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INVESTIGATION OF STUDENTS' PSYCHOLOGICAL ASPECTS ON ACITIVITY BASED LEARNING IN MATHEMATICS: A CASE STUDY IN SRI LANKA

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Abstract

Mathematics is the foundation of Science and Technology. The people cannot apart from mathematics in day to day life. Thus being "mathematically literate" will no longer be just an advantage but an absolute necessity. Despite the interest towards mathematics of school students is particularly low. It shows the poor performance of students in G.C.E. (O/L) examination. This study examines the students' self-concepts and motivation as factors that may influence students' performance and aspirations on Activity Based Learning (ABL) of mathematics in Sri Lanka. The results clearly indicate that ABL has developed students' self-concepts, motivation, aspirations and performance.

Keywords: Activity Based Learning; Aspirations; Motivation; Self-Concepts.

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1. Introduction

Mathematics is one of the most important subjects of our life. Mathematics is the foundation of science and technology and the functional role of mathematics to science and technology is multifaceted and multifarious that no area of science, technology and business enterprise escapes its application (Rao, Veerababu, & Khasim, 2012). Lack of mathematical knowledge and skills could not make a man to progress in life since it is required in our day to day life (Yadav, 2015). The basics of mathematics start from grade one in the school but its usage continues in our whole life. No matter to which field we are belong to, mathematics is everywhere. Mathematics is an international science. Mathematics is found and used in all forms of life and work, and it is completely justified to assert that mathematical questions are necessary for everyone. A human being is born with rudimentary mathematical knowledge and mathematical skills, is acquired during through formal schooling (Romano & Vincic, 2011). Mathematics and mathematical education are needed as preparation for the future profession to every individual in mastering

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knowledge, skills and abilities. At school level, a teacher has a responsibility to create mathematically knowledgeable person.

General education in Sri Lanka is divided into five parts; Primary, Junior Secondary, Senior Secondary, Collegiate and Tertiary. The government plays an important role in general education in Sri Lanka. There are approximately 10,400 schools of which 9,410 (90%) are government schools. The balance consists of around 70 private schools, 700 "Pirivena" schools and about 200-250 international schools. The government and "Pirivena" schools offer the national curriculum and their students sit the national public examinations. International schools offer foreign curricula and prepare students for overseas examinations (Widanapathirana, Mampitiya, Jayawardena, & Chandratilleke, 2014).

In Sri Lankan school curriculum Mathematics is one of the core subjects taught from Grade one to Grade eleven. The aim of the mathematics curriculum under activity-based student-centered learning model was to create individuals who are able to think mathematically, and apply mathematical knowledge effectively in solving problems and decision making in their daily life (Mampitiya, 2014).

The primary purpose of teaching at any level of education is to bring fundamental change in learner. To facilitate the process of knowledge transmission, teachers should apply appropriate teaching methods. In traditional method of teaching widely applied teacher-centered methods. Research evidence from previous studies indicates that a student-centered learning environment seems to produce higher level learning outcomes more efficiently than a traditional teacher-centered environment.

ABL is a general term for a variety of activities which make different demands on the abilities of both pupils and teachers and which have different purposes. ABL has constructivist purposes, and activities both access to information-rich possessions and cooperative interaction. The series of activities is considered as the central backbone of the course pedagogy which extant the students with prospects for "learning by doing" (Akhtar & Saeed, 2017). Activity method is that students learn by doing different activities, by trying new challenging ideas and comparing these with the existing ones. A child can be helped by providing safety, learn interesting experiences to enhance knowledge in supportive environment.

The teaching-learning process of Sri Lankan schools not in a satisfactory level and that affects poor performance of students in G.C.E. (O/L) examination. Mathematics teaching in most of the classrooms is conducted through traditional methods where learners are not motivated enough. Table 1 shows the percentages of Grades obtained for mathematics by students in G.C.E. (O/L) examination in recent ten years.

