

ATTITUDE TOWARDS USING ICT IN LEARNING AND TEACHING MATHEMATICS

Arita Takahashi
Turība University, Latvia

Abstract. *This study questions attitudes of students and mathematics teachers towards using ICT in state schools of Latvia. The author has been using Latvian education portal “uzdevumi.lv” in teaching of mathematics for several years and has observed a very wide acceptance of this learning tool both among children and teachers. On the other hand, there have been certain obstacles to apply this and other ICTs more widely. Other sites, such as “Geogebra” and “Brilliant” have been used by schools abroad. The author observes that the things that prevent schools from using such sites to a large degree depend not only from the availability of computers at school, but also from students and teachers attitudes towards using ICT in mathematics learning and teaching.*

Keywords: *Attitude towards ICT, Changing stereotypes, Flow, ICT in learning mathematics, ICT in teaching mathematics, Teacher training.*

Introduction

There have been many changes in school education system in Latvia recently. Most of them are implemented by politicians that work hard to adjust the education of Latvia to the fast changing job market of future technologies. On the other side, the teachers are not so flexible and ready to change in order to transform their teaching methods and approach to teaching. As a mathematics teacher, the author has been studying the aspects of ICT in math teaching and learning from various scientific papers and has come to some interesting conclusions and new ideas for future work. Therefore, the review of the papers and analysis of the data obtained from the questionnaires are the two methods the author is currently using. The paper describes author’s insight into the starting phase of the work. This is the beginning of a deeper research to be continued, whose results will be published after some further experiments have been carried out.

Literature Review

Thinking of ICT (by Information and Communication Technology in education we understand the mode of education that uses information and communication technology to enhance learning), not only children with special

needs are given new opportunities to improve their learning. We can remember e-learning during the Covid-19 pandemic and there were some positive aspects in distance learning. According to some scientists, e-learning enabled learning from any location, encouraged the acquisition of digital competence in students, enabled adaptation to the individual pace of students, enhanced motivation, provided access to unlimited amount of learning resources, facilitated teacher monitoring of student activities and promoted student familiarization with the use of technological and digital resources (Moreno, Aznar-Diaz, & Cáceres-Reche, 2020).

There are many gains for both children and teachers, yet there are certain things that hinder using ICT in math teaching. Schools evaluate using ICT in teaching mathematics as a very progressive idea, but when the math teachers ask for certain computer labs they need available for their lessons, some software packages to be given for free, or some repairs or technical improvements that should be done for certain computers – the schools lack resources (Zakaria & Khalid, 2016).

The administrators of schools are used to one certain rigid type of arranging labs and rooms; they prefer the traditional way of scheduling everything and they refuse “to think out of the box” to use computer labs for other subjects, not only for programming. According to a thorough research, which took place in Malaysia (Zakaria & Khalid, 2016), the benefits and constraints regarding ICT in teaching and learning mathematics can be summarised as shown in Figure1.

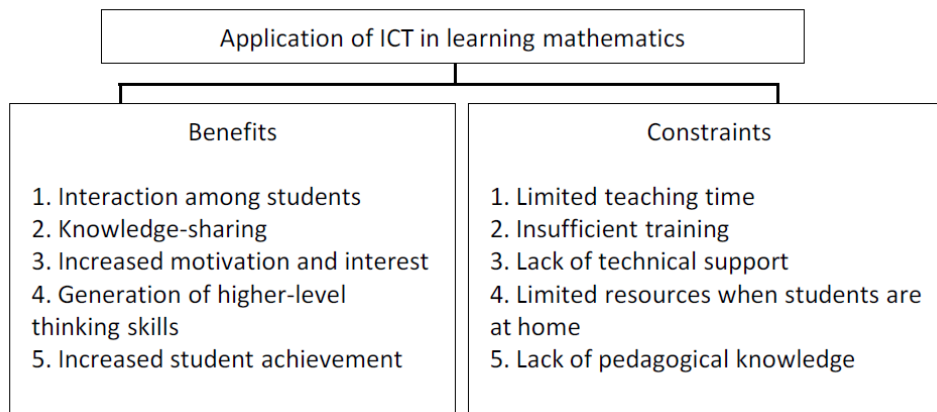


Figure 1 Summary of benefits and constraints regarding the application of ICT to learning mathematics (Zakaria & Khalid, 2016)

There is a wide range of attitudes towards the use of ICT in math teaching and learning; it is interesting that such a thing as politics in how to use calculators has influenced the attitudes for decades. According to a large study (Leung, 2006) that took place in 1999, some countries allowed using calculators in class and about 4/5 of their students used them (such politics was in Netherlands, Singapore and Australia), whereas other countries (China, Taipei, Iran, Korea, Japan,

Malaysia, Romania, Thailand and Turkey) restricted the use of calculator in classroom. Most Eastern Europe countries, including Latvia, restricted the use of calculator in classroom. Mental arithmetic was regarded as fitness training for brain, and simple addition or subtraction of numbers in math had to be done in written form on the same paper where the math problem was solved in order to show to the teacher that students “understand the solution”.

On the other hand, calculators were required for physics classes, because they allowed to solve more physics problems during a lesson and they brought effectiveness to physics lessons so that the students and the teacher could focus on the physics phenomena and not on technical procedure of calculating the values of statistics (like mean, standard deviation and error of the measurement). This politics formed believes and values not only for teachers but also for students who are the parents of nowadays’ students.

