26 (1), 2025, 131-152
Jurnal Pendidikan MIPA
e-ISSN: 2685-5488 | p-ISSN: 1411-2531
http://jurnal.fkip.unila.ac.id/index.php/jpmipa/

Students' Boredom Profile in Mathematical Problem-Solving: A Computational Thinking Perspective

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Abstract: Boredom is a mental state characterized by discomfort and dissatisfaction caused by insufficient introduction of stimulus, challenge, or meaning in the environment. Objective: This study aims to describe students' boredom profile in solving mathematics problems based on their computational thinking ability. Methods: The method used was a descriptive qualitative approach with the subject of 62 students consisting of 63% female students and 37% male students of class IX SMP Negeri 1 Semarang, then took nine students with purposive sampling technique, taking subjects based on advanced, intermediate, and basic computational thinking ability tests, taken three each category based on recommendations from subject teachers. Findings: Student boredom is influenced by five factors, namely disengagement, high arousal, inattention, low arousal, and time perception. Students with advanced computational thinking ability generally do not feel bored because they feel challenged, although they can lose interest if the problem is too easy. Students with intermediate computational thinking ability have relatively low boredom, remaining engaged despite difficulties. In contrast, students with basic computational thinking ability are more susceptible to boredom due to difficulty understanding problems, frustration, a desire to quit, and a perceived lack of engaging activities. To overcome the problem of boredom, the recommendation from this study is to provide content-differentiated learning for each student, this can also be a recommendation for further research. Conclusion: Students with advanced computational thinking can feel bored if the problems given are too easy. Meanwhile, students with basic computational thinking feel bored when they find it difficult to understand the problem.

Keywords: boredom, mathematics, problem-solving, computational thinking.

▪ INTRODUCTION

A deep understanding of mathematics is often considered an important foundation in education. Mathematics is a science that plays an important role in efforts to master science and technology and in everyday life (Siswono et al., 2016). The process requires individuals to solve problems (Istikomah & Jana, 2019; Simanjuntak & Imelda, 2019). However, it is not uncommon for the mathematics learning process to be faced with obstacles in the form of boredom experienced by students. Students tend to consider math a scary subject (Yuanita et al., 2018), stressful and boring (Ayu et al., 2021; Nurfadilah & Lukman Hakim, 2019; Sagala et al., 2023; Zahra & Hakim, 2022)

Boredom often arises when students feel unchallenged or when the material being taught is irrelevant to their interests (Bekker et al., 2023; Vuyk et al., 2024). High-achieving students may experience boredom due to insufficient intellectual challenge, while low-achieving students may feel overwhelmed and disengaged when the material is too difficult (Schwartze et al., 2024). "Boredom" first became a word in 1852, with the publication of Charles Dickens' convoluted (and sometimes boring) serials. It was not until the 1930s that science took an interest in boredom. In 1938, psychologist Joseph Ephraim Barmack examined how factory workers coped with the boredom of being a factory worker. Over time, research on boredom in academia was again popularized by Csikszentmihalyi (1990) he introduced the concept of flow, which describes that when a

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DOI: http://dx.doi.org/10.23960/jpmipa/v26i1.pp131-152
Received: 12 February 2025
Accepted: 29 February 2025
Published: 12 April 2025

person is in a state of flow, which is a condition of optimal engagement, they tend to lose awareness of time. Conversely, when in a state of disengagement, they tend to feel time moving slower than usual.

According to Eastwood (2012), Boredom is a state of mind that arises when a person feels their environment is monotonous or lacking in stimulation. Pekrun et al. (2010) state that boredom is a negative attitude or affection in the form of feelings of discomfort, lack of stimulus or challenge, and low willingness. Meanwhile, Steinberger (2016) defines boredom as a state in which a person experiences a lack of internal and external stimulation, which leads to an active pursuit of looking for something interesting to increase arousal and thus reduce feelings of boredom. It can be concluded that boredom is a mental state characterized by discomfort and dissatisfaction caused by insufficient introduction of stimulus, challenge, or meaning in the environment.

Boredom in students when learning can arise due to several factors, such as learning methods that are less interactive and the learning process is carried out in one direction by the teacher (Friantini, 2024; Mondal & Das, 2021; Ni'matul Fauziah, 2013) selection of learning strategies and teaching materials that are not by the material presented (Damayanti & Yohandri, 2022) or noise when studying, too many tasks, too high expectations, lack of self-control, too much pressure, lack of feeling valued, feeling ignored and missing opportunities, too high demands, and short assignment time (Agustina, Poppy., 2019). Typical symptoms of academic boredom may include yawning, drowsiness, constantly looking at the clock, putting your head in your hands, and slouching in class (Solhi, 2021). Schwartze et al. (2024) explain that math boredom is a construct of individual differences, indicating that students show varying tendencies to experience boredom

We can measure a person's boredom with the Multidimensional State Boredom Scale (MSBS), which is the first comprehensive measurement tool for boredom (Fahlman et al., 2011). MSBS scores show significant relationships with variables such as depression, anxiety, impulsivity, and life satisfaction. Falhman, along with Lynn, Flora, and Eastwood, conducted the development and validation of the MSBS based on theoretical and empirical definitions of boredom. The results showed a final scale with 29 items with the following five factors: a) Disengagement: Lack of engagement with the environment, b) High Arousal: Anxiety and sensitivity, c) Low Arousal: Fatigue and emptiness, d) Inattention: Difficulty focusing attention, e) Time Perception: Slow-moving perception of time.

