

The new technology as a tool of thinking visible

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Abstract

Mathematics is regarded as a difficult subject for students at all levels of education. To bring mathematics closer, more clear and to make it understandable and attractive are used different teaching tools. Today, in the XXI century digitalized teaching and learning tools, are very close to mindset of this generation of students.

In this paper computer is used as a teaching tool, to visualize and make accessible to students geometric figures in plane and space. I used Geogebra, which is dynamic software for teaching and learning from elementary school to university level. Through a dedicated computer program, students clarify thinking, thinking becomes more visible, and students become more curious, active and interested. All these activities of students have brought upgrading their success. This is evidenced by the prove of alternative hypothesis that the use of technology as a teaching tool in mathematics increased success of students in this subject.

Effective use of technology not only enhances learning, understanding and success of students, but also affects students' motivation to learn and encourages cooperation among them. During this study it is also shown that the use of technology as a teaching tool impacts in developing the thinking skills of the students and easy solution of the problems by them. In this study also I used the questionnaire for students, wanting to understand what they think about thinking, what they mean when they were asked to think about solving a problem, what is their opinion about using technology as teaching tool.

Keywords: thinking, thinking visible, thinking levels, teaching tools, digitalized teaching tools

Pedagogy is a word that describes the art of teaching. Most teachers aim is improving this art. For this art to be perfected, pedagogy requires studying teaching methods that aim to achieve teaching objectives. One of the teaching objectives is the development of students' thinking skills. We as teachers have a very important role in the classrooms, one of these is to understand and know our students, for example: how they learn, how they think, how they interact with their friends etc. My aim in my classrooms is to understand my students, particularly how they think; to do this I am trying to make my students thinking visible. I think using new technologies in the classroom assists the teacher to help students to express their ideas easier, to interact better , to concentrate in the topic.

Thinking is the cognitive process that allows us to make sense of the world, to question one's self about challenges of daily life and find their solution, in order to have a better life. The aim of this study is to observe the impact of the new technologies on making students' thinking visible. That would result in higher success in the course of Mathematics.

It is important to emphasize that during teaching Maths the development of the thinking skills is incorporated. The basic thinking skills that are crucial as far as learning objectives are concerned and described in Bloom's Taxonomy. These objectives are divided into three areas: cognitive, affective and psychomotor. According to this taxonomy, the cognitive domain is divided into: remembering, understanding, applying, analyzing, synthesizing and assessing.

Remembering is the lowest level classification of Bloom's cognitive taxonomy. This puts the emphasis on memorising or remembering, and means recalling facts that are collected in the memory. This level describes the reproduction level of the information that is remembered as it is stored. The remembering level, the lowest level of thinking skills represents the basis of other thinking levels. This means that it is the necessary level to pass in order to gain the other higher thinking levels. Teaching with new technologies, we have given tasks of this level by asking students to identify shapes, figures, objects that are taught. The interactions

among students about the figure which appear in front of them affect to make their thinking visible, because they express what they know and answer the question: what is that, what is its name, what it looks like etc. We as teachers push up our students to learn from each other, to write, to draw and this is the method how we make their thinking visible and understandable for us.

Understanding is the category that transforms information and facts in the most understandable form. Through this level, the material is understood and not simply memorized. This category only integrates the information as such but does not extend it further. In other words, during identification of this level, the teacher can understand how much the student has comprehended and organized the given material. In this case, we have given exercises with the help of new technologies, draw objects, move them to see the invisible sides of them and make solving geometric problems easier. That has to do with understanding the material, specifically, the current given unit. At the same time we ask students to apply formulas during drawing and deciding which of them will use in practise to achieve a solution to an actual problem.

Analysis is the highest level of application. The notion of analysis means decomposition, breaking a whole into its components. This decomposition is done for the purpose of showing that components act together to achieve a common goal or effect. Students are able to do this because the objects and geometric figures have their constituent elements which are possible to decompose and compose them to achieve higher thinking skills and to make them visible by using technologies and computer software as Geogebra. Synthesis is a higher level than analysis and it reveals its opposite, because it depends on the process of combining parts for forming an entirety that has not existed before. Synthesis is used to arrive at the solution of a specific problem where there should be a synthesizing of various parts – components and basic concepts that result in new and more complicated concepts. Geometric figures which are drawn with Geogebra are like puzzles, they appear as one unit it means that we synthesized objects and solved the given exercise about it. Evaluation is the highest level in Bloom's Taxonomy. Evaluation means thinking operations that are used to take decisions about various issues. In our case, we would say that the student forms his/her own thinking with certain previous criteria. While giving exercises from daily life, where a solution from daily life (e.g. problems related to geometry) is expected, we arrive at the evaluation stage when students thought through the given problem. According to Bloom's Taxonomy and use

the new technology as a tool in the process of teaching while aiming to achieve visible thinking within the teaching objectives, it is necessary to use suitable questions that reveal the degree of thinking skills.