Table 1: Grades Obtained for Mathematics in G.C.E. (O/L) by Candidates

Year	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Percentage of Passed (A+B+C+S) Students	51.06	50.38	60.38	55.35	55.35	57.23	56.70	55.18	62.81	62.24

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Percentage of Weak (W) Students	48.94	49.62	36.62	44.65	44.65	42.77	43.30	44.82	37.19	32.76

Source: G.C.E. (O/L) Examination – Performance of Candidates (Relevant year) published by Research & Development Branch, National Evaluation and Testing Service, Department of Examinations, Sri Lanka.

Figure 1 represented the serious situation faced by Sri Lanka in results of the G.C.E. (O/L) mathematics. All the authorities responsible for education in Sri Lanka are always taking actions to reduce the rate of failures in G.C.E. (O/L) mathematics. As shown in figure 1, the failure rate is reduced in the years 2016 and 2017 compared to the other years. Even though the failure rate is get lower there are considerable percentages (approximately 40%) of students are failed in G.C.E. (O/L) mathematics.

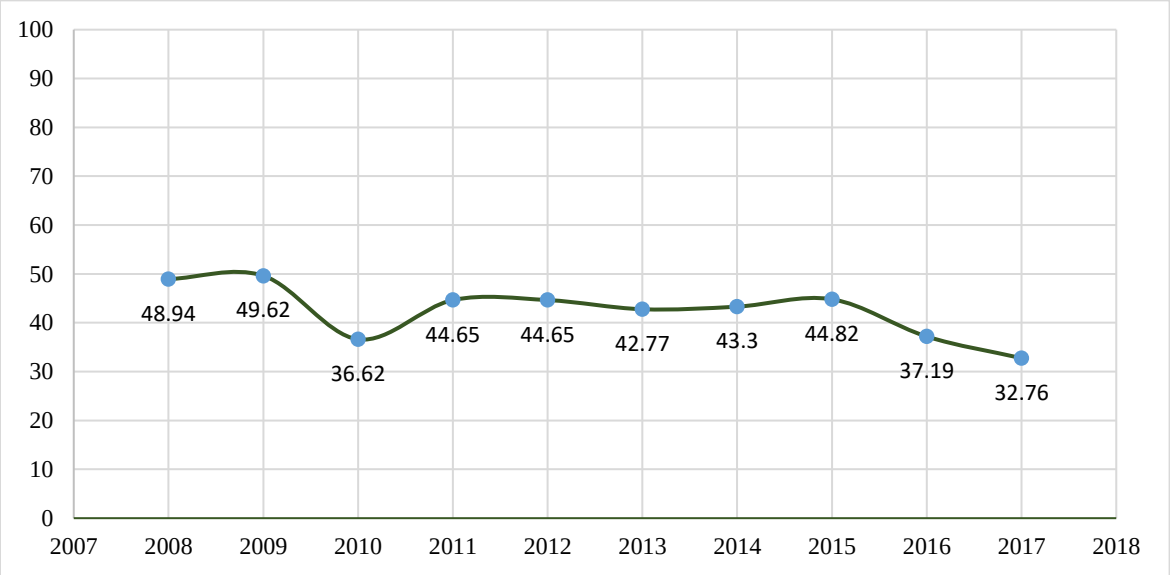

Figure 1: Percentage of Weak (W) Students in G.C.E. (O/L) Mathematics

Galewela Education Zone is a one of the education zones out of 99 Education Zones in Sri Lanka. It was obtained 69th place in 2016 (Department of Examination, Performance of Candidates, 2016) and 73rd place in 2017 (Department of Examination, Performance of Candidates, 2017) out of 99 Education Zones in Sri Lanka for overall performance of the G.C.E. (O/L) Examination. Mathematics results of the G.C.E. (O/L) examination in Galewela Education Zone further proved the critical situation faced by the Galewela Education Zone.

Table 2 shows the percentages of Grades obtained for mathematics by students in G.C.E. (O/L) examination. Approximately 60% of students in Galewela Education Zone are failed in mathematics in each year.

