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Strategies and Challenges in Numeracy Problem-Solving: A Case Study of a Gifted Student

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ABSTRACT

This study investigates the strategies, challenges, and techniques employed by a gifted student, referred to as Iwan, in solving complex numeracy problems. Using a qualitative case study design, data were collected through task-based interviews involving problem types similar to those in international assessments such as PISA. Problems required graph interpretation, arithmetic operations, pattern recognition, estimation, and the use of scribbling techniques. Verbal responses were audio-recorded, transcribed verbatim, and complemented with observational field notes on non-verbal actions. Data were analyzed thematically following Braun and Clarke's (2012) framework, with triangulation, peer review, member checking, and audit trail procedures ensuring credibility and trustworthiness. Findings revealed that Iwan integrated multiple strategies: (1) interpreting graphs as the initial step, followed by relevant arithmetic computations; (2) recognizing numerical patterns to expedite calculations; (3) using scribbling for rough work to reduce cognitive load; (4) applying estimation and scaling when exact values were unavailable; and (5) employing straightforward problem-solving by focusing only on essential data. However, obstacles emerged, including difficulties in balancing estimation and precision, interpreting scales across formats, and transitioning between representations. These challenges, alongside a tendency to overemphasize accuracy, limited flexibility in problem-solving. The study concludes that effective numeracy instruction should integrate graph literacy, arithmetic fluency, estimation skills, and flexible problem-solving approaches. Pedagogical recommendations include embedding pattern recognition, encouraging strategic use of rough work, and teaching adaptive reasoning for real-world numerical contexts. The findings contribute to both theory and practice by highlighting the cognitive strategies of gifted learners and offering insights for enhancing numeracy education.

Keywords: Gifted student, Numeracy problems, Problem-solving, Thinking and strategies.

INTRODUCTION

Numeracy, according to the World Economic Forum (WEF), ranks among the most fundamental literacy skills in the millennial age (Han et al., 2017; The Boston Consulting Group, 2016). It has a potential for helping a person to identify, analyse, and differentiate among situations in day to day life (Craig, 2018; Westwood, 2021). Further, according to Tsatsaroni and Evans (2014), literacy is understood as the way of assessing the context that surrounds the practice of various activities that involve mathematics as one of the tools for accomplishing tasks. It doesn't matter the role that is presented, whether in the classroom's role or non-role context, literacy and numeracy are important skills for problem solving (Grasby et al., 2020). Basta Hasi, George, Dreyer, Shirley Graves, and Niskane have suggested that Learning First claimed that disruptive skills include Numeracy, Scientific, ICT, Financial, Cultural and Civic ones as suggested by the Boston Consulting Group (2016). Haris, a former director of educational planning within the Ministry of Education said tht the international competitiveness of Indonesian pupils can best be described as mediocre. Mathematics according to the PISA testing service ranks in position 72 out of 78. For over the past decade or one and a half decade this value has remained unchanged.

PISA has included mathematical literacy within the indicators of PISA ability (Bazán-Ramírez et al., 2022). Numeracy or meaning mathematical literate (Genc & Erbas, 2019; Jablonka, 2015; Rakhmawati & Mustadi, 2022). As stated by PISA, numeracy is defined as the ability to understand and use mathematics in an ever – changing variety of situations, like'mathematizing" concluding with the use of mathematics to explain and understand events in numerous situations (Anwar et al., 2021; Genc & Erbas, 2019; Purnomo, Sa'dijah A, et al., 2022) including the situations around us (Irma Rachmah Hidayah et al., 2021; Machromah & Sari, 2021; Oktiningrum et al., 2016; Purnomo et al., 2021; Purnomo, Sa'dijah, et al., 2022; Rizki & Priatna, 2019; Sa'dijah et al., 2023; Smith & Morgan, 2016), workplace, society, and even in science (Tsatsaroni & Evans, 2014).