If we look at some attitudes of Iranian students that were obtained during Facebook interviews (Saadati, Tarmizi, & Ayub, 2014) then we can see that they have a reserved and old-fashioned (i.e., traditional) attitude towards using ICT for teaching mathematics, pointing out that “P8 expressed *most teachers just use power point and bring their slides and show us, without any changes in their teaching strategy... furthermore, they just reduce their activities by using power point. It is not a good idea for teaching mathematics.*” (Saadati, 2014, p.144). As Iran was a country with very strict politics regarding calculator use in math classes, it has influenced human masses for decades and the old beliefs cannot change overnight.

A calculator is the beginning form of ICT, which was available for students to purchase. Nowadays, the ICT tools have developed but the attitude has remained the same for longer than it was expected. Abstinence from calculator use in order to keep fit brain is one thing, but the shortcomings in the human to human interaction (when ITCs are used) is another.

Teaching is a form of human-to-human involvement where a teacher is trying to understand himself (his experience of knowing, practising and applying some knowledge) and at the same time trying “to migrate” this “quantum field” of his experience to another person– to his student. If a math teacher “feels numbers”, he tries to migrate the feeling as a whole to his students. To give all this to students, the teacher should be able to have free space in time and in classroom to perform an improvisation that carries away his momentary feelings that he feels when looking at certain numbers and their relationship spontaneously. In order to achieve this, teacher’s attention should not be taken away by badly working computer or by advertisements or by software which wants to update itself to a new version.

So, if we name this “aspect of flow”, then we can say that students observe their teacher in a state of “flow”. This “flow” leads the audience through certain points of experience which is communicated via intonations, gestures, emotions,

word choices, drawings, choreography, conclusions, observing mistakes and correcting them with confidence, planning (the next step of the solution), losing the thread of the story and finding it again, pausing while thinking, but storming the speech when a moment of discovery or new ideas appear.

If we regard a mathematics lesson as a piece of art – like a theatre performance – then replacing it with plain PowerPoint presentation will certainly make it more mechanic, because both the screen and the device that is used to move the slides will interrupt the “flow” and the teachers attention will be dealing with concerns regarding the arrangement of the time he would need for each slide rather than the audience. The spontaneity in dealing with mistakes, searching for solution would be missed because everything would be well-prepared and ready and already correctly solved. In case some technology does not work with the planned quality (like speed, resolution, size of the letters, shape of the math curves or geometrical objects, light in the room, reflections from the surfaces or the furniture and noise from the street or music classroom) or distraction appears – the willpower needed to keep attention to the mechanically prepared mix of information could be too high to make the experience enjoyable.

PowerPoint presentations have too little space for some improvisation for the teacher, there is less interaction between the teacher and the students and more interaction between the mechanical screen and the students. Many teachers prefer reading from the screen rather than wording their explanation in a spontaneous way. They also worry to say something in a different wording or different order than it is put in their presentation. So, the screen becomes the king of the lesson – it is not a human anymore. Technology can make math lesson more boring and less enjoyable (Saadati, 2014): “P6 said... *I can't accept to take part a math class that a lecturer use power point or some things like that.* P6 continues ... *I will sleep in this class... It is not an active class that I like.*” (Saadati, 2014, p.144).

If we look at a description of flow, we must read the formulation of Csikszentmihalyi, where he says that flow constitutes “a state in which people are so involved in an activity that nothing else seems to matter; the experience is so enjoyable that people will continue to do it even at great cost, for the sheer sake of doing it” (Csikszentmihalyi, 1990, p.4).

Also, we have to keep in mind that people cannot experience flow if distractions disrupt it (Nakamura & Csikszentmihalyi, 1990). Moreover, other authors (Bergström, Gunnarson, & Olteanu, 2021) in well-designed experiments have found out that flow can be reached if abundance of time is given to the people hoping to experience it. They point out: “Coordinating challenges with skills takes time. If there is not enough time, there is a risk that the focus will be on content alone, which can create frustration, while there is also a risk of focusing solely on flow experience, at which point the content is lost. If there is sufficient time, the students can get into flow, acquire a deeper understanding of the content and seek out greater challenges” (Bergström et al., 2021, p.22). Therefore, our guess that a

PowerPoint presentation can disappoint the students and hinder the attainment of flow state can be true.

Phiri (2016) points out that “formation of social stereotypes is another evidence of the attitude affecting people’s perception. In this case it is the social perception that is being influenced. The perception of certain undesirable traits in a particular community can easily be proved to be the result of certain attitudes that have been developed towards a particular group of individuals. Therefore, people may ignore a great deal of reality (about ICT integration in the education sector for example) and allow their perceptions to be coloured with stereotypes...” (Phiri, 2016, p.79).

Phiri (2016) states that teachers as people who have had longer life experience without having computers prefer continuing working without ICT if compared to their students whose lives without computers have been much shorter. Questionnaires that were developed and used (Phiri, 2016) showed general tendency of students having more positive attitude towards using ICT in mathematics classroom than their teachers. Phiri (2016) explains: “One possible explanation why pupils were more positive about using ICTs in learning mathematics than teachers was that pupils were in constant use of ICTs even when they were not at school. Social media such as Facebook, WhatsApp and twitter are some of the ICT facilities that have drawn the interest of youths. The unfortunate part however is that despite pupils’ perception of ICTs the youths tend to abuse these facilities in most time at the expense of using them for academic purposes.” (Phiri, 2016, p.84).