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Table 2: Grades Obtained for Mathematics in G.C.E. (O/L) by Candidates in Gale Wela Education Zone

Year	**2010**	**2011**	**2012**	**2013**	**2015**
Percentage of Passed (A+B+C+S) Students	46.56	40.07	30.40	40.44	40.49
Percentage of Weak (W) Students	53.44	59.93	60.60	59.56	59.51

Source: G.C.E. (O/L) Examination – Evaluation Report for Mathematics (Relevant year) published by Research & Development Branch, National Evaluation and Testing Service, Department of Examinations, Sri Lanka.

Figure 2 shows that the percentage of students failed in mathematics in G.C.E. (O/L) at Galewela Education Zone is always higher than the failed students in Mathematics at National Level.

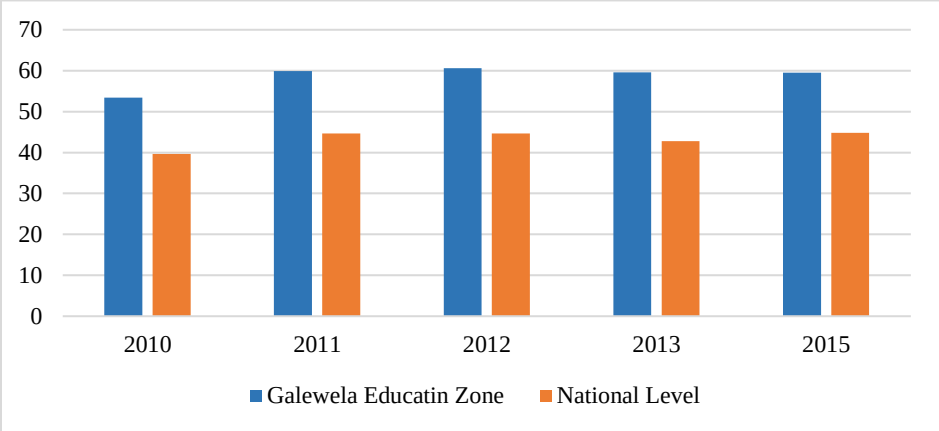

Figure 2: Percentage of Students Failed in Mathematics in G.C.E. (O/L) by Candidates

Even though activity-based student-centered method was introduced, it is not functioning at Sri Lankan Education System effectively. Thus, students' interest towards mathematics is very low. Past researches suggest that Teaching Style of teacher and Method of Instruction directly affect to the students' self-concepts, motivation, performance and aspirations. Thus, Activity Based lessons should be introduced to the Grade six students since they are starting to learn mathematics in formal way from Grade six. As method of teaching could affect students' performance and aspirations, the aim of this study is to examine the students' self-concepts and motivation as factors that may influence students' performance and aspirations on ABL of mathematics in Sri Lanka. Active learning strategies if employed in our mathematics lessons would bring about higher achievement of students in mathematics and ensure the realization of the objectives of mathematics in our schools (Festus, 2013).

Thus, this investigation facilitates the clarifying of these issues, investigating students' self-concepts, motivation, performance and aspirations, and computing relations of students' self-concepts and motivation with students' performance and aspirations. The objectives of this study as follows: (1) to investigate students' self-concepts, motivation and prior knowledge of Grade six mathematics; (2) to apply Activity Based Learning in mathematics to the experimental group while using traditional method of instruction on control group in teaching Grade six mathematics; (3) to explore students' performance and aspirations of two instructional processes in teaching Grade six mathematics; (4) to compute relations of students' self-concepts and motivation with students'

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performance and aspirations; and (5) to make valuable suggestions to enhance students' performance and aspirations in Grade six mathematics.

2. Methodology

The research used a mixed methods study. This approach is the best method for achieving a high response rate (Glasow, 2005). Questionnaires were designed collect the data which can be analyzed using advanced statistical techniques while semi-structured interviews were developed for teachers and students to know their deeper insights. Questionnaire was addressed to students' self-concepts, motivation, and aspirations in Mathematics.

2.1. Participants

Students at two schools in Gale Wela Education Zone in Sri Lanka participated in this study. One hundred and two students in Grade six and five mathematics teachers participated to the study.

2.2. Recruiting Procedure

A convenience sampling technique was used in this study. Necessary ethical approvals were obtained from relevant authorities and personal. A minimum disturbance maintained during the study for the regular work in the premises of data collection. All participants were provided information letter with details of the study and they were required to sign a consent form indicating they had understand the information letter.

