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ANALYSIS OF STUDENTS' COMPUTATIONAL THINKING ABILITY IN PRIOR MATHEMATICAL KNOWLEDGE

Lilis Marina Angraini[1)], Ilham Muhammad[2)]
[1]Universitas Islam Riau, Riau, Indonesia
[2]Universitas Pendidikan Indonesia, Bandung, Indonesia

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ABSTRAK

Penelitian ini dilatarbelakangi oleh pentingnya kemampuan Computational Thinking (CT) bagi siswa untuk mendapatkan kemampuan berpikir dan pemecahan masalah yang lebih baik. Tujuan penelitian menggambarkan kemampuan CT siswa ditinjau dari Pengetahuan Awal Matematika (PMK). Subyek penelitian ini adalah siswa SMP sebanyak 6 orang yang terdiri dari 2 siswa yang memiliki kemampuan awal matematika tinggi, 2 siswa yang memiliki kemampuan awal matematika sedang, dan 2 siswa yang memiliki kemampuan awal matematika rendah. Pemilihan subjek tidak dipilih secara acak. Metode penelitian yang digunakan adalah deskriptif kualitatif, dimana data yang disajikan diperdalam dengan wawancara. Selanjutnya instrumen yang digunakan adalah tes dan non tes. Dalam hal ini, tes CT digunakan untuk mengetahui kemampuan CT siswa ditinjau dari pengetahuan matematika awal mereka, sedangkan non tes berupa wawancara digunakan untuk mengetahui alasan jawaban tes mereka. Hasil penelitian ini menunjukkan bahwa siswa yang memiliki pengetahuan matematika awal yang tinggi mampu memenuhi indikator matematika CT dengan baik. Selanjutnya, siswa yang memiliki kemampuan awal matematika sedang mampu memenuhi beberapa indikator CT matematika, sedangkan siswa yang memiliki kemampuan awal matematika rendah tidak dapat memenuhi indikator CT matematika dengan baik.

ABSTRACT

This research was motivated by the importance of Computational Thinking (CT) ability for students to get a better thinking and problem solving abilities. The purpose of the study describes the students' CT ability in terms of their Prior Mathematical Knowledge (PMK). The subjects of this study were 6 junior high school students consisting of 2 students who had a high prior mathematical knowledge, 2 students who had a medium prior mathematical knowledge, and 2 students who had a low prior mathematical knowledge. The selection of subjects was not randomly selected. The method of research used was descriptive qualitative, where the data presented were deepened by interviews. Furthermore, the instruments used were test and non-test. In this case, the CT test was used to determine students' CT ability in terms of their prior mathematical knowledge, while the non-test in the form of interviews was used to find out the reasons for their test answers. The results of this study indicate that students who had a high prior mathematical knowledge were able

to meet the CT mathematical indicators well. Furthermore, students who had a medium prior mathematical knowledge were able to meet several mathematical CT indicators, while students who had a low prior mathematical knowledge cannot fulfill mathematical CT indicators well.

Penulis Koresponden:

Lilis Marina Angraini
Universitas Islam Riau
Jalan Kaharuddin Nasution Nomor 114, Pekanbaru, Riau, Indonesia
lilismarina@edu.uir.ac.id

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INTRODUCTION

Mathematics is an important knowledge for every students. Learning mathematics will make a person have several abilities including reasoning ability, connection ability, communication ability, logical thinking ability, critical thinking ability, and problem-solving ability. These abilities become provisions for students in facing various life challenges, including science challenges which will certainly continue to develop over time. The knowledge that is constantly developing requires good thinking ability and problem solving ability so that challenges and problems that will arise can be resolved properly.

If students have strong computational thinking (CT) skills, they can reason clearly and solve problems. It takes computational thinking to break down an issue into smaller pieces so that a solution may be found. Computational thinking is a cognitive skill that leads students to identify patterns, solve complex problems by breaking them down into simple parts, arranging and making various steps to find solutions, then building data representations through simulations.

Computational thinking is a problem solving technique that has a wide coverage area, not only to solve problems around computer science and mathematics but also to solve various problems in everyday life (Rosadi, et al, 2020), (Cahdriyana & Richardo, 2020), (Zahid, 2020). With computational thinking, students will learn how to think in a structured, logical, and critical manner. Computational thinking is very important for students to help them structured solving complex problems (Sukamto, et al, 2019), (Syarifuddin, 2019), (Fajri, 2019), (Putra, et al, 2019), (Alfina, 2017). Computational thinking is an important skill that is needed in the future according to the world economic forum. By mastering these skills, students will be better prepared to survive and compete in the coming era, where several existing professions will disappear and an era where new professions will emerge.