In the literature, the commentators define a numeracy as a full set of competencies, such as skills, knowledge, disposition, communications, and practices that are related to mathematics and even statistics (Gal et al., 2020). These competencies can be paramount for handling various situations in life. It constitutes the knowledge and skills people require in order to grapple with mathematics in their private and public lives as well as to be actively involved in and contribute to the society as a rational, decently educated, critical and socially active member of the society (Geiger et al., 2015). The International Assessment of Adult Competencies (PIAAC) program forms an integral part of the research on adult competencies. The PIAAC's main concern is the following three areas that are fundamental for adult life and employment in the industrial and knowledge global economy: reading, mathematics, and the ability to reason and solve problems in technologically rich environments (Tsatsaroni & Evans, 2014). According to PIAAC, numeracy is defined as the ability to access, use, interpret, and communicate mathematical knowledge and to engage in and manage the mathematical requirements of a variety of situations throughout adult life (PIAAC Numeracy Expert Group, 2009). According to the Australian curriculum, mathematics education forms part of the seven 'learning areas' and numeracy forms part of seven 'general capabilities' that underlie the students in becoming successful, confident, creative and active son-citizens and knowledgeable people.

The focus on argumentation/proving, problem-solving aspects and numeracy in Indonesia primary education is basically because of its role in student's learning of academic content and in skill used in everyday life (Anwar et al., 2021, 2023; Anwar, Mali, et al., 2024; Anwar, Sa'dijah, et al., 2024; Dorris et al., 2021). The Basic Education Level Education Unit consists of Graduate Competency Standards as contained in SNP No 57/2021 with respect to students' character development based on the values of Pancasila and students' literacy and numeracy competencies. Irma R. Hidayah et al. (2022) state that students experience difficulties in tackling numeracy problems. The current research is, therefore, devoted to analysis of the ways students think and the methods they use when faced with numeracy problems. The purpose of the research is to attempt to understand the gifted student's ways of thinking as well as their problem-solving behaviors. Explaining student's thinking and strategies used in solving numeracy problems is part of the insight into students' performance of mathematical tasks.

METHOD

Research Aims

This case study aims to investigate strategies, challenges, and techniques in numeracy problem-solving strategies utilized by a highly intelligent student, in order to identify obstacles, potential causes of failure, and propose pedagogical recommendations for enhancing numeracy skills.

Participant

The study includes a subject, referred anonymously to as Iwan, who is a very talented student between the ages of 10 and 12. Iwan has been recognized for its excellent skills in solving numerical problems. The selection criteria encompassed a well-documented track record of outstanding academic performance in mathematics as well as recommendations from teachers.

Procedure

The research began by selecting participant Iwan from a cohort of students engaged in an International Class Program (ICP) at a school in Malang, Indonesia. Their selection was predicated on their outstanding academic prowess in mathematics and recommendation from their educators, in accordance with the methodologies expounded by Renzulli and Reis (2021). After the recruitment process, we received informed consent in accordance with the ethical principles set forth by the American Psychological Association in 2017. This was particularly essential because Iwan is a minor, requiring approval from both the student and their parents or legal guardians.

The task based interview method that Kaufman and Sternberg (2005) describes was the strategy that this study employed for its interviews. During the interviews, Iwan was presented with a problem such as the one depicted in Figure 1, which resembles questions posed in the math contests such as PISA. During the interviewing session, all of Iwan's utterances were recorded in the audio recorder and later, all words were transcribed verbatim. Moreover, verbal aspects and observations that did not involve speech were also systematically recorded as recommended by Emerson et al. (2011).

The theme analysis approach used followed the basic steps compiled by Braun and Clarke (2012). The analysis method was done carefully and thoroughly not only to identify and arrange the recurring ideas and patterns in Iwan's approaches to problem solving but also their applications ensured that reliability and the depth of the analysis have been maintained.

To ensure credibility and to increase the degree of trust in the study's conclusions the triangulation strategy was employed which involved collecting and cross assessing multiple sources of the same phenomenon. This included looking at Iwan's answers to the questions posed to him, the body language with which he responded to those questions, and the scores he obtained on the numeracy problems. Moreover, there was a peer review of the interpretations of the data by a number of researchers with the aim of reducing bias and enhancing the understanding of Iwan's thinking processes.