Boredom characterized by disengagement and inattention can inhibit the critical thinking process required in mathematical problem solving. Hosseini et al. (2018) stated that attention and concentration training has been shown to improve problem solving ability and reduce test anxiety in students. Meanwhile, McCormick et al. (2015) also explained that engaging students in critical thinking and problem-solving skills is essential for academic and professional success, with research emphasizing the importance of student engagement, learning style, motivation, and instructor behavior. So boredom characterized by this can interfere with the thinking process and hinder students' ability to solve mathematical problems. This is important given that mathematical problem solving is not just a basic skill, but a complex and essential ability that includes analysis, reasoning, evaluation, and reflection (Anderson, 2009).

Problem solving is at the core of mathematics learning and teaching should focus on students' ability to engage and solve mathematical problems (Booker, 2007). This is in line with the NCTM (2020) objectives which emphasize problem solving as one of the key skills that students must master in preparing them for the challenges of real life.. National Council of Teachers of Mathematics (NCTM) (2020): Standards For The Preparation of Secondary Mathematics Teachers sets standards for skills in mathematics learning that are expected of students, although NCTM 2020 focuses on the preparation of mathematics teachers, the standards referred to are problem solving, mathematical reasoning, and communication, mathematical modeling, mathematical representation, use of tools and technology, procedural mastery based on conceptual understanding, diversity, and inclusion, engagement in mathematical discussions. Mathematical problem solving is an important skill that students need to develop both for academic purposes and in real life (Jatmiko, 2018; Noviantii et al., 2020). Problem solving is a planned process that needs to be done in order to obtain a definite solution to a problem, both routine and non-routine (Dostál, 2015; Goldhammer et al., 2014). According to Ersoy & Bal-Incebacak (2017) Problem solving skills train students to find solutions to certain problems in mathematics learning and find the right solution.

Some research on mathematical problem solving conducted by Daulay & Ruhaimah, 2019; Lee, 2017; Son et al., 2019; Thiangthung, 2016; Yapatang & Polyiem, 2022 uses indicators based on the stages of problem solving according to Polya (1973). Polya's problem solving steps consist of (1) understanding the problem (understanding the problem), (2) devising a plan, (3) carrying out the plan, and (4) looking back. Problem solving evolves over time as the complexity of problems increases (Wu et al., 2024). Computational thinking is one of the learning processes that instill problem solving skills in the current educational situation (Tan et al., 2021).

Ting-Ting Wu's (2024) research shows that 37 computational thinking articles are closely related to problem solving because the articles cite Wing's (2006) theory, which states that computational thinking is a fundamental skill in solving problems. Computational thinking popularized by Wing (2006) defines computational thinking as an approach to solving problems, designing systems and understanding human behavior that draws on basic computational concepts. Such thinking encompasses concepts such as decomposition, pattern recognition, abstraction, and algorithms (Ansori, 2020; Nuzzaci, 2024). Computational thinking is considered a fundamental skill today (Doleck et al., 2017). The rapid development of technology makes all countries compete in technological development (Nuraini et al., 2023).

As the main component in the era of Society 5.0, humans are expected to create a balance of economic progress and solve social problems in physical and virtual space (Tan et al., 2021). Therefore, education must be able to develop the abilities needed to welcome the era of society 5.0 with one of the abilities that must be developed, namely the ability of computational thinking (Rara et al., 2022). Computational thinking is closely related to computational logic, mathematics, algorithms, and rationality, which are the main weaknesses of student abilities (Ansori, 2020). Education related to computational thinking has great potential and requires further research to engage students in meaningful learning and develop valuable thinking skills and digital competencies (Angeli & Giannakos, 2020).

Several researchers have previously examined computational thinking, problem solving and boredom. Computational thinking has been shown to significantly improve students' problem solving ability in mathematics (Kaswar & Nurjannah, 2024; Astuti et al., 2023). Computational thinking is also closely related to the problem-solving process, with common stages that include decomposition, pattern recognition, abstraction, and algorithm development (Wu et al., 2024; Maharani et al., 2019). Students with higher computational thinking ability tend to exhibit more systematic and flexible problem-solving strategies (Yuntawati et al., 2021). Meanwhile, cognitive load can play an important role in students' ability to solve complex problems such as mathematics (Gupta & Zheng, 2020). High cognitive load can hinder the learning process and cause boredom (Sunawan et al., 2017), so students with higher computational thinking skills tend to face challenges in problem solving in a more structured and adaptive manner, which results in them experiencing boredom less often due to difficulty in thinking.

Based on previous literature, no researchers have directly linked computational thinking and boredom. Computational thinking is very important as a basic competency for the contemporary world. In this study, the researcher will directly link computational thinking and boredom, as suggested by Schukajlow (2016) the need for further studies on the measurement of boredom and boredom reduction strategies for students. Researchers have formulated some important questions: What is the level of boredom of students with advanced, intermediate, basic computational thinking ability in the context of solving mathematical problems? What are the causes of student boredom when solving math problems based on their computational thinking ability? How can computational thinking-based learning strategies be optimized to reduce student boredom? The purpose of this study is to describe the boredom of students when solving math problems in terms of computational thinking ability, describe the factors that cause boredom of students who have advanced, intermediate, basic computational thinking ability when solving math problems and provide solutions to reduce boredom based on the findings.

▪ METHOD

Participants

The data sources in this study were 62 students with 63% female students and 37% male students of class IX SMP Negeri 1 Semarang. 62 ninth-grade students were simultaneously given a computational thinking ability test and a boredom test. The results of the computational thinking test were used to take the main subjects in the study using the purposive sampling method, three students with advanced computational thinking, three students with intermediate computational thinking, and three students with basic computational thinking were taken. The purposive sampling technique is a sampling technique with specific considerations (Sugiyono, 2007). In this context, the research subjects were selected according to the purpose and intent of the study, which was determined based on the results of the computational thinking ability test and teacher interviews. Some of the factors considered by the researcher in determining the research subjects related to the students to be selected are communicative, meaning that they can convey the message well, the message received by the subject is the same as the intention of the message conveyed by the researcher and responsive, meaning that they can respond or respond to questions asked by the researcher well.

