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SKAFFOLDING TECHNIQUE IN GRAPHING ELEMENTARY FUNCTIONS – A CASE STUDY

Abstract

In this paper, the authors present the application of the scaffolding technique in drawing graphs of some elementary functions. First-year students of the Faculty of Architecture, Civil Engineering, and Geodesy were tested using two exams: an entrance test and an exit test. The obtained results show whether students are more successful in drawing graphs of elementary functions after using the scaffolding technique in math teaching. Based on the research results, scaffolding can indeed help students in graphing elementary functions.

Keywords: scaffolding, elementary functions, math teaching

СКАФОЛДИНГ ТЕХНИКА У ЦРТАЊУ ГРАФИКА ЕЛЕМЕНТАРНИХ ФУНКЦИЈА – СТУДИЈА СЛУЧАЈА

Сажетак:

У овом раду аутори су приказали примјену скафолдинг технике у цртању графова неких елементарних функција. Студенти прве године Архитектонско-грађевинско- геодетског факултета тестирани су помоћу два теста – улазног и излазног. Добијени резултати нам показују да ли су ученици успјешнији у цртању графика елементарних функција након примјене скафолдинг технике у настави математике. На основу резултата истраживања, скафолдинг техника може помоћи ученицима у цртању графика елементарних функција.

Кључне ријечи: скафолдинг, елементарне функције, настава математике

1. INTRODUCTION

The concept of scaffolding, which falls within the domain of Mathematical Education research, was introduced by Wood, Bruner, and Ross [1] and is based on the developmental theories of Vygotsky [2]. Significant changes are needed in relation to traditional approaches to teaching because the teacher's role is shifting from 'showing and telling' to providing responsible guidance in the development of a student's own thinking. This orientation necessitates a variety of support for students' thought constructions, fostering individual thinking and leading to the creation of mathematically valid understandings. The term "scaffolding" has been used to reflect the way in which adult support is adjusted as the child learns and is eventually removed when the student can "stand on his own" [1]. According to Wood, Bruner, Ross, and Vygotsky [1], [2], key aspects of scaffolding in mathematical education include:

Gradual Release of Responsibility: The teacher begins by providing substantial support and guidance, gradually reducing this support as students gain confidence and competence. This gradual release allows students to take on increasing levels of responsibility for their learning.

Tailored Support: Scaffolding is personalized to the individual student's needs, abilities, and prior knowledge. Teachers must be attuned to students' levels of understanding and provide appropriate support accordingly.

Promotion of Critical Thinking: Scaffolding encourages students to engage in higher-order thinking skills such as problem-solving, analysis, and synthesis. Rather than simply memorizing facts or procedures, students are challenged to actively construct their own mathematical understanding.

Creation of Valid Understandings: The ultimate goal of scaffolding is to foster the development of mathematically valid understandings. This involves not only arriving at correct answers but also understanding the underlying concepts and principles.

Flexibility and Adaptability: Scaffolding should be flexible and adaptable, allowing for modifications based on students' progress, feedback, and changing needs. Teachers must be prepared to adjust their support strategies as necessary to ensure optimal learning outcomes.

Scaffolding provides a structure that helps students construct knowledge by building upon their existing abilities. Commonly used in problem-solving, it is usually provided in the following three forms: 1) breaking the task down into smaller tasks, 2) keeping the task constant but increasing the weight of the material, or 3) creating scaffolding within a single task [3]. Linder et al. used scaffolding in redesigning an introductory computer science course to engage students in their chosen subject majors and better prepare them for higher-level teaching. Their scaffolding structure included classroom activities and short one-week assignments targeting skills needed for the final classwork, resulting in weaker students building skills earlier in the course and students displaying more confidence in their programming and problem-solving skills [3], [4].