On the contrary, teachers have no sufficient experience to feel confident while using ICT in mathematics class and they remain unwilling to change their teaching practices (Phiri, 2016). Some results show (Saal, van Ryneveld, & Graham, 2019) that unconfident teachers who were forced to use ICT when teaching mathematics, achieved lower results if compared to their lessons designed in “a more traditional way”. Students were given computers for use at home and at school and depending on how they used the ICT, their studying results worsened or improved.

The authors (Saal et al., 2019) observe that “we found that only the use of computers to look up ideas had a significant negative relationship with the mathematics achievement of students” (Saal et al., 2019, p.419). The authors explain this negative relationship by the fact that “the students relied too much on computers to search for ideas in mathematics” (Saal et al., 2019, p.419). The authors also point out possible addiction to computers as negative side effect that distracts the students’ attention. They show a confession of one student: “The distribution of the tablets had a negative effect, and I regret to say that I could not able to stop playing game for hours both at school and at home” (Saal et al., 2019, p.417). Although one can suspect the young people felt “carried away” while surfing the Internet, and read and watched some non-related information that was

not about mathematics, either. And another important result, obtained (Saal et al., 2019) during the same experiments was the fact that “students who were taught by teachers who recently attended professional development for integrating IT in mathematics education performed better” (Saal et al., 2019, p.419). So, if teachers understand what they are doing and why they are doing it, they perform better than the ones who act under some poorly explained law enforcement or directive.

Extremely captivating seems the fact discovered through experiments, that the mathematics we know is conditioned by the way our bodies and minds acquire it (Leung, 2006, p.34) and that mathematics learned through the medium of ICT as embodied in our minds is different from that learned through the traditional medium of paper and pencil. Nevertheless, from the perspective of the ways mathematics is used nowadays compared to the ways it was used decades ago, we must understand that there is no way we can stubbornly stay with paper and pencil. There are the decades full of new ideas of how to use Artificial Intelligence (AI) approaching us, and we must be ready to appreciate it.

Methodology

To find out children’s attitude towards using various ICT in learning mathematics, some questionnaires were given to three groups of 13-year old 7-graders and one group of 14-year old 8-graders of a state school. There were questions with “multiple choice” type answers which were “yes, definitely”, “rather yes”, “uncertain”, “rather no” and “definitely no”. The first question was statement “*Using calculator in mathematics is cheating*” and the second was a statement of opposite type “*Using calculator is using a tool that improves one’s speed of learning*”. Then points from 0 to 4 were assigned to the answers on the first question and points in reverse order from 4 to 0 to the second question. Then the same two questions about mathematics website *uzdevumi.lv* were repeated. They were statements “*Using uzdevumi.lv in mathematics is cheating*” and “*Using uzdevumi.lv is using a tool that improves one’s speed of learning*”. In the beginning, it was planned to use classical Likert scale, but then since the purpose was to find out if a calculator was a “goodie” or not, i.e., to find out how “good” the calculator was; it was found pointless to give 1 point in the direction of “good” from people who wanted to vote for calculator as a “bad” thing. The website “*uzdevumi.lv*” could have been prised as a very good thing by everybody, because such websites are regarded as moving towards progress. But there are children who do not feel any enhancement from using such sites because their eyes get more tired when looking in a screen rather than when using paper-printed books or paper and pen. Moreover, there could be other reasons too that make old-style learning resources more appreciable than those we can use in computers.

Table 1 Scales according which responses are scored (made by author)

	yes, definitely	rather yes	uncertain	rather no	definitely no
Using calculator in mathematics is cheating	0 points	1	2	3	4 points
Using calculator is using a tool that improves one's speed of learning	4 points	3	2	1	0 points
Using uzdevumi.lv in mathematics is cheating	0 points	1	2	3	4 points
Using uzdevumi.lv is using a tool that improves one's speed of learning	4 points	3	2	1	0 points

All 94 children were informed that the questionnaires were going to be anonymous and they all agreed to participate in providing their viewpoints. The first two questions were given about calculator to find out if they were influenced by old stereotypes of previous generations who were schooled under very conservative old-style calculator politics of soviet-type education. The soviet-type education believed that using calculators to study mathematics would not promote fit and hard-working brain development. Nevertheless, it allowed (even enforced) using calculators to study physics.

To sum all the points gained from the first two questions under one common trait which was called “Using calculator is good”, first the points gained from the first two questions were compared separately. To make them more comparable, the first question was re-written “using calculator is not cheating” and then the number of answers was flipped from “rather agree” to “rather disagree” and vice versa. Also, the number of answers from “strongly agree” was changed with the number of “strongly disagree” so as to make the scales to match.

The answers to the first two questions of 21 children belonging to group 7c are depicted in bar chart in Figure 2. As can be seen from Figure 2, most of the children have a very positive attitude towards the use of calculator.

