explanation, and there is a clear need for more analytical studies involving emotional engagement (Simpson & Marshall, 2010). Cognitive engagement in class is therefore more closely related to the time and energy devoted to cognitive processes, but only in the classroom. Learning and personal development should occur both in and out of the classroom (Kuh, Douglas, Lund, & Ramin-Gyurnek, 1994, Bear et al., 2018). In addition, students with high engagement levels attend school routinely and attain higher grades than their colleagues with low engagement levels. Designing curriculum that causes students to engage the subject outside of the classroom has therefore become more prevalent in recent years. Therefore, the fourth and final student engagement factor measures students' perceptions of their level of cognitive engagement out of the classroom by altering the wording of the cognitive engagement in class questions so students report their level of engagement out of class. It has been demonstrated that engagement is, directly and indirectly, related to intelligence, interest, motivation, and pleasure with learning outcomes within many academic fields (Yin, 2018). Likewise, engagement is a construct that is shaped from the multifaceted relations of perceptions, feelings, and motivation which is corresponding to the progress of self-determination theory in the motivation realm (Mercer and Dörnyei, 2020). Various engagement theories have expanded perspectives and emphasized the need for strategic initiatives in the education system to ensure that every learner remains actively involved in their schooling. Christenson, Wylie & Reschly, (2012) emphasize that a learner, if engaged in mathematical tasks and activities, can also show a better achievement by impacting students' emotional, cognitive, and behavioural development. In mathematical learning, Engagement is an important construct that connects theoretical and practical problems in cognitive engagement. (Lehtinen, Hannula-Sormunen, McMullen, & Gruber, 2017). In the same manner, affective and behavioural engagement focus on students' involvement in mathematical tasks and activities are also crucial. (Fredricks, Blumenfeld, and Paris 2004). Hence encouraging students to use their abilities and explore the learning opportunities that enable them to be actively engaged. (Broido, 2014; Xie and Derakhshan, 2021). Active engagement will provide them with opportunities to deploy skills in real contexts (Huang & Jiang, 2020; Kalyuga et al., 2010). To help them develop skills, application of Experiential Learning has brought immense benefits. (Carroll, 2007; Morris & Bilich-Eric, 2016). Experiential Learning provides real-world experiences in which students interact and to evaluate the course material and become involved with a topic being taught. (Boggu and Sundarsingh, 2019). Bradberry and De Maio, 2019 mentioned about the Socratic method of learning that is research based and allows the students to apply their classroom knowledge to real life situations to foster active learning which leads to better engagement. Being a part of daily activities, going to classes, completing schoolwork and paying attention to the educator, are all indicators of classroom engagement (Woods et al., 2019). In Experiential Learning, students are built up by the renovation of changes as they learn by action (Afida et al., 2012). Students take ownership of their learning which regulates a stronger connection between the learning involvement, practices and reality (Salas et al., 2009). The National Policy on Education (NPE, 1986) stated that "Mathematics should be visualized as the vehicle to train a child to think, reason, analyze and to articulate logically". When students engage in hands-on activities, collaborative problem-solving and real-life applications, they begin to see mathematics not as a set of rigid procedures but as a meaningful and relatable discipline. To cater to this approach of learning Mathematics, the researcher used the Experiential Learning Approach given by David Kolb as an intervention module to examine the effectiveness of Mathematics on middle stage students on Student Engagement. Kolb Experiential Learning cycle has four stages for effective learning. Concrete experience (CE), reflective observation (RO), abstract conceptualization (AC) and active experimentation (AE).