Computational thinking is a series of activities that require problem solving skills and techniques. The characteristics in computational thinking are formulating problems by decomposing the problem into smaller parts so that they are easier to solve (Lestari & Annizar, 2020), (Tresnawati, et al, 2020). Such strategy in computational thinking allows students to turn complex problems into several procedures or steps that are not only easier to solve, but also provide an efficient way to think critically (Kadarwati, et al, 2020), (Lestari & Annizar, 2020), (Syarifuddin, 2019). Computational thinking can train the brain to get used to thinking logically, structured, and critically.

The way to implement computational thinking is to understand the problem, collect all the data from the problem, then start looking for solutions according to the existing problem. In computational thinking, there is what is called decomposition, where students solve a complex problem into small problems to be solved. Furthermore, computational thinking is thinking with algorithms where we think by sequencing the steps in solving a problem so that it becomes logical, sequential, orderly and easily understood by others. Computational thinking ability is important for students to have so that they have better-thinking ability (Kawuri, et al, 2019), (Maharani, 2020).

There are four computational thinking skills, namely: problem decomposition, pattern recognition, pattern abstraction and generalization, and algorithmic thinking (Nurmuslimah, 2020), (Grover & Pea, 2018), (Román-González, et al, 2017), (Tabesh, 2017), (Gadanidis, 2017), (Sung, et al, 2017), (Kale, et al, 2018).

Research related to the importance of CT ability has been carried out previously (Kadarwati, et al, 2020), (Lestari & Annizar, 2020), (Cahdriyana & Richardo, 2020), (Zahid, 2020) (Tresnawati, et al, 2020). Whereas this study wanted to see the students' CT ability in terms of their prior mathematical knowledge. This is done with the hope that the future researchers could compile teaching materials that aimed to improve students' CT ability in terms of their prior mathematical knowledge. The purpose of this study was to describe students' computational thinking ability in terms of their prior mathematical knowledge.

METHOD

This study aimed to describe students' mathematical CT ability in terms of their prior mathematical knowledge. In this case, the research method used was descriptive qualitative, where the data are presented and then deepened by interviews. This research was conducted at one of Junior High Schools at Pekanbaru by selecting 6 junior high school students (not randomized) as the research samples, consisting of 2 students who had a high prior mathematical knowledge, 2 students who had a medium prior mathematical knowledge, and 2 students who had a low prior mathematical knowledge. Furthermore, this research was conducted from April 20 to May 20, 2020.

This study used a written test instrument in the form of a description aiming that students can explore their understanding in written form so that data concerning the students' mathematical CT ability were obtained. By using the essay test, the results of the students' answers will represent the CT ability they have mastered. The results of the students' answers were further strengthened by interviews to find out how far the

students have mastered the questions given. The interview method used in this research is a semi-structured interview, which is asking a series of structured questions, then deepening one by one to get further information. In this case, the interview questions asked by the researcher were adjusted to the conditions of the students at the time of the interview while still considering the core problems that have been predetermined by the researcher. Researchers can develop questions and decide for themselves which questions should be asked to research subjects. The analysis of the results of the written test was carried out by describing the students' computational thinking ability and then supported by interviews as a form of clarification of the research subjects regarding their test answers.

RESULTS

The data presented in this study were obtained from the results of the CT test and the results of interviews with six research subjects consisting of 2 students who had a high prior mathematical knowledge, 2 students who had a medium prior mathematical knowledge, and 2 students who had a low prior mathematical knowledge. Students who had a high prior mathematical knowledge were symbolized as S_1 and S_2. Students who had a medium prior mathematical knowledge were symbolized as S_3 and S_4. Students who had a low prior mathematical knowledge were symbolized as S_5 and S_6.