Research Design and Procedures

This research uses a qualitative descriptive approach. Bogdan and Bilken(1992) define qualitative research methods as research procedures that produce descriptive data in the form of written or spoken words from people and observed behavior. According to Sugiyono (2017), the descriptive method describes or analyzes a research result but cannot be used to draw broader conclusions. The qualitative approach was carried out to describe the boredom of students with advanced computational thinking ability, intermediate computational thinking, and basic computational thinking when solving math problems. This research was conducted in the even semester of 2024/2025 at SMP Negeri 1 Semarang, Central Java.

The researcher started the research by giving problem-based mathematics test questions along with the MSBS questionnaire to 62 ninth grade students, then assessing the results of the test questions at each step based on the indicators of computational thinking ability. Furthermore, selecting 9 students as the final subject of the study based on the results of the test questions. The last step is to ask questions about the feelings felt when working on the problem. The data that has been obtained is then analyzed to get a conclusion.

Instruments

The researcher is the main instrument; according to Sugiono (2015), the researcher is one of the research instruments in descriptive research. Researchers are the key because they act as data collectors and interpret the data obtained during the research process. The auxiliary instruments used in this research are tests, questionnaires, and interviews. In determining the main subject of the study, researchers used problem-based mathematics problems on the material of the system of linear equations of two variables with indicators of computational thinking from Kidd, Lonnie R, & Morris, Jr. (2017), namely Abstraction, Algorithm, decomposition, Generalization. The assessment of the results of working on the problem will be used to classify students into three categories, as in Table 1.

Tabel 1. Indicators of computational thinking ability test

Components of Computational Thinking	Indicator	Value Range
Abstraction	Students focus on important information and ignore irrelevant information.	0-20
Algorithm	Students design the steps to solve the problem.	0-10
Decomposition	Students are able to break complex problems into more straightforward and easier-to-work parts.	0-25
Generalization	Students can formulate solutions into a general form that can be applied to similar problems, creating generic solutions that can be reused for various situations/contexts.	0-45

Students who fulfill the advanced computational thinking ability category score 71-100 from the maximum score. The intermediate computational thinking category includes students scoring 50-70, and the basic computational thinking category includes students scoring less than 50.

Meanwhile, to measure the level of student boredom in this study using the Multidimensional State Boredom Scale (MSBS) questionnaire, which was validated by Fahlman et al. in 2011. MSBS is the first and only complete measurement scale to measure momentary (state boredom). The scale consists of 29 questionnaire items that measure boredom on a 7-point Likert scale, then grouped into five factors as in Table 2.

Table 2. Grouping of boredom factors

MSBS Scores	
Components	**Question Number**
Disengagement	2. 7. 9. 10, 13. 17. 19. 22. 24. 28
High Arousal	5. 12. 14. 21. 27
Inattention	3. 16. 20. 23
Low Arousal	4. 8. 15. 25. 29
Time Perception	1. 6. 11. 18. 26

Measurement is done by calculating the average of each boredom factor according to the scoring guidelines from Fahlman (2011). The next stage is conducting interviews, Creswell (2016) states that conducting interviews can be done in various ways, including face-to-face interviews, telephone interviews, or interviews in focus group interviews of certain groups. In this study, researchers interviewed respondents directly by asking about their feelings when solving math problems. The interview instrument in this study is an interview guide, which contains questions that will be asked of the research subject presented in Table 3.

Table 3. Interview guidelines

Indicator	Question
Disengagement Disengagement from a particular activity or situation.	1. How often do you feel like leaving/stopping when working on a problem? 2. What do you usually do when you don't feel up to the task? 3. Does the difficulty of understanding formulas make you want to give up? 4. Does the sheer number of problems to do make you want to quit?
High Arousal Boredom is full of energy and restlessness.	1. How do you feel when you face a complex problem? 2. How often do you feel anxious or unsettled when working on problems? 3. Does the fear of wrong answers make you feel anxious?
Inattention Lack of attention to detail.	1. Do you often lose focus when working on problems? 2. How often does your mind wander to other things when working on math problems?
Low Arousal Feelings of lethargy or lack of energy often accompany a more passive boredom.	1. Do you often feel sleepy when working on problems? 2. How often do you feel lethargic and lackluster when working on problems? 3. Does the lack of variety of questions make you feel bored?
Time Perception A person's perception of the flow of time/how	1. How did you feel about the time that passed while working on the problem? 2. Does time pass very slowly when working on the problem?

they perceive the duration of an event.	3. Does the lack of fun learning activities make the time feel long?

Data Analysis

The data analysis method for qualitative data uses analysis, according to Miles and Huberman. The stages of research analysis include 1) data reduction, which means summarizing, selecting the main things, focusing on important things, and looking for themes and patterns, 2) data presentation, in this case Miles and Huberman stated "the most frequent form of display data for qualitative research data in the past has been narrative text." 3) Conclusion, conclusions in qualitative research are in the form of new findings that have not previously existed. Findings can be in the form of a new description or description of an object that was previously dim or dark so that after being examined clearly, it can be a causal or interactive relationship, hypothesis, or theory.

In this study, the data validity test was carried out using source triangulation. According to Moleong (2015), triangulation is a data validity checking technique that utilizes something else outside the data to check or compare the data. Source triangulation is done by checking the data obtained through the source because this study compares data from different sources, namely three sources from each computational thinking ability.

▪ RESULT AND DISSCUSSION

Category Student Boredom in Solving Math Problems

The level of student boredom when solving problem-based mathematics problems obtained from the MSBS questionnaire was analyzed based on five factors, as shown in Table 1. Each factor was calculated with the average of each item according to Falhman's MSBS assessment guidelines. The results of filling out the questionnaire are presented in figure 1 and table 4.