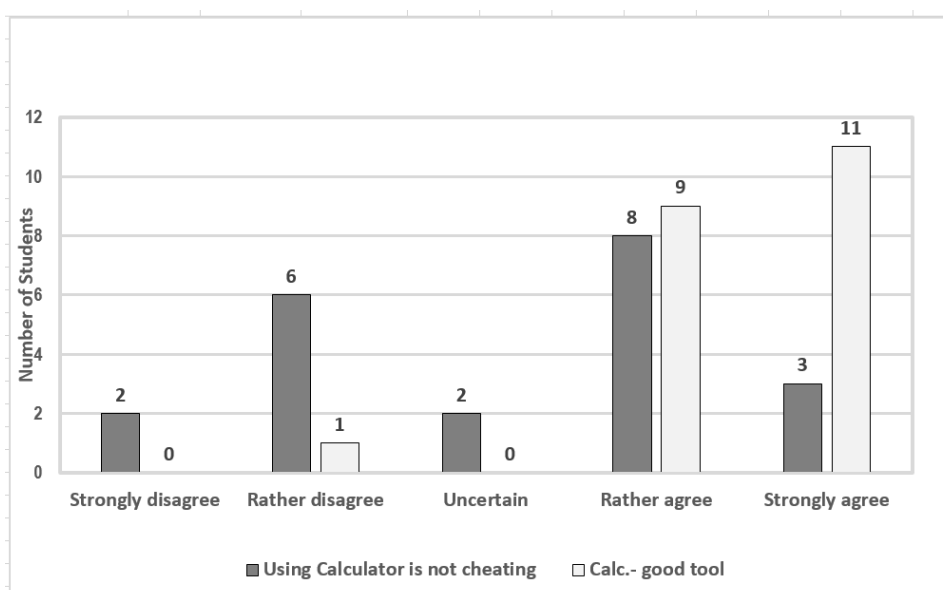


Figure 2 Children attitudes towards using calculator (group 7c) (made by author)

If we combine the two questions as a single approach to the attitude towards calculators, then the answers can be represented as the sums of the answers to both questions. If these sums of answers are expressed as percentages, then we can see the overall picture of how students from 7c relate to the use of calculators.

Table 2 shows that the sum of points in total is 42, because they come from answers to two questions (not to one question).

If we look at how children feel about using calculator – whether using calculator is a good thing – we can see that 32% strongly agree and 41% rather agree that it is so. We can also see that 5% of children are uncertain about their position, 17% rather disagree that using calculator when learning mathematics is good and 5% of them strongly disagree that it is a good thing.

Table 2 Children attitudes towards using calculator – the sum of answers (group 7c) (made by author)

	Using Calculator is good	Using Calculator is good, Percent
Strongly disagree	2	5
Rather disagree	7	17
Ucertain	2	5
Rather agree	17	40
Strongly agree	14	33

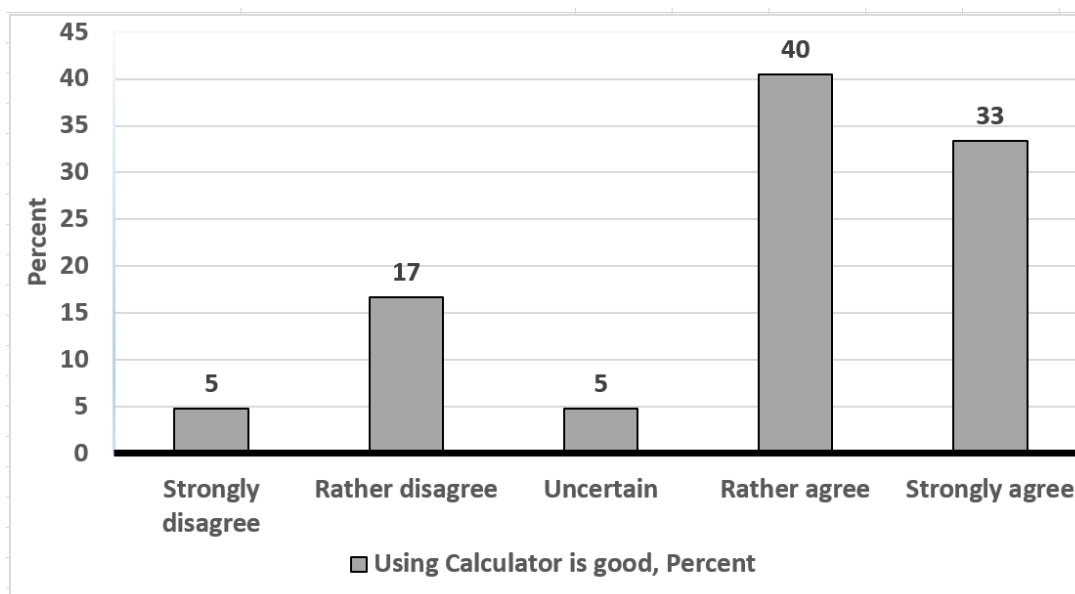


Figure 3 Children attitudes towards using calculator – the sum of answers depicted in percentage of all the answers given (group 7c) (made by author)

The questions about website uzdevumi.lv were processed in analogous way.

Regarding teachers’ attitudes towards using ICT in teaching mathematics three separate free-style interviews with three different mathematics teachers were performed. The conversations were recorded with teachers’ permissions, and the teachers were informed that all their texts will be anonymous and only the

most important ideas will be analysed in the results. A detailed description and analysis of the data is provided in the next section.

Research results

There were 26 children to answer the questionnaire in group 7a. As we can see from Figure 4, the distribution of data regarding the first question reminds a bimodal one.