Because, we as teacher through questions we help our students to think, to learn better and to be more successful in their answers. Also at one side we are faced with their questions directed to us, which give us information about student's engagement, their thinking levels and in the other side their thinking becomes visible. Furthermore by listening our students answer when they express their opinion and idea we inspire them for new ideas. Actually together with other students teachers become active listeners. A very important role in learning is imitation of others, how others think and therefore we should be teachers as thinking images presented to the students expressed Richhart, R (2011). Students need to see how others learn and how others are wrong continues Richhart, R (2011).

We make students' thinking visible through our questioning, listening and documenting (Richhart,2011) so that we can build on and extend thinking on way to deeper and richer understanding.

If the student describes, creates connections, makes decisions than we have facts that bring us in evaluating his/her thinking, because the student has already made his thinking visible. The important role of that model of thinking and learning helps us to see that education is much more than delivery of content. A quality education is also about the development of the habits of mind and thinking dispositions that will serve students as learners both in our own classrooms and in the future (Costa &Callick,2009, Richhart,2002). For this reasons we as teacher our duty is to develop the thinking skills of our students and to prepare them for the challenges of the XXI century.

Research Methodology

This research paper was completed as part of teaching Maths at high school in Tetova with the students of second year during second semester. According to the syllabus, I teach geometry like planimetry and stereometry. As teaching tools I used a laptop and a projector, where I used Geogebra as software for Maths of all levels. Student's evaluation is done based on the geometry chapter and gathered information about their success. The impact of the IT as teaching tools to the thinking skills of my students, their opinion about thinking is evaluated through the questionnaire given in Appendix. The sample content is 150 students

of second year, from them 37% were male. At the end of teaching the chapter about planymetri the students are evaluated and I got these results which were analyzed in following hypotheses:

Ho: New technology as teaching tool in Maths has not improved the success of students.

Ha: New technology as teaching tool in Maths has improved the success of students.

Using Megastat for data analysis, we came to the conclusion and verified that the average of students' success after using technology as teaching tool was higher than the students' average success before using technology as a teaching tool. Therefore, we have accepted the second hypothesis: New technology as teaching tool in Maths has improved the success of students.

Results achieved were as follows:

0.000	hypothesized value
2.673	Mean after techn
2.140	Mean before techn
0.533	Mean difference (after-before)
0.874	Std.dev
0.080	Std.error
150	N
df	149
6.71	t
1.93E-10	p-value (one tailed,upper)

At the end we had the value of $t=6.71$, which is higher than the critical value $t=3.357$ and $p=1.93E-10 < 0.05$, which means that H_0 falls and H_a is accepted.

During this study, we also used a questionnaire as a research tool which was given to students who are taught with technology as a tool. Through this questionnaire, we also concluded that hypothesis zero (H_0 : New technology is not a preferred as teaching tool among students) is incorrect in comparison with the alternative hypothesis (H_a : New technology is a preferred teaching tool among students who are taught with technology as teaching tool).

Results from questionire:

We have the students' opinions about the use of new technology as a teaching tool as follows:

All of the students think that new technology helps them to study and understand better the given material; When we asked students about using new technology as a tool of learning and teaching, 80% answered that IT brought changes to their knowledge and they are satisfied, Math's classes are more attractive and it improved their independency in solving problems. The answer of the question what they think about thinking and what happened in their mind when teachers ask from them to think; most of them answered that they recall their prior knowledge, they try to make connection between old knowledge and new knowledge, in their mind appear pictures of the thinking concept. Also most of them answered that new technology helps them to find in their mind the deposited knowledge. According to students' opinion new technology as teaching tools and drawing tool inspire and encourage them to find the solution of the given geometric problem easier. They also say that such teaching and learning tool should not only be applied in the subject of Mathematics, but also in other subjects, because this would boost student's achievements.

The demand for applying this teaching tool in other courses shows that this tool of teaching and learning is the most useful and popular with students because these students have seen the difference and benefits of this teaching tool versus traditional teaching tool. One more reason to use new technology as teaching tool is teaching natives of digital technology.

Conclusion:

This study has resulted in the following conclusions.

Through new technology in the process of teaching, students develop their visible thinking and thinking skills. New technology allows for a better follow up of students' progress. Through new technology as tool of teaching and learning, there is a higher interactivity among students and contributes to student's higher success meaning higher learning. New technology encourage students to express their ideas. The demand for applying this teaching tool in other courses shows that this tool of teaching and learning is the most useful and popular with students because these students have seen the difference and benefits of this teaching tool versus traditional teaching tool. According to student opinion, new technology as teaching tool helps them in overcoming various eventual problems related to the study materials. They also say that such teaching should not only be applied in the subject of Mathematics, but also in other subjects, because this would boost student's achievements. One more reason to use new technology as teaching tool is teaching these young people who are natives of digital technology

Recommendation

According to this research my recommendation is that if we as teachers understand how our students think we are able to have information about their learning and understanding. Teaching is not only process of teaching facts but process of teaching how to learn and how to think; for these technology helps us and students. New technology should be applied in all subjects, because it makes students more curious, active and the subject is more attractive for them. Also I suggest to Maths teachers to use Geogebra computer program as teaching tool, because it is interactive and open softwer from elementary school to university level.

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