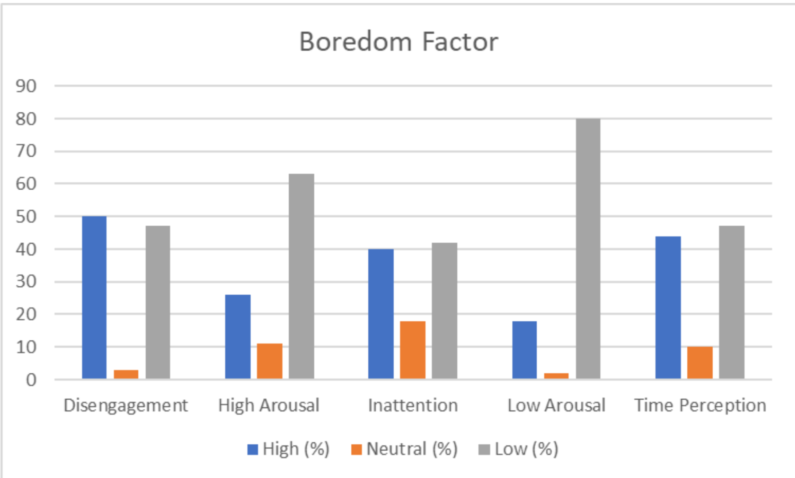


Figure 1. Diagram of student boredom factor

Figure 1 shows factor analysis of student boredom revealed some interesting trends in five most critical dimensions of learning. The levels of disengagement, inattention and time perception were high, which indicate the challenge of maintaining students actively engaged in learning. Meanwhile, the factor of arousal, both high and low, showed a different trend with low levels dominating, indicating that boredom is not necessarily associated with students' level of arousal.

Table 4. Results of the MSBS Questionnaire

Boredom factor	**High (%)**	**Neutral (%)**	**Low (%)**
Disengagement	50	3	47
High Arousal	26	11	63
Inattention	40	18	42
Low Arousal	18	2	80
Time Perception	44	10	47

The primary factor analysis, namely disengagement, high arousal, inattention, low arousal, and time perception, shows variations in the level of student boredom. 50% of students showed a high level of disengagement, meaning half felt like stopping when working on math problems. Only 3% of students were in the neutral category, while the other 47% had low levels of disengagement.

High arousal was found in 26% of students, indicating that a small proportion experienced tension or anxiety during math problem solving. Math anxiety can affect cognitive functioning, physical health, attitudes, and academic performance (Jalal, 2020). In contrast, the majority of students (63%) had low high arousal, which indicated that they felt calmer and had control over the math problems they were working on, as described by Magdalena & Gabriela (2019) student engagement, which is considered self-regulated learning, manifested through goal focus, attendance, concentration, and positive collaboration. In addition, 40% of the students showed a high level of inattention, which means they often lost focus while working on math problems.

Attention is a critical component of higher order thought processes, contributing to intelligence, memory, and sensory sensitivities (Burgoyne & Engle, 2020). When students experience distraction or do not find the material interesting, tend to experience decreased concentration. This is reinforced by the data that only 42% of students had low inattention, meaning they were able to maintain focus well, most likely because they were challenged to be able to solve math problems. One of the most significant findings was low arousal, which was experienced by 80% of students. Low arousal describes students feeling less motivated and unchallenged in learning. This shows that students are quite active and interested in solving math problems.

In addition, students' time perception in learning is also an important indicator in assessing their level of boredom. A total of 44% of students reported having a high time perception, indicating that they felt that time went slowly or experienced boredom when solving math problems. This is in accordance with Csikszentmihalyi's (1990) Flow theory, which explains that when someone is in a state of flow, which is a condition of optimal engagement, they tend to lose awareness of time. Conversely, when students feel bored or less interested, they are more aware of the length of the learning duration. On the other hand, 47% of students have a low time perception, which indicates that they feel that time goes faster, possibly because students are too focused on doing math problems, so they feel that time goes so fast.

The results of the computational thinking ability test given are that out of 62 students, 21 are categorized as having advanced computational thinking ability, 22 as having intermediate computational thinking ability, and 19 as having basic computational thinking ability. The next action was to select nine research subjects by taking three students with advanced computational thinking ability, three with intermediate computational thinking ability, and three with basic computational thinking ability.

Table 5. Grouping of research subjects

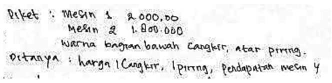
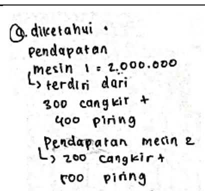
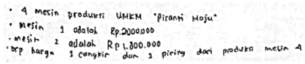
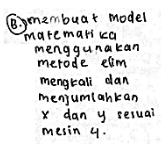
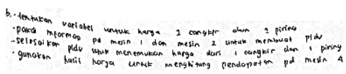
Subject Initials	Category	Subject Code
DGO	Advanced computational thinking	CT-H1
NAS	Advanced computational thinking	CT-H2
JY	Advanced computational thinking	CT-H3
AKN	Intermediate computational thinking	CT-M1
ARA	Intermediate computational thinking	CT-M2
GSAP	Intermediate computational thinking	CT-M3
NS	Basic computational thinking	CT-L1
MNFR	Basic computational thinking	CT-L2
RIAP	Basic computational thinking	CT-L3

Table 5 shows that subject DGO has advanced computational thinking ability with code CT-H1, subject AKN has intermediate computational thinking ability with code CT-M1, and subject NRA has basic computational thinking ability with code CT-L1. This analysis is taken from the test scores of math problems with computational thinking indicators and recommendations from teachers. Furthermore, interviews were conducted one by one directly regarding student boredom when solving math problems.