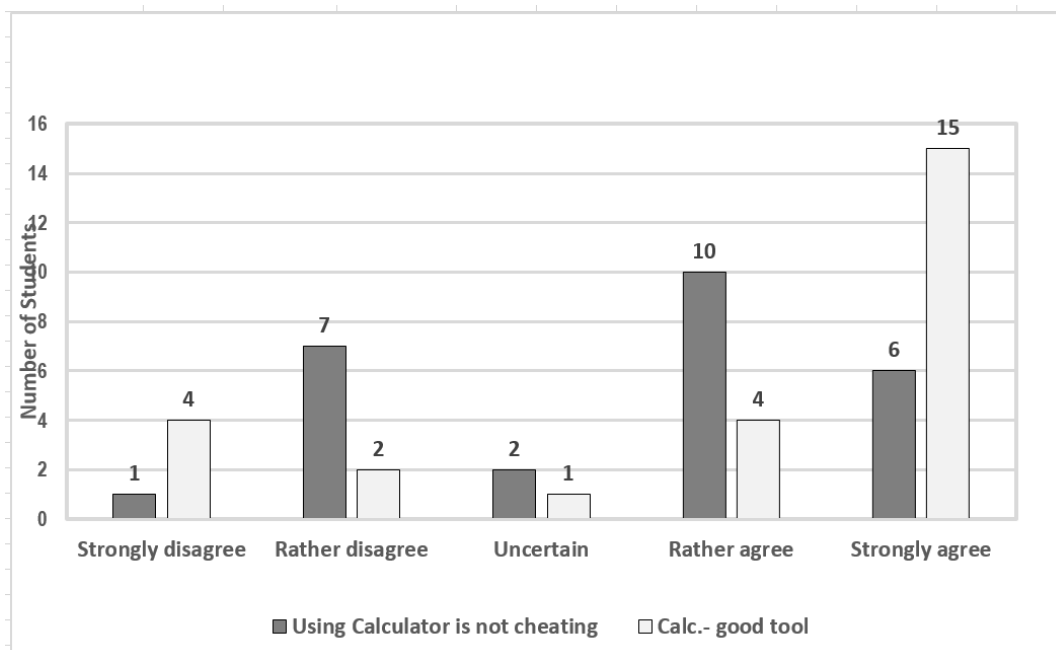


Figure 4 Children attitudes towards using calculator (group 7a) (made by author)

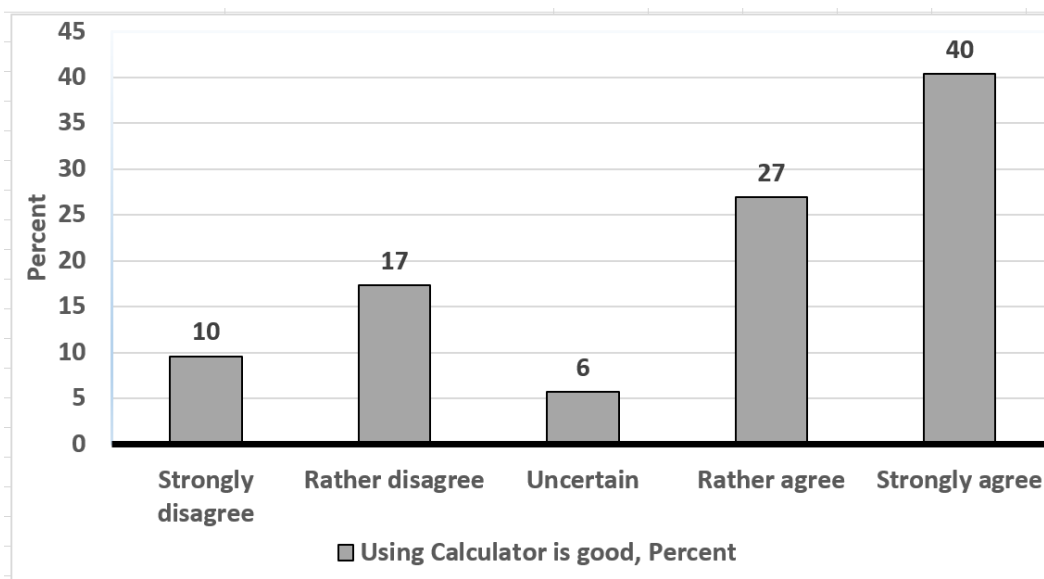


Figure 5 Children attitudes towards using calculator – the sum of answers depicted in percentage of all the answers given (group 7a) (made by author)

If we analyse the answers to the second question, then we can see a clear unimodal distribution with data from group 7c, but bimodal from group 7a.

Now, switching our attention to group 7b, we can see that the subgroup with a negative attitude towards calculator use is strongly represented among these 25 students (see Figure 6).