Although the scaffolding technique is used in many areas of education, it is particularly interesting and applicable in learning mathematics. In this paper, the authors deal with drawing graphs of elementary functions using the scaffolding technique in the first year of technical studies. Graphing elementary functions is important for first-year technical students to understand the functions themselves. Graphs of functions have been studied in several papers. For example, in paper [5], the author deals with drawing graphs of logarithmic functions based on scaffolding implementation. The authors concluded the following: 1) In the step of understanding the problem, students experienced limitations in understanding logarithmic symbols. The students did not recognize the symbols in the question, 2) in the step of designing the plan, the students decided to create tables for drawing logarithmic graphs. They chose a number that corresponds to 2^x. This shows that they knew the correlation between logarithmic and exponential functions, 3) In the step of making the plan, the students accurately drew the points based on the table previously made in the plan development phase. They connected the dots to make a graph. In this step, scaffolding was not carried out, 4) in the step of looking back, students did not check the answers they had already received. The students realized that the answers they received did not correspond to the instructions on the questions. Students who are accustomed to looking back will have better reasoning than students who do not check back. In paper [6], the authors obtained their results based on the realized obligations of the students (homework) as well as two oral protocols with first-year students of the Faculty of Mechanical Engineering and second-year students of the Faculty of Architecture and Civil Engineering of the University in Banja Luka who completed five tasks related to sketching graphs of linear functions and functions $f(|x|)$ and $|f(|x|)|$. By analyzing the feedback, they found that abstraction and generalization are in many cases difficult activities that may be beyond the students' ability. In these cases, teacher intervention through means of helping understand mathematical concepts, within the appropriate placement of mathematical construction of objects, significantly helped students understand and achieve their generalization goals and abstractions.

Paper [7] presents reflections on using a scaffolding approach to engage civil engineering students in learning Structural Analysis subjects. In this approach, after listening to lectures on theory, students are provided with a series of practice problems, each accompanied by the steps, formulas, hints, and tables needed to solve the problem. Gradually, with increasing confidence in the application of the method as a tool for structural analysis, the amount of help provided is reduced until eventually, no help is provided at all. The author concluded that the scaffolding approach is a suitable practice for involving students in their learning. Every student participates actively, whereby stronger students are given the opportunity to advance faster. Weaker students receive more attention along with the ability to advance at a slower pace. Students are assisted in learning alone or in a group through properly designed guided tasks, which are gradually removed with increasing student competence. The students' answers through evaluation show their very high level of satisfaction with this unit and the teaching adopted style.

Problem-solving is the most important ability. When solving problems, students not only utilize existing mathematical knowledge but also engage all high-level thinking skills. However, students still face many difficulties when solving problems. Students' difficulty with problems that cannot be solved by one routine procedure requires critical analysis and an understanding of a concept and application of mathematical skills [8]. One strategy used for solving problems is scaffolding.

This study provides empirical research in the area of drawing graphs of elementary functions before and after applying the scaffolding technique in teaching with first-year students of the Faculty of Architecture, Civil Engineering and Geodesy.

2. METODOLOGY AND RESEARCH

2.1. METODOLOGY OF THE RESEARCH

Students of the Faculty of Architecture, Civil Engineering and Geodesy in Banja Luka in their first year of study, enrolled in the academic year 2023/24, were observed for the use of the scaffolding technique in learning mathematics. Students enrolled in civil engineering and geodesy study programs took a mathematics test during the entrance exam, while architecture students took a test of their own choice - a mathematics test or a spatial ability test. In the first year of the academic year 2023/24, a total of 149 students were enrolled, with 85 students enrolled in the Architecture department, 39 students enrolled in the Civil Engineering department, and 25 students enrolled in the Geodesy department. In the research, a total of 111 first-year students from the Faculty of Architecture, Civil Engineering, and Geodesy participated.

For the purposes of this research, we conducted two tests, an entrance test and an exit test, that consisted of 4 types of tasks. In the given tests, knowledge of the following elementary functions was required: quadratic function, exponential function, logarithmic function, and trigonometric functions sin x and cos x. Each test is scored with a total of 20 points.