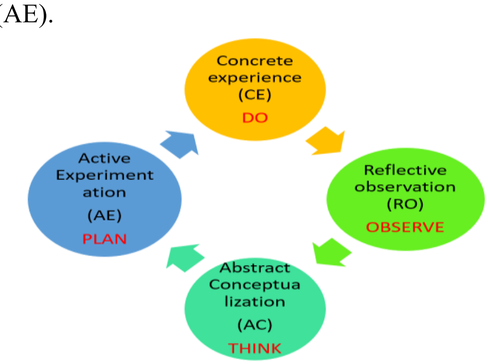

Fig1.1 Kolb Experiential Learning Cycle (1984)

a) Concrete experience (CE) - A new experience or situation is presented to students that can take place in the present or by reliving a recent event but feelings and interpersonal relationships are important. (Chesimet, Githua, & Ng'eno, 2016., Akella2010)
b) Reflective observation (RO) – Learners make sense of the experience and focus on understanding the ideas and concepts by careful observation. Since collaboration at the initial stage gives them a different perspective to the learning experience.
c) Abstract Conceptualization (AC) – Students dive deep, use logic and a systematic approach to solve problems. Collaboration takes place initially; students share their reactions and observations about the experiences thus leading to provide answers to the question arising from the experiences Chesimet, Githua, and Ng'eno (2016)
d) Active Experimentation (AE) - This involves testing the fittingness of abstract conceptualizations formulated against new concrete experiences. Emphasis on practical applications and testing theories that lead into new experiences.
In Experiential learning, students are involved, active, engaged and responsible for their own learning which brings in holistic development. This aligns with Gandhi's definition of education, which emphasizes that education should be an all-round drawing out of the best in a child and man—body, mind and spirit.

II. OBJECTIVE OF THE STUDY

1. To compare the behavioural engagement scores of experimental and control groups of middle stage students.
2. To compare the cognitive engagement scores of experimental and control groups of middle stage students.
3. To compare the affective engagement scores of experimental and control groups of middle stage students.

III. METHODOLOGY

This study employed a quasi-experimental pre-test–post-test control group design to investigate the effect of the Experiential Learning Approach on the engagement of eighth-grade students in mathematics. The researcher conducted quantitative research on 80 students (40 experimental and 40 control) of middle stage students in a private school situated in an urban area. While the experimental group was taught using Experiential Learning strategies, the control group received instruction through traditional methods. This design enabled the researcher to compare Students engagement about Mathematics when taught using Experiential Learning Module through quantitative data.

IV. SAMPLE OF THE STUDY

The study sample consisted of 80 students (40 experimental and 40 control) of grade 8th from a private CBSE school in an urban area.

V. TOOLS USED AND STATISTICAL PROCEDURES

The researcher had used a standardized, pre-validated instrument adopted from Kong et al. (2003), to measure the variable Engagement. This tool caters to 3 different types of engagement behavioural, affective and cognitive components, and demonstrates strong internal consistency reliability in prior studies (e.g., Cronbach's α values ranging from 0.79 to 0.90 for subscales). Data collected through this tool were scored and analysed using statistical software to maintain accuracy, reduce manual error, and support transparent, replicable quantitative analysis. The Student Engagement in the Mathematics Classroom Scale developed by Kong, Wong, & Lam (2003) which follows a Five-Point Likert format which uses a 57-item standardized instrument covering cognitive (20 items), affective (21 items) and behavioural engagement (16 items). Cognitive engagement assessed surface and deep learning strategies and reliance on teacher guidance. Affective engagement measured students' interest, achievement motivation, anxiety, and frustration toward mathematics. Behavioural engagement evaluated attentiveness, diligence, and time invested in learning inside and outside the classroom.