There are four computational thinking skills, namely: problem decomposition, pattern recognition, pattern abstraction and generalization, and algorithmic thinking (Nurmuslimah, 2020), (Grover & Pea, 2018), (Román-González, et al, 2017), (Tabesh, 2017), (Gadanidis, 2017), (Sung, et al, 2017), (Kale, et al, 2018). A further explanation of these skills is described below.

a. Decomposing a phrase into its constituent pieces is a manner of thinking about it. The indication is whether or not students can recognise facts learned from the issues provided and recognise facts requested in relation to the difficulties provided.
b. The key to finding the best solution to an issue and understanding how to solve a particular kind of problem is pattern recognition. The indication is whether or not students can identify similar or dissimilar patterns or traits while working through the difficulties provided to develop a solution.
c. Generalisation is a strategy for tackling brand-new issues based on how you handled comparable issues in the past. Students' ability to articulate the logical procedures used to develop a solution to the difficulties provided.
d. Algorithmic thinking is a way of getting a solution through clear definitions of the steps taken. The indicator is that students can mention general patterns of similarities/ differences found in the problems given; students can conclude patterns found in a given problem.

The following Table 1 concludes the computational thinking ability of students who have a high prior mathematical knowledge in solving problems based on the description and data analysis of S_1 and S_2 subjects. The checkmark (√) indicates the achievement of students' computational thinking indicators. Meanwhile, the unmarked rows or columns indicates that the students did not have the computational thinking yet.

Table 1. Achievement of Computational Thinking Indicators for students who Had a High Prior Mathematical Knowledge in Solving Problems

No	Indicator	Interpretation of Indicators	Subject S_1 for Problem Number 1	Subject S_1 for Problem Number 2	Subject S_2 for Problem Number 1	Subject S_2 for Problem Number 2
1	Decomposition	Students are able to identify information that is known from the problems given	√	√	√	√
		Students are able to identify the information asked about the problems given	√	√	√	√
2	Pattern recognition	Students may identify similar or distinct patterns or traits while addressing issues and creating solutions.	√	√	√	√
3	Algorithmic Thinking	Students are able to list the logical procedures that were used to provide a solution to the difficulties that were presented.	√	√	√	√
4	Generalization and Pattern Abstraction	Students can identify broad patterns of similarities and contrasts in a specific topic.	√	√	√	√
		Students are able to draw conclusions from patterns found in a problem given	√	√	√	√

Based on the answers of tests and the interviews of students who have a high prior mathematical knowledge, it can be seen that the two subjects fulfill all of the students' computational thinking indicators. The following table 2 shows the conclusion of the computational thinking ability of students who had a medium prior mathematical knowledge in solving problems based on the description and data analysis of the S_3 and S_4 subjects. The check mark (√) indicates the achievement of the student's computational thinking indicator. Meanwhile, the unmarked row or column indicates that the students did have the computational ability yet.

Table 2. Achievement of Computational Thinking Indicators for Students Who Have a Medium Prior Mathematical Knowledge in Solving Problems

No	Indicator	Interpretation of Indicators	Subject S_3 for Problem Number 1	Subject S_3 for Problem Number 2	Subject S_4 for Problem Number 1	Subject S_4 for Problem Number 2
1	Decomposition	Students are able to identify information that is known from the problems given	√	√	√	√
		Students are able to identify the information asked about the problems given	√	√	√	√
2	Pattern recognition	Students may identify similar or distinct patterns or traits while addressing issues and creating solutions.	√	√	-	-
3	Algorithmic Thinking	Students are able to list the logical procedures that were used to provide a solution to the difficulties that were presented.	√	√	-	-
4	Generalization and Pattern Abstraction	Students can identify broad patterns of similarities and contrasts in a specific topic.	√	√	-	-
		Students are able to draw conclusions from patterns found in a problem given	√	√	-	-

Based on the answers of tests and the interviews of students who had a medium prior mathematical knowledge, it can be seen that this one subject fulfilled several indicators of students' computational thinking. The following is table 3 which shows the conclusion of the computational thinking ability of students who have a low prior mathematical knowledge in solving questions based on the description and data analysis of subject S_5 and subject S_6. The check mark (√) indicates the achievement of the student's computational thinking indicator. Meanwhile, the unmarked rows or columns indicate that the students did not have the computational ability yet.