The first test - the entrance test was solved by students at the beginning of the second semester of their first year of study, before the lectures on elementary functions. We note that elementary functions are studied during secondary education and were also an integral part of the Mathematics entrance exam at the Faculty of Architecture, Civil Engineering, and Geodesy.

The second test - the exit test was solved by the students after attending the teaching units on elementary functions. The authors of this paper used the scaffolding technique during the lectures for a total of three weeks (three hours per week). Tasks from book [9], [10] were used for lectures and test construction.

Students solved each test within one school class, or 45 minutes.

For the statistical study, the IBM SPSS was used as the analytical-statistical software package. Descriptive statistics were used for presenting and summarizing data. Also, the Paired Samples t-Test, non-parametric Mann-Whitney U test, The Wilcoxon signed-rank test, The Kruskal-Wallis test and the Spearman’s rank correlation coefficient were used. No normal distribution was noticed by the variables that were observed [11].

2.2. RESEARCH QUESTIONS

This paper aims to answer the following research questions (RQs):
RQ1: How successful are students in drawing graphs of elementary functions before using the scaffolding technique in mathematics teaching, i.e., with only prior knowledge from high school and after applying the scaffolding technique? Is there a statistically significant difference in drawing graphs of elementary functions based on the study program profile?
RQ2: How successful are students in drawing graphs of quadratic functions before and after applying the scaffolding technique? Is there a statistically significant difference in drawing graphs of quadratic functions based on the study program profile?
RQ3: How successful are students in drawing graphs of exponential functions before and after applying the scaffolding technique? Is there a statistically significant difference in drawing graphs of exponential functions based on the study program profile?
RQ4: How successful are students in drawing graphs of logarithmic functions before and after applying the scaffolding technique? Is there a statistically significant difference in drawing graphs of logarithmic functions based on the study program profile?
RQ5: How successful are students in drawing graphs of trigonometric functions sin x and cos x before and after applying the scaffolding technique? Is there a statistically significant difference in drawing graphs of trigonometric functions based on the study program profile?

3. RESULTS AND DISCUSSION

With the label U1, U2, U3 and U4 we marked the tasks on the entrance test, and with I1, I2, I3 and I4 the tasks on the exit test.

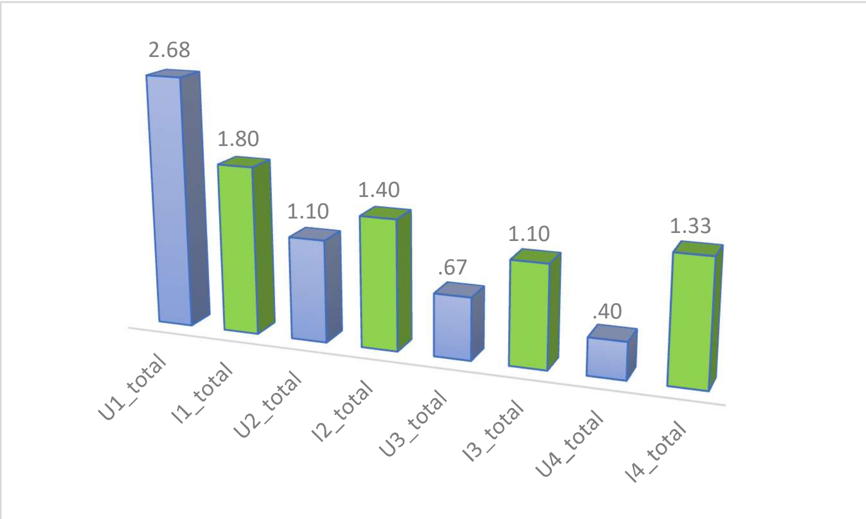

Figure 1. Success by tasks on the entrance and exit tests (arithmetic means).

From Figure 1, it can be seen that students achieved better performance on all tasks in the exit test, except the first one.
We will analyze and statistically process the data obtained from the entrance and the exit tests, in accordance with the research questions.