2.3. Instrumentation

A pre-test was prepared for the purpose of appointing students into two homogeneous groups in experimental and control. A post-test was constructed to measure students' performance after the intervetion. Based on the findings of (Chandrasena, 2013), a closed ended, self-reported questionnaire of mathematics was constructed. Each of the scales is measured on a four point Likert scale (1=*strongly disagree* to 4=*strongly agree*). This scale comprises survey items related to students' self-concepts, motivation and aspirations on mathematics. The survey items related to motivation in the questionnaire comprises three different motivational orientations: mastery, intrinsic and ego in mathematics. Semi-structred interview schedules were developed for teachers and students to know their perception on ABL.

2.4. Procedure

Pre-test is given to all the students in selected two schools who are willing to participate for the study. They were assigned in two homogeneous groups in fifty students in experimental group and fifty two students in control group based on their pre-test marks. Questionnaire of self-concepts, motivation and aspirations administered prior to the intervention for both Experimental and Control groups. Activity Based Instructions used for Experimental group while used Traditional Method of Instructions to Control group. The lessons indicated in Table 3 were selected for teaching which needed 26 periods for each group.

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Table 3: Selected Lesson for teaching-learning process

Unit	Name of the Lesson	Number of Periods
19	Constructing Algebraic Expressions & Substitution	04
20	Mass	05
21	Ratio	06
22	Data Collection & Data Representation	06
23	Data Interpretation	05
	Total Number of Periods	**26**

Student-centered teaching methods such as group activities, mathematical games and presentations were used to Experimental Group. Control group was taught using Traditional Method which is more or less teacher centered-method. Lesson plans for both groups were written and used in the teaching-learning process. Post-test was conducted after the intervention to assess the performance of the students in both Experimental and Control groups. Same questionnaire was administered again to measure students' self-concepts, motivation and aspirations towards mathematics in both groups after the intervention. Semi-structured interviews were conducted for five mathematics teachers who taught for Grade six and ten randomly selected students from both Experimental and Control groups which is five from each.

2.5. Data Analysis

Survey data were initially entered in Microsoft Excel sheets form which datasets were prepared for use in SPSS. Quantitative data analyses (reliabilities, frequencies, descriptives, mean comparisions, regression analysis and correlation analysis) were performed using SPSS 17.0. Decriptive analyses were carried out on the data for students' mathematics self-concepts, motivation, aspiration and performance, followed by reliability tests. To find the significant difference between the mean scores, "independent samples t-test" was applied at the significant level of 0.05. Qulitative data were analyzed using Thematic and Content analysis.

3. Results and Discussion

Table 4: Reliability Estimates (Cronbach's Alpha) for Total Sample and Subgroups

	Grouping Categories	Self-Concepts	Motivation	Aspirations
Prior to the Intervention	Experimental	.894	.717	.725
	Control	.825	.605	.660
	Overall	.872	.643	.702
After the Intervention	Experimental	.889	.838	.805
	Control	.721	.604	.689
	Overall	.839	.752	.772

* All Chronbach's Alpha values are greater than 0.60

Table 4 shows the reliability estimates for questionnaire. The results of the reliability estimates for total sample, and accorss experimental and control groups show acceptable measures, with Alpha

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coefficients ranging between .604 to .894 prior to the intervention and after the intervention (Aron & Aron, 2003).

Table 5: Reliability Estimates (Cronbach's Alpha) for Mathematics Motiation Items

	Grouping Categories	Mastery Motivation	Intrinsic Motivation	Ego Motivation
Prior to the Intervention	Experimental	.802	.748	.813
	Control	.736	.636	.673
	Overall	.783	.666	.792
After the Intervention	Experimental	.777	.691	.702
	Control	.646	.697	.623
	Overall	.725	.658	.667

* All Cronbach's Alpha values are greater than 0.60

Table 5 shows the reliability estimates for Motivation items in the Questionnaire. The results of the reliability estimates for total sample, and accorss experimental and control groups show acceptable measures, with Alpha coefficients ranging between .623 to .813 prior to the intervention and after the intervention (Aron & Aron, 2003).