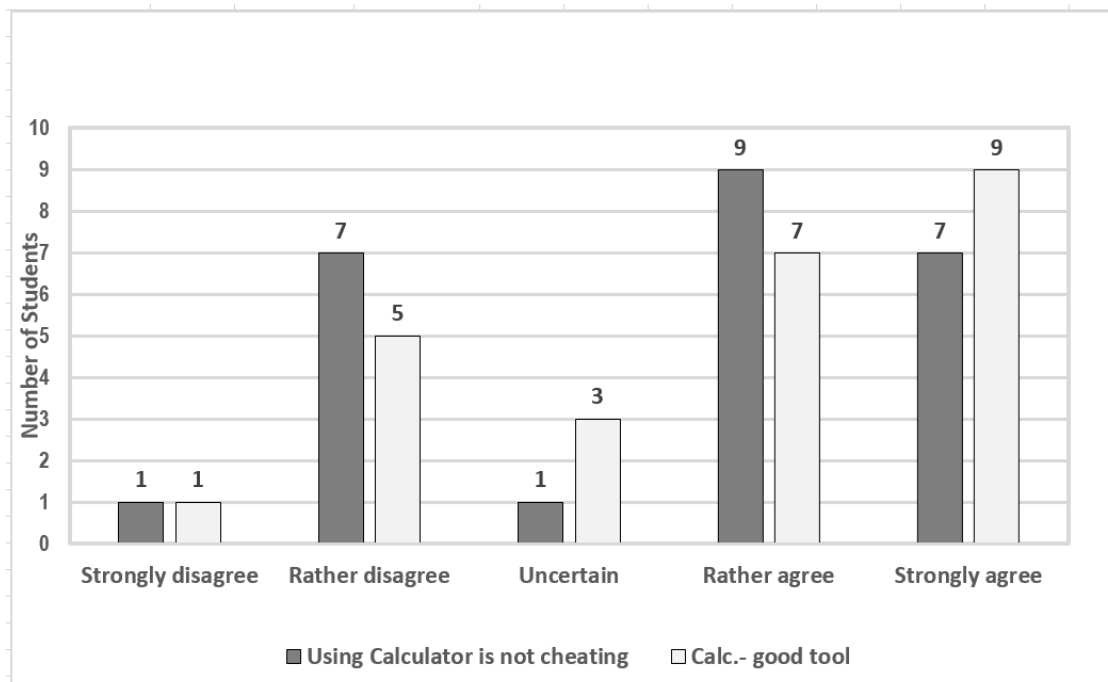


Figure 6 Children attitudes towards using calculator (group 7b) (made by author)

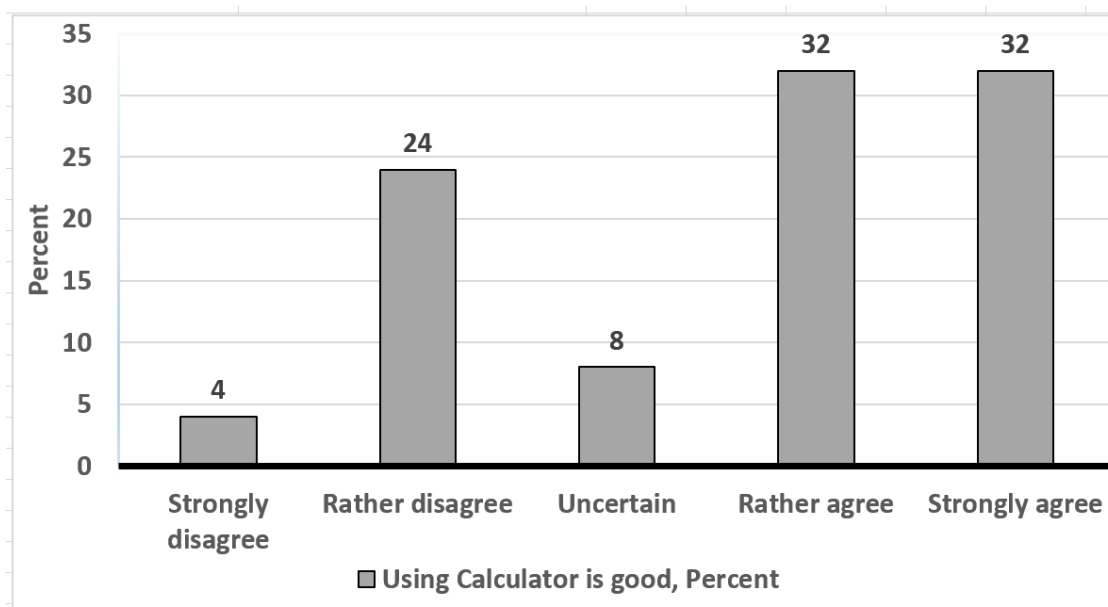


Figure 7 Children attitudes towards using calculator – sum of answers depicted in percentage of all the answers given (group 7b) (made by author)

We can see the same tendency in Figure7 as well.

There is a very interesting tendency one can observe when looking at bar chart of group 8b consisting of 8-graders (see Figure 8). There are no children who are uncertain about their position with this issue. This could be explained by characteristics of 14-year old children. They want to feel certain, so they take sides and do not give “blurry” answers.

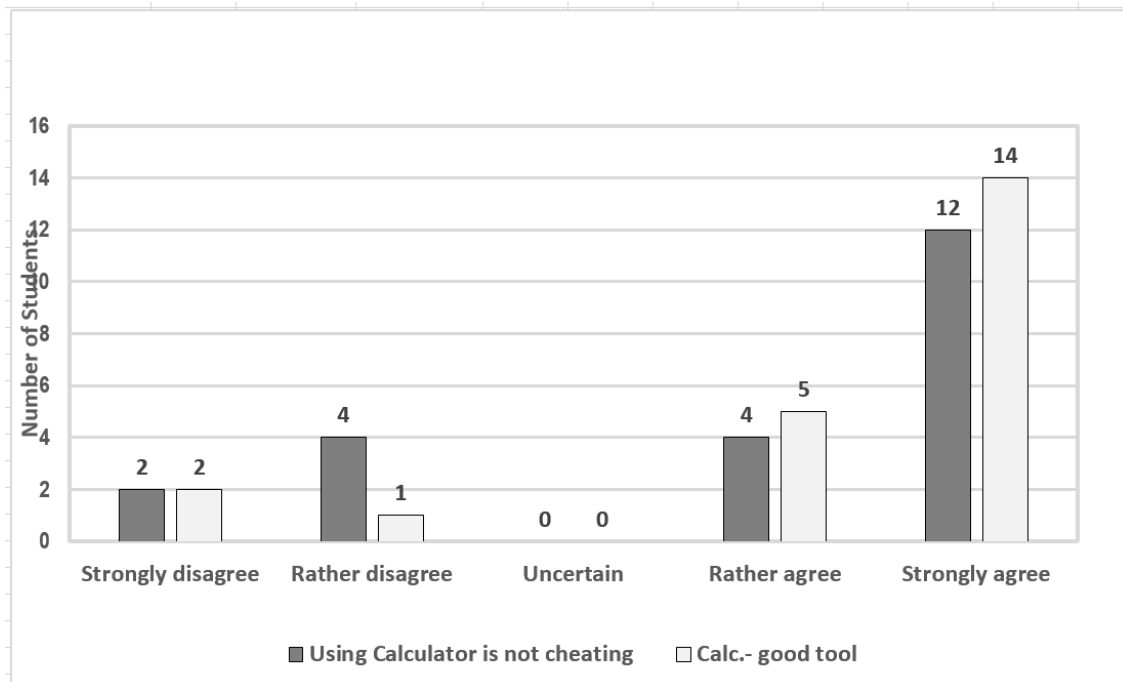


Figure 8 Children attitudes towards using calculator (group 8b) (made by author)