Table 3. Achievement of Computational Thinking Indicators for Students Who Have a Low Prior Mathematical Knowledge in Solving Problems

No	Indicator	Interpretation of Indicators	Subject S_5 for Problem Number 1	Subject S_5 for Problem Number 2	Subject S_6 for Problem Number 1	Subject S_6 for Problem Number 2
1	Decomposition	Students are able to identify information that is known from the problems given	√	√	-	-
		Students are able to identify the information asked about the problems given	√	√	√	√
2	Pattern recognition	Students may identify similar or distinct patterns or traits while addressing issues and creating solutions.	√	√	√	-
3	Algorithmic Thinking	Students are able to list the logical procedures that were used to provide a solution to the difficulties that were presented.	-	√	√	-
4	Generalization and Pattern Abstraction	Students can identify broad patterns of similarities and contrasts in a specific topic.	-	-	-	-
		Students are able to draw conclusions from patterns found in a problem given	-	√	-	-

Based on the answers of tests and the interviews of students who had a low prior mathematical knowledge, it can be seen that the two subjects did not meet the students' computational thinking indicators well. Based on the results of data analysis on students' computational thinking ability in solving problems, it can be seen that students in the high mathematical ability prior mathematical knowledge category have met all indicators of computational thinking well. In this case, students are able to identify information that is known and asked about the problems given. They were also able to recognize the same/ different patterns or characteristics in solving a given problem in order to build a solution. In addition, students were able to mention the logical steps used to construct a solution to the problems given. Students were also able to mention general patterns of similarities/ differences found in a given problem and were able to draw conclusions from patterns found in the problems given.

Students who had a high prior mathematical knowledge had the highest computational thinking ability among students who had a medium and low prior mathematical knowledge. This is shown by the number of indicators of computational thinking ability that can be achieved by students. Based on data analysis, it shows that students who had a high prior mathematical knowledge had algorithmic thinking ability in computational thinking by doing it in a detailed and systematic manner. In addition, it can also be seen from the way students do it with mathematical models. This is in line with the opinion stated by Isroil, et al. (2017) that "students who have high prior mathematical knowledge in designing completion plans by making mathematical models in accordance with the information on the questions".

Students with a high prior mathematical knowledge were able to take steps to solve problems well. These students also showed accuracy in looking for patterns which were then used to draw conclusions from the problems given. These students were also able to use their logical skills and then easily analyzed the problems given and students with a high prior mathematical knowledge were able to account for the answers.

Furthermore, based on the results of data analysis on students' computational thinking ability in solving problems, it can be seen that students in the medium prior mathematical knowledge category have met several indicators of computational thinking well. Computational thinking is part of the problem solving ability, but computational thinking emphasizes thinking about solving problems with logic. One of the students who had medium mathematical ability was able to identify information that is known and asked about the problem given (indicator 1), can recognize patterns or characteristics that are the same/ different in solving a given problem in order to build a solution (indicator 2), were able to recognize patterns or the same/ different characteristics in solving the problems given in order to build a solution (indicator 3), and were able to mention the logical steps used to construct a solution to the given problem (indicator 4). As for number 1, these students can meet indicators 1, 2, and 3. However, they cannot meet indicator 4. Judging from the results of the interview, the student is correct in the steps to work on question number 1, but not quite right in answering question number 1. This is in line with the opinion stated by Oktaviana, et al, (2018) that "students with problem solving ability are answering correctly, it's just that they are less careful when giving conclusions".

Furthermore, students who had a medium prior mathematical knowledge were only able to meet indicator 1 in computational thinking. This shows that not all students with medium prior mathematical knowledge were able to recognize the same/ different patterns or characteristics of problem solving, and state the logical steps used to construct a solution to a given problem. For this reason, students who had a medium prior mathematical knowledge need to improve their computational thinking ability.

Then based on the results of data analysis about students' computational thinking ability in solving problems, it can be seen that students in the low prior mathematical knowledge category have not met al indicators of computational thinking well. One of the students who had low prior mathematical knowledge was able to identify the information that is known and what is asked of the problems given (indicator 1), was

able to recognize the same/ different patterns or characteristics in solving the problems given to build a solution (indicator 2), was able to mention the logical steps used to prepare a solution to the problem given (indicator 3), was unable to mention the general pattern of similarities/ differences found in the given problem, but was able to draw conclusions from the patterns found in the given problem which means students were not able to meet (indicator 4) in question number 2. This can be seen in Figure 9, based on the results of the interview that the student was correct in the steps to work on question number 2, but when it was applied to the writing, it was seen that the students saw that the results of the interview were different from the way they wrote. It is possible that this occurred because the student was not careful in answering or it could be that the student was just guessing the answer to question number 2.