An independent sample t-test revealed that there was no significant difference between the marks of pre-test in the experimental (M=48.86, SD=17.73) and control (M=48.15, SD=22.20) groups; t(100)=0.18, p=0.86.

Table 6: Mean Comparison (Independent sample t-test) of independent variables

	Before			After		
	t	df	Sig.	t	df	Sig.
Self-Concepts	- 2.107	100	.038	5.811	100	.000
Motivation	- .307	100	.760	4.058	100	.000

Inspection of the descriptive statistics in Table 7 shows that students' mean self-concepts and mean motivation is developed after the intervention in experimental group. The independent sample t-test conducted after the intervention (Table 6) showed that there were significant differences between the self-concepts (Experimental: M=3.44, SD=0.53; Control: M=2.81, SD=0.58; t(100)=5.81, p=0.00) and motivation (Experimental: M=3.02, SD=0.50; Control: M=2.68, SD=0.34; t(100)=4.06, p=0.00).

Table 7: Descriptive Statistics for Self-Concepts and Motivation

	Grouping Variable	Self-Concepts		Motivation	
		Before	After	Before	After
Mean	Experimental	2.9660	3.4360	2.5444	3.0244
	Control	3.2327	2.8058	2.7201	2.6827
SD	Experimental	.71674	.52635	.44844	.50109
	Control	.55403	.56721	.34998	.33665

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Skewness	Experimental	- .459	- .841	- .146	- .324
	Control	- .803	.003	.485	.410
Kurtosis	Experimental	- 1.092	.220	- .176	- 1.412
	Control	.301	- .992	- .139	- .285

As shown in the Table 8 students' mean marks and mean aspirations of students in experimental group are higher than students in control group. The independent sample t-test conducted after the intervention (Table 9) showed that there were significant differences between the performance (Experimental: M=62.82, SD=14.87; Control: M=52.33, SD=19.02; t(100)=3.10, p=0.00) and aspirations (Experimental: M=3.27, SD=0.66; Control: M=2.82, SD=0.66; t(100)=3.47, p=0.00).

Table 8: Descriptive Statistics for Performance and Aspirations

	Grouping Variable	**Post Test**	**Aspirations**
Mean	Experimental	62.82	3.2733
	Control	52.33	2.8205
SD	Experimental	14.869	.65962
	Control	19.027	.65666
Skewness	Experimental	- .405	- .542
	Control	0.062	.288
Kurtosis	Experimental	- .468	- 0.844
	Control	- .809	- .892

Table 9: Mean Comparison (Independent sample t-test) of dependent variables

	t	**df**	**Sig.**
Performance	3.095	100	.003
Aspirations	3.474	100	.001
*** All values are significant at p < 0.05**			

Table 10 shows that descriptive statistics for the mastery, intrinsic and ego motivation items. Mean motivations of mastery, intrinsic and ego in experimental group are higher than the control group.

Table 10: Descriptive Statistics for Motivation Items in the Questionnaire

	Grouping Variable	**Mastery**	**Intrinsic**	**Ego**
Mean	Experimental	3.1300	3.0167	2.9267
	Control	2.8333	2.6763	2.5385
	Overall	2.9788	2.8431	2.7288
SD	Experimental	.65750	.57168	.65738
	Control	.65012	.49443	.46162

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	Overall	.66736	.55788	.59606
Skewness	Experimental	- .034	- .711	- .612
	Control	- .113	- .133	- .370
	Overall	- .514	- .286	- .170
Kurtosis	Experimental	.410	- .103	- .162
	Control	- .528	- .239	1.309
	Overall	- .500	- .538	- .081

Table 11: Factor Correlations of Motivation Questionnaire

		Mastery Motivation	**Intrinsic Motivation**	**Ego Motivation**
Mastery Motivation		1		
Intrinsic Motivation		.524	1	
	Sig.	.000		
Ego Motivation		.253	.261	1
	Sig.	.010	.008	

* All correlations are significant at $p < 0.05$

It was also demonstrated significant correlations between Mastery, Intrinsic and Ego Motivations. Highest significant correlation (0.524) was associated with Intrinc and Mastery Motivations.
Table 12 shows the regression analysis of self-concepts and motivation with performance and aspirations. All the regression values between self-concepts, mastery motivation, intrinsic motivation and ego motivation with performance and aspirations were significant (p<0.05).