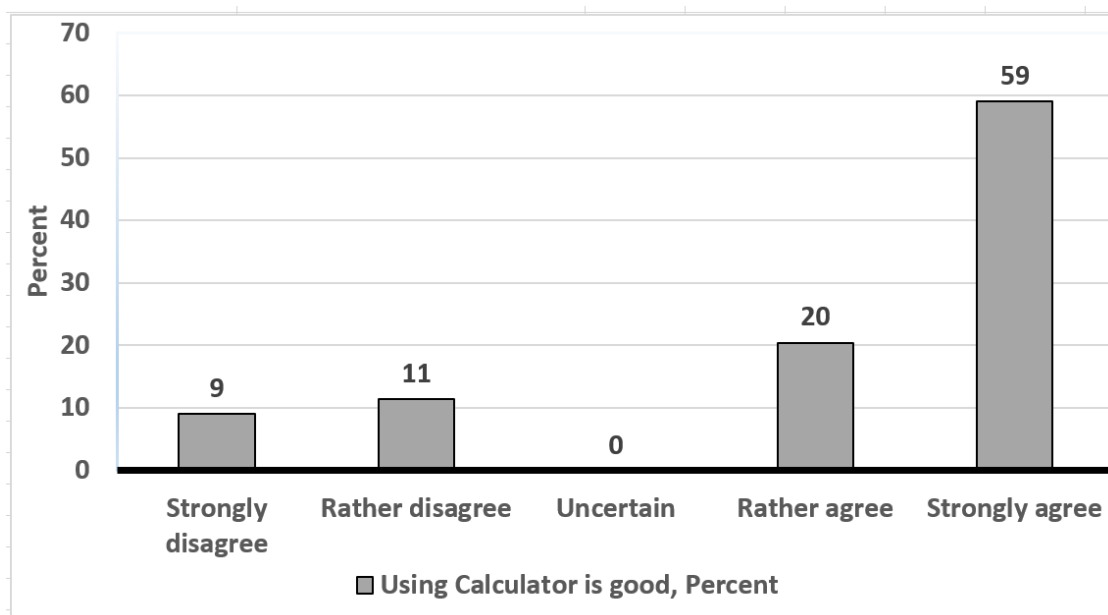


Figure 9 Children attitudes towards using calculator – sum of answers depicted in percentage of all the answers given (group 8b) (made by author)

The bar diagram in Figure 9 reminds the shape of an exponential distribution; this could also be explained with teenage decision-making.

The data about attitudes towards learning platform “uzdevumi.lv” were gathered all together – regardless of any groups, because there was no theoretical reason to show the obtained data separately group by group.

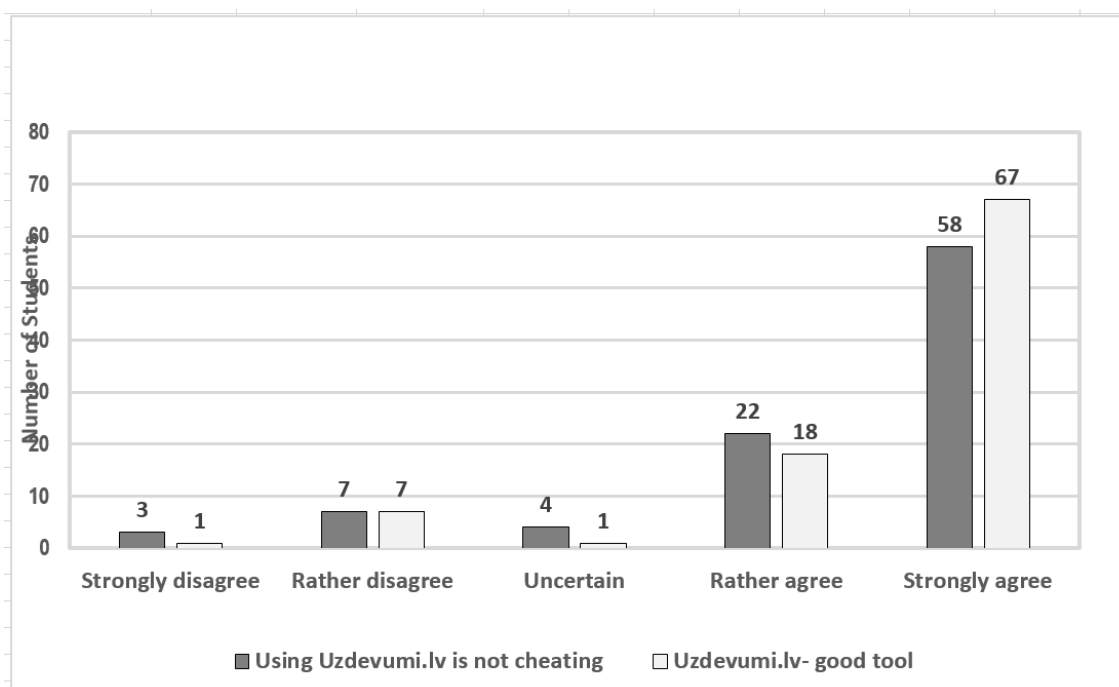


Figure 10 Children attitudes towards using Uzdevumi.lv (all groups together) (made by author)

We can see that the attitudes toward using education portal uzdevumi.lv among students are much more positive than towards using calculator. The bar chart looks like a unimodal distribution which has some exponential characteristics – it grows exponentially towards positive attitudes.