RQ1: How successful are students in drawing graphs of elementary functions before using the scaffolding technique in mathematics teaching, i.e., with only prior knowledge from high school and after applying the scaffolding technique? Is there a statistically significant difference in drawing graphs of elementary functions based on the study program profile?
Table 1 shows the final success of students on the entrance and exit tests, according to the department. Looking at the arithmetic mean, it is clear that the students of geodesy achieved the greatest progress, and the students of architecture the weakest.

Table 1. Success on the entrance and exit test - according to the department

		N	Mean	Std. Deviation	Minimum	Maximum
Entrance_total	CE	39	6.18	4.762	0	19
	ARCH	46	4.26	3.511	0	16
	GEO	26	3.88	3.882	0	16
	Total	111	4.85	4.159	0	19
Exit_total	CE	39	6.59	6.129	0	20
	ARCH	46	4.52	5.876	0	20
	GEO	26	6.15	5.801	0	18
	Total	111	5.63	5.971	0	20

The Paired Samples t-Test showed there is not a statistically significant difference in success between the entrance and the exit test for all tested students (t=-1.378, df=110, p=0.171). The Wilcoxon signed-rank test showed a statistically significant difference in success between the entrance and the exit test for geodesy students (Z=-2.100, p=0.036). However, it can be seen from table 1 that students of geodesy did not achieve the maximum number of points neither on the entrance nor on the exit test.

The Kruskal-Wallis test at a significance level of 0.05 showed a statistically significant difference between groups (study programs) in the entrance test (χ2=6.748, df=2, p=0.034), while the Mann-Whitney U test revealed this difference between civil engineering and geodesy students, as well as between civil engineering and architecture students. In the exit test, there was no statistically significant difference in success between groups (χ2=4.810, df=2, p=0.090), but the Mann-Whitney U test determined that there is a statistically significant difference in success between civil engineering and architecture students. Civil engineering students were more successful in solving tasks in the exit test (table 1).

A positive correlation with the significance at the 0.01 level of success was obtained between success in the entrance exit tests (rs=0.249).

RQ2. How successful are students in drawing graphs of quadratic functions before and after applying the scaffolding technique? Is there a statistically significant difference in drawing graphs of quadratic functions based on the study program profile?

Task 1 (entrance test). Draw graphs of quadratic functions: (a) $f(x) = x^2$ (1 point) (b) $f(x) = -x^2$ (1 point) (c) $f(x) = 4 - x^2$ (2 points) (d) $f(x) = |4 - x^2|$ (2 points).

Task 1 (exit test). Draw graphs of quadratic functions: (a) $f(x) = (x+1)^2$ (1 point) (b) $f(x) = -(x+1)^2$ (1 point) (c) $f(x) = x^2 - 4x + 5$ (2 points) (d) $f(x) = |x^2 - 4x + 5|$ (2 points).

The Paired Samples t-Test showed a statistically significant difference in the success of solving the first task between the entrance and exit tests (t=4.540, df=120, p=0.000). Specifically, students exhibited poorer performance in drawing graphs of quadratic functions in the exit test (table 2).

The Kruskal-Wallis test indicated that there was no statistically significant difference between groups (study programs) in the success of solving the first task, neither in the entrance test (χ2=0.767, df=2, p=0.681) nor in the exit test (χ2=5.298, df=2, p=0.071).

Table 2. Success on the entrance and exit test - drawing graphs of quadratic functions

		N	Mean	Std. Deviation	Minimum	Maximum
U1_total	CE	39	2.67	1.691	0	6
	ARCH	46	2.85	1.577	0	6
	GEO	26	2.42	2.212	0	6
	Total	111	2.68	1.773	0	6
I1_total	CE	39	1.87	1.989	0	6
	ARCH	46	1.65	2.273	0	6
	GEO	26	1.96	1.928	0	6
	Total	111	1.80	2.084	0	6

RQ3: How successful are students in drawing graphs of exponential functions before and after applying the scaffolding technique? Is there a statistically significant difference in drawing graphs of quadratic functions based on the study program profile?