Boredom of Students with Advanced Computational Thinking Ability

Boredom when solving math problems can affect students' learning process, including students with advanced computational thinking abilities. The following are the results of solving the problem of two-variable linear equation system material by students with advanced computational thinking ability.

Table 6. Problem solving results of students with advanced computational thinking

	CT-H1	CT-H2	CT-H3
Abstraction	 Diket : Mesin 1 2.000.00 Mesin 2 1.800.000 warna bagian bawah cangkir, atas piring. Ditanya : harga 1 cangkir, 1 piring, pendapatan mesin 4	 a. diketahui : pendapatan mesin 1 = 2.000.000 └> terdiri dari 300 cangkir + 400 piring Pendapatan mesin 2 └> 200 cangkir + 500 piring	 • 4 mesin produksi UMKM "Piranti Maju" • mesin 1 adalah Rp.2000000 • mesin 2 adalah Rp 1.800.000 • brp harga 1 cangkir dan 1 piring dari produksi mesin 4
Algorithm	 Menggunakan Metode Eliminasi	 b. membuat model matematika menggunakan metode elim mengkali dan menjumlahkan x dan y sesuai mesin 4.	 b. • tentukan variabel untuk harga 1 cangkir dan 1 piring • pakai informasi pd mesin 1 dan mesin 2 untuk membuat pldv • selesaikan pldv utk menemukan harga dari 1 cangkir dan 1 piring • gunakan hasil harga untuk menghitung pendapatan pd mesin 4

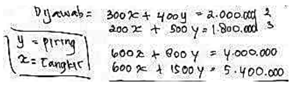
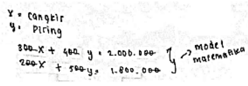
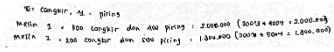
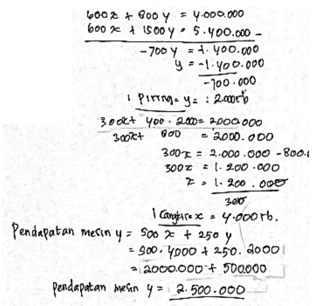
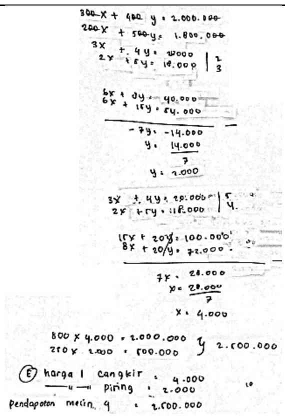
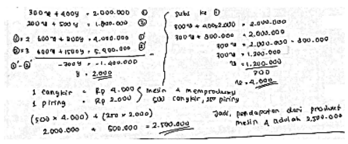
Decom-position			
General-ization			

Table 6 presents the results of the computational thinking ability test by students who have advanced computational thinking ability. It can be seen that students understand the problem well and convey answers coherently. In addition, students also fulfill the four indicators of computational thinking ability. Computational thinking can improve problem solving skills (Yadav et al., 2016). Although it can be seen that students easily solve math problems, it is not uncommon for students with advanced computational thinking ability to also experience boredom when solving math problems.

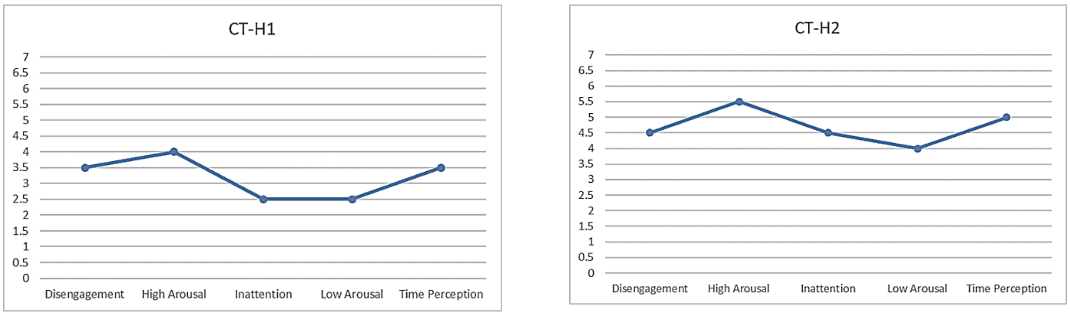


Figure 2. (a) boredom level graph of subject CT-H1 (b) boredom level graph of subject CT-H2

Figure 2 shows the level of boredom experienced by students with advanced computational thinking ability. Five boredom factors show that CT-H1 has a low level of boredom, while CT-H2 has a higher level of boredom when solving math problems. The following interview supports this.

Q : What did you feel when working on the problem?
CT-H1 : I feel challenged when working on problems because I like math.
CT-H2 : I feel that I have often done problems like this.
Q : Do you feel anxious and nervous when working on problems

CT-H1 : I am a little anxious because I want my answer to be correct and there are no mistakes.
CT-H2 : I was restless, wanting to leave the room immediately.
Q : How did you feel about the time that passed while working on the problem?
CT-H1 : Time seems to pass quickly
CT-H2 : I felt that the time went longer than usual because of the questions given easy for me to do.

The results of interviews with CT-H1 subjects show that CT-H1 subjects do not feel bored when working on math problems because they feel challenged to work on problems and want to give the best answers to each solution. The time felt goes faster because it is too focused on the problem given. In contrast, the subject CT-H2 felt bored when solving math problems because he had often received similar problems, and the feeling of wanting to leave the room was very high. The problems given are too easy, so there is no challenge, and the time goes longer than usual. This is in line with the opinion of Schwartze et al. (2024) that High-achieving students may experience boredom due to a lack of adequate intellectual challenge, this is due to the lack of challenge of the problems given.