Looking at these charts, we can understand that children do not have conservative stereotypes. They show that their feelings forwards using ICT in learning mathematics are positive. It is not this way with the mathematics teachers.

The first interview was quite positive, and the teacher mentioned that she has been attending courses to learn how to use “Geogebra” and “Desmos” in her mathematics classes, but she could not use all the ICTs she learned – so, she mostly used uzdevumi.lv. She also mentioned using uzdevumi.lv very often – mostly during her lessons. She admitted that she had been giving some homework in uzdevumi.lv as well, but not all students did the homework because they were lazy. We also must admit that the laziness of students does not disappear if the homework has to be done using ICT. If some ICT does their work for them, i.e., like calculator does some sums or some other person provides them with a copy

of solution of the hardest problem, which was given as homework, then students are more likely to “study”.

The second teacher uses uzdevumi.lv during her mathematics lessons so that the children access certain mathematics tests via their mobile phones. Her comment (transformed to written English) goes approximately like this:

“Small children (12 years), if they are doing tasks on the phone, then if the phone hangs up, they are helpless– children are not really mobile phone experts. They only imagine themselves as such. The use of ICT in teaching mathematics does not promote interest in mathematics and does not help to overcome laziness. If we are talking about grammar school students – maybe it is different there. ICT is a fashion thing. Children must learn to work with a printed book and write with a pen on paper. In math, a graph board for writing with chalk is the best thing ever. What is the point of a child learning how to draw graphs in Geogebra, if everything will have to be drawn with a pencil on paper in the exam anyway? ICT– it is following the latest fashion. At home, children do not try to use ICT themselves. So what is the point if they try ICT at school once in their life? They don't learn it from one single time.”

The third teacher had very similar ideas:

"Uzdevumi.lv" homework cannot be graded for children, because then the grades will be too good. There is no way to control how that child learns that high grade. Maybe the parents complete the tasks instead of the children– it cannot be found out later.

She praises blackboard and chalk:

“A child's interest in new ICT is only at the initial stage– I say this from my own experience... After that, the interest in ICT disappears. What grammar schools have said– what is best? A blackboard and chalk are best. That's all grammar schools use. Children will like chalk and a regular blackboard best.”

Conclusions

The results obtained show that students do not have negative stereotypes about using calculator and “uzdevumi.lv” to learn mathematics. Nevertheless, as regards the use of calculator, some students believe using it is like cheating; therefore, the data obtained look like a bimodal distribution. Using site “uzdevumi.lv” is not considered cheating at all, by comparison. At the same time, the teachers of the school believe that blackboard, chalk, book and pen are the best tools for learning mathematics.

List of References

- Csikszentmihalyi, M., (1990). *Flow: The psychology of optimal experience*. Harper&Row.
- Bergström, T., Gunnarson, G., & Olteanu, C. (2021). The importance of flow for secondary school students' experiences in geometry. *International Journal of Mathematical Education in Science and Technology*, DOI: <https://doi.org/10.1080/0020739X.2021.1989511>
- Leung, F. (2006). The Impact of Information and Communication Technology on Our Understanding of the Nature of Mathematics. *For the Learning of Mathematics* 26 (1), 29-35. Retrieved from: <https://www.jstor.org/stable/40248521>
- Moreno A. J, Aznar-Diaz I. & Cáceres-Reche P. (2020). E-Learning in the Teaching of Mathematics: An Educational Experience in Adult High School. *Mathematics*, 8(5) 840. DOI: <https://doi.org/10.3390/math8050840>
- Nakamura, J., & Csikszentmihalyi, M. (1990). Flow theory and research. In C. R. Snyder & S. J. Lopez (Eds.), *Handbook of positive psychology*, 193-206.
- Phiri, W., (2016). Pupils' and teachers' perception toward the use of Information and Communication Technology (ICT) in the teaching and learning of mathematics in selected secondary schools of Central Province, Zambia. *International Journal of Multidisciplinary Research and Development*, 3(1), 77-87.
- Saadati, F., Tarmizi, R. A., & Ayub, A. F. (2014). Utilization of Information and Communication Technologies in Mathematics Learning. *IndoMS-JME (Journal of Mathematics Education)*, 5(2), 138-147. Retrieved from: <https://ejournal.unsri.ac.id/index.php/jme/article/view/1498/545>
- Saal, P. E., van Ryneveld, L., & Graham, M.A. (2019). The Relationship between using Information and Communication Technology in Education and Mathematics Achievement of Students. *International Journal of Instruction*, 12(3), 405-424. DOI: <https://doi.org/10.29333/iji.2019.12325a>
- Zakaria, N. A., & Khalid, F. (2016). The Benefits and Constraints of the Use of Information and Communication Technology (ICT) in Teaching Mathematics. *Creative Education*, 7, 1537-1544. DOI: <http://dx.doi.org/10.4236/ce.2016.711158>