Task 2 (entrance test). Draw graphs of exponential functions: (a) $f(x) = 2^x$ (1 point) (b) $f(x) = -2^x$ (1 point) (c) $f(x) = 1 - 2^x$ (2 points).

Task 2 (exit test). Draw graphs of exponential functions: (a) $f(x) = 2^{x+1}$ (1 point) (b) $f(x) = -2^{x+1}$ (1 point) (c) $f(x) = 2 - 2^{x+1}$ (2 points).

The Paired Samples t-Test showed a statistically significant difference in the success of solving the second task between the entrance and exit tests (t=-3.038, df=110, p=0.003). The students showed better performance in solving the second task in the exit test (table 3).

Table 3. Success on the entrance and exit test - drawing graphs of exponential functions

		N	Mean	Std. Deviation	Minimum	Maximum
U2_total	CE	39	1.67	1.528	0	4
	ARCH	46	.63	1.218	0	4
	GEO	26	1.08	1.383	0	4
	Total	111	1.10	1.433	0	4
I2_total	CE	39	1.59	1.482	0	4
	ARCH	46	1.17	1.582	0	4
	GEO	26	1.50	1.449	0	4
	Total	111	1.40	1.515	0	4

The Kruskal-Wallis test at a significance level of 0.05 showed a statistically significant difference between groups (study programs) in the success of solving the second task in the entrance test (χ^2=15.139, df=2, p=0.001), while the Mann-Whitney U test revealed this difference between civil engineering and architecture students (U=487.500, Z=-3.906, p=0.000). Civil engineering students were more successful than architecture students (table 3). The Kruskal-Wallis test indicated that there was no statistically significant difference between groups (study programs) in the success of solving the second task in the exit test (χ^2=2.776, df=2, p=0.250).

It is evident that civil engineering students were the most successful, while architecture students were the least successful in drawing graphs of exponential functions (table 3).
However, the obtained results are not satisfactory.

RQ4: How successful are students in drawing graphs of logarithmic functions before and after applying the scaffolding technique? Is there a statistically significant difference in drawing graphs of logarithmic functions based on the study program profile?

Task 3 (entrance test). Draw graphs of logarithmic functions: (a) $f(x) = log_3 x$ (1 point) (b) $f(x) = log_3(x+1)$ (2 points) (c) $f(x) = log_3 x$ +1 (2 points).

Task 3 (exit test). Draw graphs of logarithmic functions: (a) $f(x) = log_{1/2} x$ (1 point) (b) $f(x) = log_{\frac{1}{2}}(x-1)$ (2 points) (c) $f(x) = log_{1/2} x$ - 1 (2 points).

The Paired Samples t-Test showed a statistically significant difference in the success of solving the third task between the entrance and exit tests (t=-2.368, df=110, p=0.02). The students showed better performance in solving the third task in the exit test (table 4).

Table 4. Success on the entrance and exit test - drawing graphs of logarithmic functions

		N	*Mean*	*Std. Deviation*	*Minimum*	*Maximum*
U3_total	*CE*	*39*	*1.13*	*1.704*	*0*	*5*
	ARCH	*46*	*.48*	*1.243*	*0*	*5*
	GEO	*26*	*.31*	*1.050*	*0*	*5*
	Total	*111*	*.67*	*1.416*	*0*	*5*
I3_total	*CE*	*39*	*1.18*	*1.918*	*0*	*5*
	ARCH	*46*	*.89*	*1.479*	*0*	*5*
	GEO	*26*	*1.35*	*2.077*	*0*	*5*
	Total	*111*	*1.10*	*1.784*	*0*	*5*

The Kruskal-Wallis test at a significance level of 0.05 showed a statistically significant difference between groups (study programs) in the success of solving the third task in the entrance test (χ^2=9.184, df=2, p=0.01), while the Mann-Whitney U test revealed this difference between civil engineering and architecture students (U=356.500, Z=-2.513, p=0.012), as well as civil engineering and geodesy students (U=685.000, Z=-2.360, p=0.018). Civil engineering students were more successful in solving the third task in the entrance test (table 4). The Kruskal-Wallis test indicated that there was no statistically significant difference between groups (study programs) in the success of solving the third task in the exit test (χ^2=0.544, df=2, p=0.762).