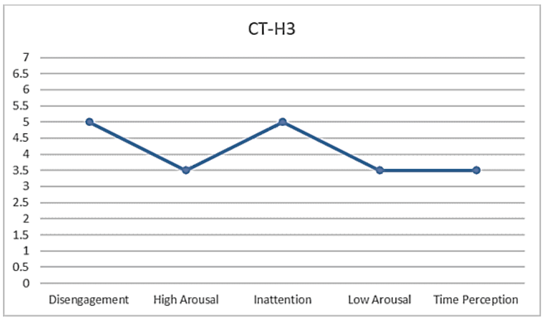


Figure 3. Boredom level graph of subject CT-H3

In contrast to subjects CT-H1 and CT-H2, subject CT-H3 showed variations in the five boredom factors. In Figure 3, it can be seen that the disengagement and Inattention factors are high. This is evidenced in the interview where subject CT-H3 revealed, "I am less able to focus when working on problems because my surroundings are too noisy, so it is difficult to focus." Overall, subject CT-H3 did not feel bored when working on math problems. "I don't feel bored, just feel a little anxious because the people around me think the problem is difficult." This shows that the boredom factor can arise from the surrounding circumstances, distractions from the surrounding environment can interfere with focus and feelings of pressure when working on math problems. Noisy environments can increase boredom during mundane tasks compared to quiet environments (Anderson et al., 2022).

Boredom of Students with Intermediate Computational Thinking Ability

Students with intermediate computational thinking ability generally have a good understanding of the material but still face challenges in certain aspects. The following are the results of the completion of students with intermediate computational thinking ability.

Table 7. Problem solving results of students with intermediate computational thinking

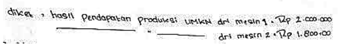
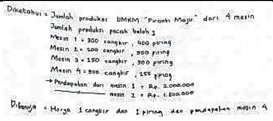
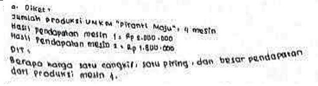
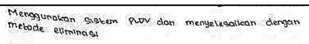
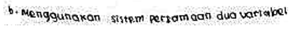
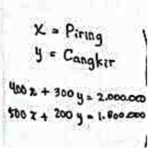
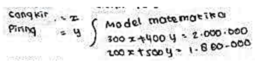
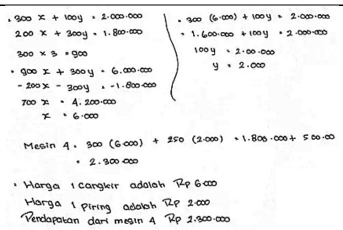
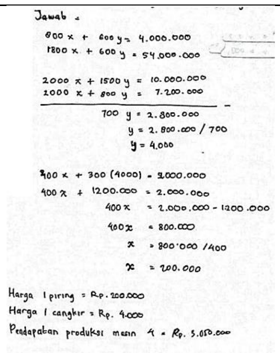
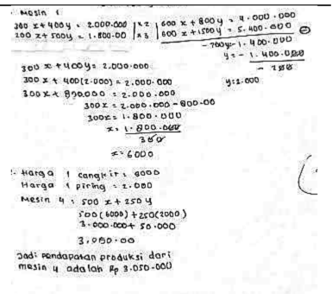
	CT-M1	CT-M2	CT-M3
Abstraction			
Algorithm		X	
Decomposition	X		
Generalization			

Table 7 shows the results of solving mathematical problems of students with intermediate computational thinking ability; it can be seen that students can solve the problem only by calculating less careful students. Of the four indicators of computational thinking ability, there are some things that students with intermediate computational thinking ability do not have, for example subject CT-M1 is lacking in decomposition and subject CT-M2 in algorithm.

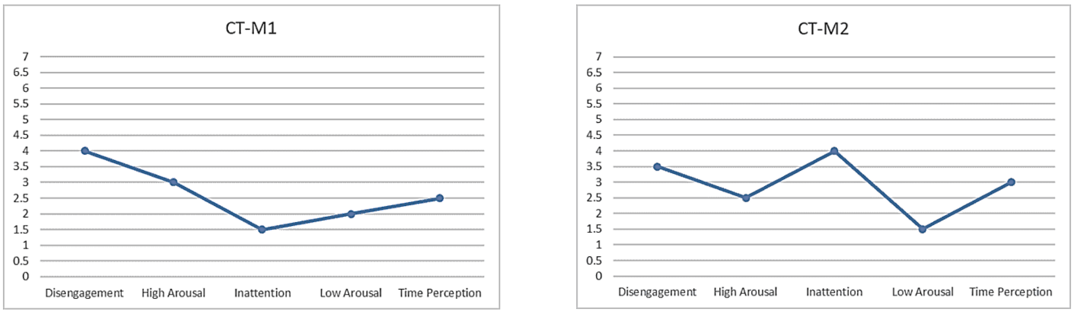


Figure 4. (a) boredom level graph of subject CT-M1 (b) boredom level graph of subject CT-M2

Figure 4 shows the level of boredom of students with intermediate computational thinking ability in CT-M1 and CT-M2 subjects. Five boredom factors, disengagement, high arousal, inattention, low arousal, and time perception, are at number 4 or below, meaning the subject does not feel bored when working on math problems. The following interview reinforces this.

Q : What did you feel when working on the problem?
CT-M1 : At first it was difficult to determine the problem, but after a while I was able to work on it.
CT-M2: The problem was difficult to understand, but after trying the method, I finally understood it. solve the problem.
Q : Do you often lose focus when working on problems?
CT-M1 : No, I focused on finding a way to solve the problem.
CT-M2 : Sometimes, when my mind is stuck, I divert to something else for a while.
Q : How often do you feel lethargic and uninspired when doing your work? Problem?
CT-M1 : I don't feel lethargic but dizzy when I can't find an answer.
CT-M2 : I am not lethargic and eager to work on the problems, so it doesn't feel like I am doing anything. time goes fast.