Meanwhile, the other student who had low prior mathematical knowledge was unable to identify known information which is part of indicator 1 in computational thinking. These students also could not meet indicators 3 and 4. Students who had low prior mathematical knowledge were too fast in answering the problems given so that the answers were not correct. Students were also not careful and did not understand what information was known from the questions and students were not able to take responsibility for their answers. This is in line with the opinion stated by Oktaviana, et al. (2018) that "students who have low prior mathematical knowledge tend to want to answer questions quickly so they don't write down the information on the questions and are not careful when working on questions, causing errors when answering questions".

For this reason, it is necessary to apply computational thinking (CT) to improve CT ability in students who had medium and low prior mathematical knowledge. It is also necessary to maintain CT ability in highly capable students because this learning can provide experiences of (1) self confidence in dealing with situations, (2) persistence in working in difficult problems, (3) the ability to deal with ambiguity, (4) the ability to handle open problems, (5) putting aside differences to work with other people in order to achieve common goals or solve problem solutions, and (6) knowing one's fears and weaknesses when working with others". Improving CT ability can be given questions that refer to the CT ability indicator. This is in line with Nurmuslimah's research (2020) that "the application of computational thinking and Islamic culture based questions has a positive influence on student learning outcomes and learning motivation".

CONCLUSION

Based on the results and discussion of the research, it is found that students who have a high prior mathematical knowledge can fulfill the students' computational thinking indicators well. Then students who have a medium prior mathematical knowledge can fulfill several indicators of computational thinking, but not all students who have a medium prior mathematical knowledge can fulfill those indicators of computational thinking. Meanwhile, students who have a low prior mathematical knowledge cannot meet the indicators of computational thinking well. For this reason, students who have medium and low prior mathematical knowledge need to improve their computational thinking ability. In addition, students who have a high prior

mathematical knowledge need to maintain their computational thinking ability. This can be done by applying computational thinking in learning.

REFERENCES

Alfina, A. (2017). Berpikir Komputasional Siswa dalam Menyelesaikan Masalah yang Berkaitan dengan Aritmatika Sosial Ditinjau dari Gender. *Simki-Techsain* 1(4), 1-6. URL: http://simki.unpkediri.ac.id/mahasiswa/file_artikel/2017/f7d3e9131ddd452b1a425ded076877b6.pdf

Cahdriyana, R. A. & Richardo, R. (2020). Berpikir Komputasi dalam Pembelajaran Matematika. *LITERASI* XI(1). DOI: http://dx.doi.org/10.21927/literasi.2020.11(1).50-56

Fajri, M, *et al*. (2019). Computational Thinking, Mathematical Thinking Berorientasi Gaya Kognitif pada Pembelajaran Matematika di Sekolah Dasar. *Dinamika Sekolah Dasar* 1(1), 1-18. DOI: http://dx.doi.org/10.31258/biogenesis.18.1.68-84

Grover, S. & Pea, R. (2018). Computational Thinking: A Competency whose Time has Come. *Computer Science Education: Perspectives on Teaching and Learning in School* 19. DOI:10.5040/9781350057142.ch-003

Gadanidis, G. (2017). Artificial Intelligence, Computational Thinking, and Mathematics Education. *The International Journal of Information and Learning Technology* 34(2), 133-139. DOI:10.1108/IJILT-09-2016-0048

Isroil, A, dkk. (2017). Profil Berpikir Siswa SMP dalam Menyelesaikan Masalah Matematika ditinjau dari Kemampuan Matematika. *JRPM*, 2(2), 93-105. DOI: https://doi.org/10.15642/jrpm.2017.2.2.93-105

Kadarwati, S, *et al*. (2020). Keefektifan Computational Thinking (CT) dan Problem Based Learning (PBL) dalam Meningkatkan Kreativitas Siswa terhadap Penyelesaian Soal-Soal Cerita Materi Perbandingan (Skala pada Peta) di Sekolah Dasar. *Jurnal Karya Pendidikan Matematika* 7(1), 63-68. DOI: https://doi.org/10.26714/jkpm.7.1.2020.63-68

Kale, U, *et al*. (2018). Computational What? Relating Computational Thinking to Teaching. *TechTrends* 62(6), 574-584. DOI:10.1007/s11528-018-0290-9