VI. RESULTS/FINDINGS

Student engagement was examined through both descriptive and inferential statistical procedures to determine the extent and quality of students' involvement in mathematics learning under an

Experiential Learning Approach (experimental group) compared to traditional instruction (control group). Normality assumptions were verified using the Shapiro–Wilk test and equality of variances was confirmed through an F-test for all three engagement dimensions ($p > 0.05$), that supported the use of independent samples t-tests assuming equal variances ($df = 78$, $\alpha = 0.05$). Across all dimensions, the experimental group reported higher engagement scores, which indicated a stronger response to Experiential Learning Approach intervention. Cognitive Engagement showed a notable difference, with the experimental group recording a higher mean ($M = 3.28$, $SD = 0.42$) than the control group ($M = 2.75$, $SD = 0.35$). The difference was statistically significant, $t(78) = 5.21$, $p < 0.05$. The effect size, $\omega^2 = 0.25$, indicated a large and meaningful impact, suggesting that approximately 25% of the variance in cognitive engagement can be attributed to the teaching method. Further examination of central tendency values (median and mode) supports this trend which reflected deeper conceptual processing, improved idea-linking and greater application-based thinking among students exposed to experiential tasks.

Affective Engagement also showed a significant distinction. The experimental group achieved a mean of $M = 3.37$ ($SD = 0.40$), compared to the control group mean of $M = 2.75$ ($SD = 0.27$). The difference was statistically significant, $t(78) = 4.01$, $p < 0.05$, with an effect size of $\omega^2 = 0.16$, that reflected a large practical effect. These scores imply that students in the experimental condition experienced greater interest, achievement motivation, and emotional positivity toward mathematics, along with lower levels of anxiety and frustration, highlighting enhanced motivational resilience.

Behavioural Engagement exhibited the highest magnitude of difference. The experimental group demonstrated very high engagement ($M = 3.99$, $SD = 0.42$) compared to the control group ($M = 2.94$, $SD = 0.30$). The results were highly significant, $t(78) = 9.39$, $p < 0.05$, and the effect size of $\omega^2 = 0.53$ indicates a very large educational impact, with 53% of behavioural engagement variance explained by the intervention. This suggests that experiential learning activities substantially strengthened students' attentiveness, persistence, classroom participation, and learning time investment.

Thus, the data provided the researcher evidence that the Experiential Learning Approach enhances engagement holistically, strengthening not only how students think (cognitive), but also how they feel (affective) and participate (behavioural) during mathematics learning among middle stage students.

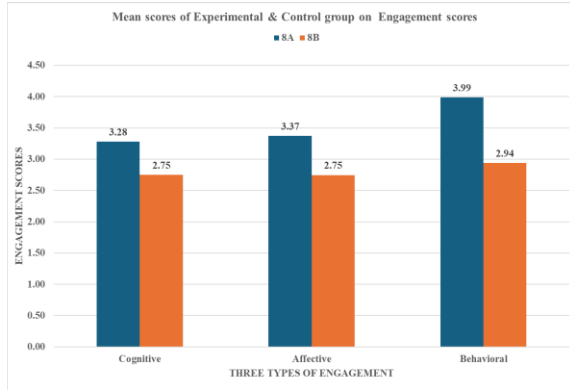

Fig 1.2- Mean comparison of Experimental and Control Group

VII. CONCLUSION

The study concludes that the Experiential Learning Approach significantly and comprehensively improves middle-stage students' engagement in mathematics compared to traditional teaching. Learning experiences structured through Kolb's cycle promoted deeper reasoning, stronger emotional motivation, sustained effort, and higher participation, making engagement gains both statistically significant and educationally substantial. The findings affirm that mathematical engagement increases when students actively experience, reflect, conceptualize, and apply learning rather than only receive instruction passively.

VIII. LIMITATION OF THE STUDY

As the study relied on quantitative data from a single school context, the generalizations of the findings is limited. The intervention duration was relatively short, which might not fully capture long-term effects on Engagement. Additionally, the study did not qualitatively measure the relationship Experiential Learning and Engagement to get a holistic approach of the intervention module.

IX. RECOMMENDATIONS FOR FUTURE RESEARCH

Future studies can be conducted in order to explore the long-term impact of Experiential Learning on Engagement. Even expanding the sample to include multiple schools or grade levels would allow broader generalisations. Further research may also explore how teacher training, resource availability, and classroom structure influence the effectiveness of Experiential Methods on Engagement.

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