From the results of the interviews, subjects CT-M1 and CT-M2 felt not bored while working on math problems, and the subjects felt challenged when working on problems even though they had difficulty understanding the problem. In Figure 3 and the results of the interviews, both subjects felt that time was running fast because they were too focused on finding answers to the problems given. This finding supports Csikszentmihalyi's (1990) research, which explains that when someone is in a state of flow, which is a condition of optimal engagement, they tend to lose awareness of time.

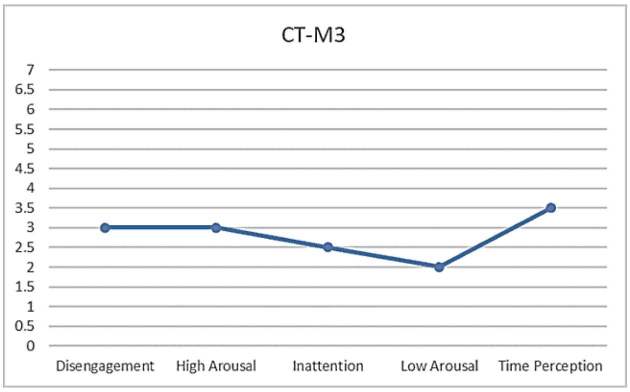


Figure 5. Boredom level graph of subject CT-M3

Not much different from subjects CT-M1 and CT-M2, Figure 5 shows that the level of boredom of subject CT-M3 is low. As subject CT-M3 said, "I feel challenged to do the problem; the problem given has never been encountered." The low arousal factor shows that subject CT-M3 does not feel bored or lose interest when working on math problems. In addition, the subject CT-M3 also said that the time he felt went as usual, did not feel faster, and did not feel slower during the problem-solving process.

Boredom of Students with Basic Computational Thinking Ability

Students with basic computational thinking ability tend to face more difficulties in solving math problems. The following are the results of students with basic computational thinking ability.

Table 8. Problem solving results of students with basic computational thinking

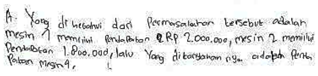
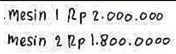
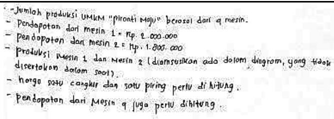
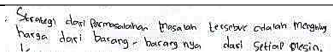
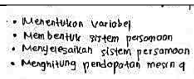
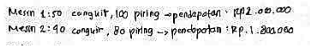
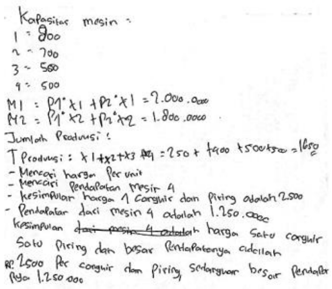
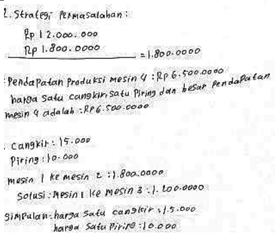
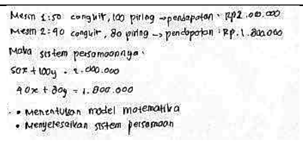
	CT-M1	CT-M2	CT-M3
Abstraction			
Algorithm		X	
Decomposition	X	X	
Generalization			

Table 8 presents the results of solving mathematical problems of students with basic computational thinking ability. It can be seen that students lack understanding of the problems presented. Figures 5 and 6 present the level of boredom of students with basic computational thinking ability.

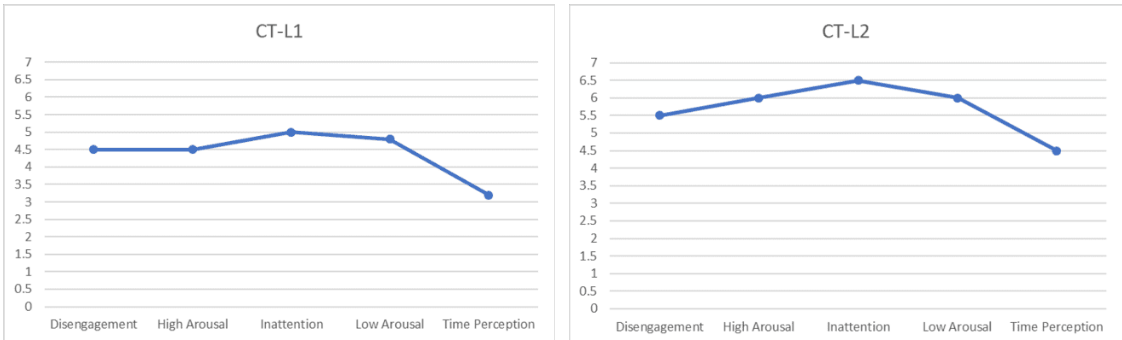


Figure 6. (a) Graph of boredom level of subject CT-L1 (b) Graph of boredom level of subject CT-L2

In Figure 6, subjects CT-L1 and CT-L2 experienced quite high boredom. Five boredom factors, namely disengagement, high arousal, inattention, low arousal, and time perception, are above number 4, which means that the subject feels bored when working on math problems. The following interview reinforces this.

Q : How often do you feel like leaving/quitting when you are in the middle of a program? working on the problem?
CT-L1 : Often, because the questions are tricky.
CT-L2 : I often think the problems are too difficult and forget how to solve them. solve it.
Q : How often does your mind drift to other things when working on problems? math?
CT-L1 : Most of the time, when I can't work I think of something else to do. outside of working on the problem.
CT-L2 : Very often, I want the time to pass quickly so that I can chat with my friends. friends.
Q : Does the lack of fun activities in learning make time feels long?
CT-L1 : Not really, because I was busy thinking about other things and had little time. Hurry up.
CT-L2 : Yes, I don't know what to do when people focus on working on the problem, there was nothing fun around me.