Table 12: Relation of students' self-concepts and motivation with performance and aspirations (Regression Analysis)

			Performance	**Aspirations**
Self-Concepts		Sig.	.001	.000
		R Square	.115	.352
Motivation	Mastery	Sig.	.030	.000
		R Square	.046	.297
	Intrinsic	Sig.	.002	.000
		R Square	.095	.218
	Ego	Sig.	.001	.003
		R Square	.112	.087
	Overall	Sig.	.000	.000
		R Square	.141	.341

* All regressions are significant at $p < 0.05$

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Figure 3 shows that 11.5% of self-concepts and 14.1% of motivation affect performance while 35.2% of self-concepts and 34.1% of motivation affect to aspirations. Ego motivation is highly affects (11.2%) to performance and Mastery motivation is highly affects (29.7%) to aspirations of Grade six students.

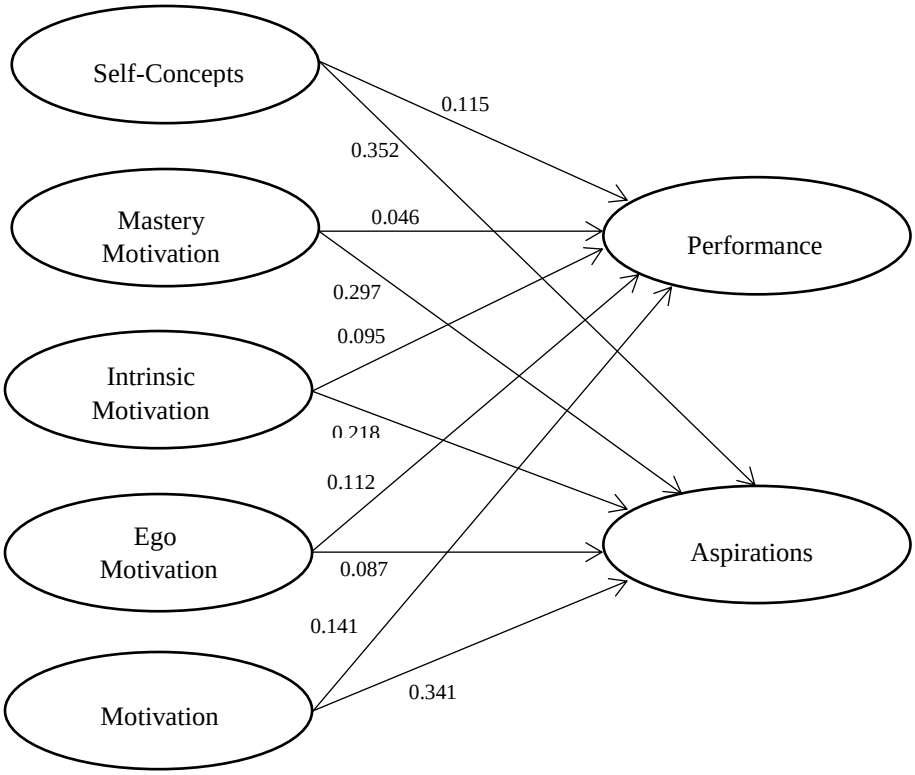

Figure 3: Effects on Outcome Variables

Note: All values are significant ($p<0.05$)

4. Conclusion and Suggestions

The study revealed that Activity Based Learning (ABL) made all the students as active learners and at the same time it improves peer learning environment and team spirit among students. Also it showed that self-concepts and motivation are directly affected to students' performance and aspirations. Performance and aspirations of students can be developed through ABL. Qualitative findings revealed that less support from peer students, inadequate time period and non-willingness by the teachers on ABL were some identified barriers in promoting ABL in classroom practices. Thus it is suggested to facilitate mathematics learning through suitable activities to improve students' meaningful learning.

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