RQ5: How successful are students in drawing graphs of trigonometric functions sin x and cos x before and after applying the scaffolding technique? Is there a statistically significant difference in drawing graphs of trigonometric functions based on the study program profile?

Task 4 (entrance test). Draw graphs of exponential functions: (a) $f(x) = \sin x$ (1 point) (b) $f(x) = 2\sin x$ (2 points) (c) $f(x) = \sin 2x$ (2 points).

Task 4 (exit test). Draw graphs of exponential functions: (a) $f(x) = \cos x$ (1 point) (b) $f(x) = \frac{1}{2}\cos x$ (2 points) (c) $f(x) = \cos\frac{x}{2}$ (2 points).

The Paired Samples t-Test showed a statistically significant difference in the success of solving the third task between the entrance and exit tests (t=-5.110, df=110, p=0.000). The students showed better performance in solving the fourth task in the exit test (table 5).

Table 5. Success on the entrance and exit test - drawing graphs of trigonometric functions

		N	Mean	Std. Deviation	Minimum	Maximum
U4_total	CE	39	.72	1.621	0	5
	ARCH	46	.30	1.113	0	5
	GEO	26	.08	.272	0	1
	Total	111	.40	1.223	0	5
I4_total	CE	39	1.95	2.200	0	5
	ARCH	46	.80	1.529	0	5
	GEO	26	1.35	1.672	0	5
	Total	111	1.33	1.875	0	5

The Kruskal-Wallis test at a significance level of 0.05 showed no statistically significant difference between groups (study programs) in the success of solving the fourth task in the entrance test (χ^2=3.641, df=2, p=0.162) nor in the exit test (χ^2=5.799, df=2, p=0.055). The Mann-Whitney U test determined that there is a statistically significant difference in success between civil engineering and architecture students in the exit test, for task 4 (U=665.000, Z=-2.303, p=0.021), table 5.

CONCLUSION

In mathematics, just like in all cognitive abilities or academic subjects, there is a ladder. You cannot understand multiplication if you don't understand addition. We call this a developmental ladder. Each step relies on the previous one. If you skip to the top of the ladder, your foundation is not stable. It is necessary to build skills from the ground up. We achieve this through the use of the scaffolding technique during learning [12].

According [13] teachers found that benefits of Scaffolding in Education are: improves the likelihood that students will retain new information, helps connect foundational knowledge to new concepts , engages students with their learning and tracking their own progress, gives students more autonomy and independence in the classroom, bridges student learning gaps in traditionally difficult course content, reduces students' feelings of frustration, improves communication between students and teachers , encourages students asking for help, keeps classes organized and on schedule.

Based on the obtained results, we can conclude that students performed better on the exit test after the implementation of the scaffolding technique in lessons on elementary functions. However, the results obtained are not satisfactory, and we believe that students achieved a low average number of points in both tests and in all tasks. This can be justified by the fact that the students were attending high school from 2019 to 2023, and were affected by the COVID-19 pandemic and online learning. Additionally, no "rewards" were offered for successfully completing the tests, so some students did not make much effort.

From Figure 1, it can be seen that students performed best on the first task, quadratic functions, on both the entrance and exit tests, while they performed worst on the fourth task, trigonometric functions. A similar result was obtained in paper [14], the students achieved the lowest success in the entrance exam for enrolled to the faculty in solving problems in trigonometry.

Based on the results obtained, we conclude that the greatest progress was made by geodesy students, while architecture students showed the weakest performance, even though geodesy students did not achieve the maximum number of points on either the first or second test. In almost all tasks, civil engineering students achieved the best results.