Based on the interview results, it was found that students with basic computational thinking ability tend to experience a high level of boredom when solving math problems. They find it difficult to understand the problem, so they desire to stop or leave the work before it is finished. In addition, inattention often occurs, where students divert their thoughts to other things when they cannot solve the problem. The lack of fun activities during the problem-solving process also makes time feel longer for them. This aligns with research by Eastwood (2012) Boredom can be defined as a state of mind that arises when a person feels their environment is monotonous or lacks stimulation.

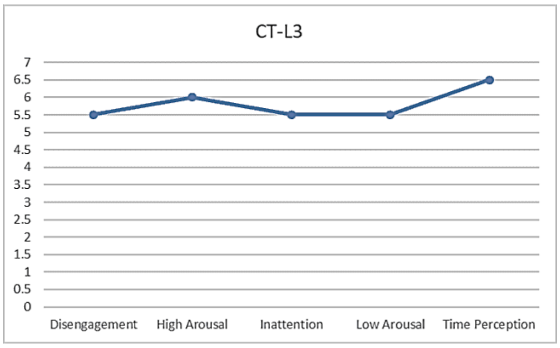


Figure 7. Boredom level graph of subject CT-L3

Figure 7 shows the level of boredom in the subject CT-L3, just like the subjects CT-L1 and CT-L2, and the subject CT-L3's level of boredom is high. This is indicated by relatively high scores on all boredom factors, especially disengagement, inattention, and time perception. Subject CT-L3 had difficulty maintaining focus when working on math problems and felt that time went very slowly. In addition, a relatively high level of arousal indicates that the subject feels tense or frustrated when facing complex problems. In the dialog where subject CT-L3 said, "I can't focus on the problem because I don't know what to do, the time around me feels long and boring." Boredom often arises when the material taught is irrelevant to their interests or too difficult (Bekker et al., 2023; Schwartze et al., 2024; Vuyk et al., 2024). This condition indicates that students with basic computational thinking ability are more prone to boredom in solving mathematical problems.

The Relationship Between Boredom and Computational Thinking Ability

Analysis of the pattern of boredom that arises in various categories of computational thinking ability shows different characteristics. In students with advanced computational thinking ability, a unique pattern of boredom was found where boredom actually arises when facing problems that are too easy, not because of difficulty. This can be explained because they have a strong conceptual understanding so they seek intellectual challenges. When problems are too easy, there is not enough cognitive stimulus, the need for complexity and challenging problem solving is not met, so time feels slower due to lack of cognitive engagement. According to Schwartze et al. (2024) that High-achieving students may experience boredom due to a lack of adequate intellectual challenge.

Meanwhile, students with intermediate computational thinking skills showed a relatively low level of boredom despite facing difficulties. This happens because the level of difficulty of the problem is in accordance with their zone of proximal development. They still have high motivation to solve the problem, feel challenged but not too overwhelmed, so that time feels fast because they focus on the problem solving process. This is in line with the results of research from Schukajlow (2015) which states that students who have higher initial interest can enjoy the tasks given compared to students who have low interest. In contrast to the two previous categories, students with basic computational thinking skills showed the highest level of boredom with a consistent pattern. Difficulty understanding the problem led to frustration, lack of problem decomposition ability overwhelmed them, motivation decreased due to feeling unable to solve, and time seemed to pass slowly due to the inability to engage in the process. Boredom can lead to indifference, demotivation and poor achievement (Vuyk et al., 2024)

These patterns arise because of the interaction between the level of cognitive ability with task complexity, the need for different intellectual stimulation, the perception of self-efficacy in solving problems, and the suitability of the challenges provided with the abilities possessed. This finding is in line with Csikszentmihalyi's Flow theory which explains that optimal engagement occurs when there is a balance between challenge and ability. When the challenge is too low (as in advanced students) or too high (as in basic students), boredom or anxiety will arise.

An important implication of this pattern is the need for differentiation of mathematics learning based on students' computational thinking ability. In a study conducted by Utami (2024) the highest boredom occurred in the learning phase, indicating the need for improved learning strategies. Teachers need to design lessons that provide challenges according to the ability level of each group of students. For advanced students, more complex and challenging problems need to be given. Intermediate students can be given problems that suit their developmental zone, while basic students need more intensive scaffolding and support in the problem-solving process. With this differentiation approach, it is expected to create an optimal learning experience and minimize boredom at all ability levels.

▪ CONCLUSION

Based on the results of interviews and data analysis, students' boredom level in solving math problems is closely related to their computational thinking ability. Students with advanced computational thinking generally do not feel bored when working on problems because they feel challenged and are motivated to solve every problem, they stay focused, so time seems to run faster. However, students with advanced computational thinking ability can also feel bored when they feel the problems given are not challenging. Meanwhile, students with intermediate computational thinking showed relatively low boredom. Despite difficulties understanding the problem, they still had a high level of interest and engagement in problem-solving.

Conversely, students with basic computational thinking tend to experience high boredom when working on math problems. Difficulty in understanding the problem causes them to lose focus, experience feelings of frustration, and have the desire to quit before completing the task. In addition, factors such as lack of fun activities and distraction from the surrounding environment also contribute to increased boredom.

Based on the findings of this study, to reduce students' boredom in solving mathematical problems, strategies are needed that are on the level of students' computational thinking ability, what can be done by teachers is to provide differentiated learning content for students based on students' computational thinking ability. This can also be used as a recommendation for further research on boredom, computational thinking ability, and differentiated learning.

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