Kawuri, K. R, *et al*. (2019). Penerapan Computational Thinking untuk Meningkatkan Kemampuan Berpikir Kritis Siswa Kelas X MIA 9 SMA Negeri 1 Surakarta pada Materi Usaha dan Energi 6. *Jurnal Materi dan Pembelajaran Fisika (JMPF)* 9(2), 116-121. DOI: https://doi.org/10.20961/jmpf.v9i2.38623

Lestari, A. C. & Annizar, A. M. (2020). Proses Berpikir Kritis Siswa dalam Menyelesaikan Masalah PISA Ditinjau dari Kemampuan Berpikir Komputasi. *Jurnal Kiprah* 8(1), 46-55. DOI: https://doi.org/10.31629/kiprah.v8i1.2063

Maharani, A. (2020). Computational Thinking dalam Pembelajaran Matematika Menghadapi Era Society 5.0. *Euclid* 7(2), 86-96. DOI:10.33603/e.v7i2.3364

Nurmuslimah, H. (2020). Peningkatan Prestasi Belajar Siswa pada Mata Pelajaran Matematika Menggunakan Pendekatan Soal Berbasis Kebudayaan Islam dan Computational Thinking. *Prosiding Seminar Nasional Integrasi Matematika dan Nilai Islami* 3(1), 78-84. Prosiding Seminar Nasional Integrasi Matematika dan Nilai Islami. URL Prosiding: http://conferences.uin-malang.ac.id/index.php/SIMANIS

Oktaviana, D. V, dkk. (2018). Analisis Kemampuan Pemecahan Masalah Matematis Siswa Kelas IX MTs dalam Menyelesaikan Soal Model PISA pada Konten Perubahan dan

Hubungan. *JSE-MAT,* 4(1), 47-56. DOI: https://doi.org/10.25134/jes-mat.v4i1.909

Putra, M. R. A. L, *et al*. (2019). Penerapan Kemampuan Problem Solving pada Siswa SMP Menggunakan Pendekatan Computational Thinking (CT) Berbasis Role Playing Game (RPG). *Journal Format* 8(2), 158-164. DOI: http://dx.doi.org/10.22441/format.2019.v8.i2.009

Roman-Gonzalez, M., Perez-Gonzalez, J. C., & Jimenez-Fernandez, C. (2017). Which cognitive abilities underlie computational thinking? Criterion validity of the Computational Thinking Test. *Computers in Human Behavior*, 72, 678-691. DOI: https://doi.org/10.1016/j.chb.2016.08.047

Rosadi, M. E, *et al.* (2020). Sosialisasi Computational Thinking untuk Guru-Guru di SDN Teluk dalam 3 Banjarmasin. *Jurnal SOLMA* 9(1), 45-54. DOI: https://doi.org/10.29405/solma.v9i1.3352

Sung, W, *et al*. (2017). Introducing Computational Thinking to Young Learners: Practicing Computational Perspectives through Embodiment in Mathematics Education. *Technology, Knowledge and Learning* 22(3), 443-463. DOI: 10.1007/s10758-017-9328-x

Sukamto, T. S, *et al*. (2019). Pengenalan Computational Thinking sebagai Metode Problem Solving kepada Guru dan Siswa Sekolah di Kota Semarang. *ABDIMASKU* 2(2), 99-107. DOI: https://doi.org/10.33633/ja.v2i2.51

Syarifuddin, M. (2019). Experiment Computational Thinking: Upaya Meningkatkan Kualitas Problem Solving Anak melalui Permainan GORLIDS. *Jurnal Mitra Pendidikan,* 3(6), 807-822. URL: https://e-jurnalmitrapendidikan.com/index.php/e-jmp/article/view/565/373

Tresnawati, D, *et al*. (2020). Membentuk Cara Berpikir Komputasi Siswa di Garut dengan Tantangan Bebras. *Jurnal PkM MIFTEK* 1(1), 55-60. DOI: https://doi.org/10.33364/miftek/v.1-1.55

Tabesh, Y. (2017). Computational Thinking: A 21st Century Skill. *Olympiads in Informatics* 11, 65-70. DOI: 10.15388/ioi.2017.special.10

Zahid, M. Z. (2020). Telaah Kerangka Kerja PISA 2021: Era Integrasi Computational Thinking dalam Bidang Matematika. PRISMA 3, 706-13. Retrieved from https://journal.unnes.ac.id/sju/index.php/prisma/article/view/37991