Based on the research cited in the introduction and the results obtained in this study, we believe that the scaffolding technique is very useful in teaching mathematics, especially in lessons on elementary functions. Elementary functions and drawing their graphs are fundamental topics in mathematics and should be given more class time in universities, during which the scaffolding technique should be used. Additionally, research could be conducted in secondary schools as bases of future students [15]. Such research should be extended to future generations in order to obtain more relevant results.

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LITERATURE

[1] D.Wood, J.S.Bruner, J G.Ross, "The role of tutoring in problem solving", Journal of Psychology and Psychiatry, vol. 17, 1976, pp. 89-100, https://doi.org/10.1111/j.1469-7610.1976.tb00381.x

[2] L.S.Vygotsky, Mind in society: The development of higher psychological processes, M. Cole, V. John-Steiner, S. Scribner and E. Souberman, Eds., Cambridge, Harvard University Press, 1978.

[3] N. Ozlem Erdil, "Influencing Student Motivation Trough Scaffolded Assignments in a Quality Analysis Course and Its Impact on Learning", in ASEE Annual Conference & Exposition, june 2017, doi: 10.18260/1-2--28526

[4] S. Linder, D. Abbott, M. Fromberger, "An Instructional Scaffolding Approach to Teaching Software Design", Journal of Computing Sciences in Colleges, vol. 21, no.6, 2006, pp. 238-250.

[5] I. Augustina, Subanji, S, Irawati, "Constraints of students in drowing logarithmic graphs based on Polya steps and scaffolding implementation", Journal of physics: Conference Series 1200, 5th International Symposium on Mathematics Education and Innovation (ISMEI), 2019, doi:10.1088/1742-6596/1200/1/012005

[6] S. Kosić-Jeremić, D. A. Romano, "Primjena scaffoldinga pri realizaciji zadataka akademske nastave matematike", Časopis za teoriju i praksu odgoja i obrazovanja, broj 61 (231), 2012, pp. 119-131.

[7] D. Hardjito, "The Use of Scaffolding Approach to Enhance Students' Engagement in Learning Structural Analysis", International Education Studies, vol.3, no. 1, february 2010, doi: 10.5539/ies.v3n1p130

[8] S. Arifin at al, "Scaffolding in mathematical problem-solving", Journal of physics: Conference Series 1480, National Conference on Mathematics Education (NaCoME), 2020, doi:10.1088/1742-6596/1480/1/012054

[9] S. Kosić-Jeremić, Matematika u arhitekturi 2, Banja Luka , Univerzitet u Banjoj Luci, Arhitektonsko-građevinsko-geodetski fakultet, 2022.

[10] S. Maksimović, Diferencijalni i integralni račun 1, Banja Luka, Univerzitet u Banjoj Luci, Arhitektonsko-građevinsko-geodetski fakultet, 2022.

[11] Lj. Preradović, Đajić Vlado, Analitičko-statističke tehnike u savremenim istraživanjima, Banja Luka, Arhitektonsko-građevinski fakultet, 2011.

[12] J. Mclsacc. „What is Scaffolding in Teaching?: A Simpe Explanation." exceptionallives.org. https://exceptionallives.org/blog/scaffolding-in-teaching-a-simple-explanation/ (Accessed Martch 26, 2024).

[13] 7 Scaffolding Learning Strategies for the Classroom, University of San Diego, Proffessional and Continuing Education. https://pce.sandiego.edu/scaffolding-in-education-examples/ (Accessed Martch 27, 2024).

[14] S. Kosić-Jeremić, Lj. Preradović, "Achievement in university entrance examination relative to attendance in preparation classes and type of secondary school completed: a case study of geodesy undergraduate candidates", International Journal of Education and Research, vol.2, no.9, 2014, pp. 59-70. http://www.ijern.com/journal/2014/September-2014/06.pdf

[15] Lj. Preradović, S. Kosić-Jeremić, "Student achievement in the university entrance examination and the effects of preparation classes – a case study of civil engineering students", Technical gazette, Vol. 22 No. 3, 2015, pp. 785-791, https://doi.org/10.17559/TV-20140513114019