Action Research: How does practical toolkit implementation affect academic performance of a student?

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Topic: Development of application of mathematics to real-life through modeling questions
Statement of a Problem: Students struggle to solve modeling problems in mathematics, interpret and connect them to real-life situations.
Purpose of the Research: Examine the effect of solving toolkit modeling and application problems in mathematics in groups on the students' understanding.
Research Question: To what extent does toolkit application in class affect the development of mathematical modeling skills of a student?

H_o: There is no difference between the academic performance of students before and after the implementation of the modeling toolkit activity.

H_1: There is a difference between the academic performance of students before and after the implementation of the modeling toolkit activity.

Methodology: Students of 11 grade standard level of mathematics were given a pre-test formative assessment before introducing a toolkit practice application activity. The results of the formative assessment were recorded. Later, teacher has introduced application of exponential function modeling lesson. The activity is based on the "cooling" activity. After the activity students were again tested on the topic of the toolkit. The data of their results was collected and analyzed. For analysis Paired sample T-test was used along with the students demographics (Muijs, 2004) .

Data findings:
Overall, the average result for the formative assessment before the introduction of the toolkit activity is 57.2%, while the results for the second formative assessment that was conducted after the toolkit increased to 69.6%. However, it is observed, that results for the first assessment are varying greater with standard deviation 20.3. In addition, it is observed that

the minimum mark has changed from 16 to 55, indicating an increase of 39 points. The results of the descriptive statistics are demonstrated in Table1.

Table 1.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
FA1	13	16.00	80.00	57.2308	20.35581
FA2	13	55.00	80.00	69.6154	9.23344
Valid N (listwise)	13				

Further, an independent paired sample t-test was conducted to compare the results of the formative assessment before and after the implementation of the toolkit. According to the results in Table 2, there is a significant difference in scores for group before toolkit ($M = 57.2$, $SD = 20.4$) and group after the toolkit ($M = 69.6$, $SD = 9.23$); $t = -2.393$, $p = 0.034$, $d = 0.84$. These results indicate that there is statistical difference between the variables and groups of students. It means, that introduction of toolkit modeling activity has positively affected the academic performance of the students in the group.

Table 2.

Paired Samples Test

		Paired Differences					t	df	Significance	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			One-Sided p	Two-Sided p
Pair 1	VAR00001 - VAR00002	-12.38462	18.67056	5.17828	-23.66712	-1.10211	-2.392	12	.017	.034

Evaluation: The obtained results demonstrate the significant difference with effect size d=0.84, which indicate a large effect of the toolkit on the outcome. This, in turn, can be explained by the active learning process and differentiated instruction (Tomlinson, 2014). Since there was no uniformal instruction to the toolkit, students had freedom to approach the problem from any angle they wanted. Moreover, development of communication skills as well as critical thinking skills allowed students to evaluate their results and reflect on them in a more thoughtful manner (Sofronio & Poutos, 2016). Thus, the more students are engaged with the lesson material in an active way, the more it is likely to influence their topic understanding.

Despite the large effect size, there are certain limitations to the study. First, small class sizes may not reflect the general effect of the variable on the larger population (Cohen et al., 2007). Second, control for difficulty of the topic could be subjective, even though the formatives were conducted on the different topics but in the same area of Functions exploration.

Use of mathematical toolkit is not a new direction in teaching strategies. However, in classes that have lost their motivation, especially high school students after the prolonged online learning experience, it is important to keep their motivation using such active learning activities.

Conclusion: To conclude, use of toolkit modeling has shown itself effective in positive effect on the academic performance of high school students. However, the study should be extended on the larger cohort with stricter control for mediating variables.

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The purpose of this study is to explore teaching strategies for effective group work in the distance learning mode with the aim of improving students' application and interpretation of mathematics in real-life situations. The study includes two cycles of action research. The first cycle focuses on the case study of a 12-grade students' experience in online group work. Observations showed that neither random grouping nor student choice of a group resulted in effective collaboration among students. The second cycle involves a quantitative descriptive research design to evaluate the effectiveness of studied online group work strategies. Students perform an exploration group project on the statistical analysis. The measurement tools include an evaluation survey with a 5-point Likert scale and students' assessment in the unit test. Expected findings include higher results of students in the summative assessment compared to results of the previous cohort.