Conformability and consistency were sought in an audit trail that was very carefully created. This trail consisted of the detailed records of the entire course of the study which included the first ideas on the research problem, and its design, to the last stages which included data collection and data analysis. The paper contained detailed explanations of the processes undertaken in making choices and decisions, the thematic analysis coding systems which were used, and the arguments justifying the ways of analysis. The study provided more accountability by tracing the process of the research in that an audit trail was created, hence increasing openness to external review.

To improve the validity and the reliability of the research findings, a member-checking procedure as `report' has been revised by Birt et al. (2016) was implemented. Through this procedure, Iwan had the opportunity to assess the work that the researchers did in analyzing the interview data. The materials and opinions raised by Iwan were then captured so as to ensure that their viewpoints and ways of solving problems were represented in the findings. This step was necessary in strengthening the validity of the study To ensure that the matrices of meaning were accurate, at least, they reflected the perspective of the participant.

Ethical considerations

The study was done in accordance with the ethical principles specified by the (AERA, 2011), guaranteeing the confidentiality and anonymity of participant Iwan. The research was carried out with meticulous regard for Iwan 's welfare and confidentiality.

Contribution to both the theoretical and practical aspects

This investigation broadens our understanding of the specific problem-solving strategies and techniques of reasoning used by high-achieving learners in mathematics. The findings are relevant for the theoretical stance to the extent that they disclose practical aspects such as pattern recognition and logical guessing, as well as for the practical side, in that they provide information about good strategies for the instruction of numeracy. The emphasis of this study is to explain the cognitive strategies that expert children use in the process of solving number tasks, and this makes the study relevant to mathematics education practitioners as well as researchers.

FINDINGS AND DISCUSSION

This section of this research attempts to explain Iwan's method for numeracy in a more structured way. This part is further divided into four key subsections. The first subsection, which is entitled Elaboration on Iwan's Strategies for Numeracy Problem Solving, focuses on the exact strategies and methods that Iwan employs with respect to the solution of mathematical problems. The second subsection, Obstacle and its Impact in Numeracy Problem-Solving analyses the potential barriers which Iwan faces and how they might affect his performance in solving quantitative problems. It also evaluates the strategies that he employs in order to provide good solutions. The third subsection, titled "Factors and Other Aspects which may Lead to Failure in Problem Solving," considers a number of aspects which may disrupt a good problem-solving process. Last of all, the "Recommendations" subsection gives practical suggestions based on our research that are aimed at increasing the understanding of mathematics and the effectiveness in dealing with similar situations.

Elaboration on Iwan's Strategies to Numeracy Problem Solving

This section will provide a comprehensive analysis of Iwan's problem-solving procedures for numeracy problems, accompanied by pertinent references.

Analysis of Graphs and Mathematical Operations

Iwan exhibited a distinct and well-defined strategy for solving numeracy problems. He initiated the process by analyzing graphs, a crucial proficiency for comprehending visual data. When questioned about his approach to numeracy problems, this strategy is apparent in his response; see transcription 1. Iwan utilized arithmetic operations such as multiplication, addition, and subtraction to obtain the ultimate solution. This denotes a versatile strategy that integrates graph analysis and mathematical operations to resolve numeracy challenges.

Transcription 1

Turn	Transcript	
1	Researcher	: when you look at this problem, what is your first step?
2	Iwan	: The first step? Okay.
3	Researcher	: Yes, tell me the steps.
4	Iwan	: Sure. So, I use a formula/equation. The formula is used to find the total income based on this graph. So, this graph explains the number of Cuban Rondo visitors. The formula used is to multiply the number of visitors by the ticket price per visitor, and you get the total income for one month. So, in this case, the income for October for ticket sales is around 21 million Indonesian Rupiah.
5	Researcher	: Okay, thank you, but wait. You just told me how to solve the numeracy problem for question number 1, right?
6	Iwan	: Yes.
7	Researcher	: Okay. Now, please tell me how to approach numeracy problems in general? Like problems with graphs and pictures?
8	Iwan	: Yes. Well, it depends on the type of numeracy question and what needs to be solved. For example, if we are asked to find the total income from a graph, I have to multiply the number of visitors by the ticket price per visitor, and most importantly, I also have to understand how to read the graph, know the x and y-axis on the graph.

Iwan's strategy of numeracy problems begins with the interpretation of graphical data, his ability that can be described as the interpretation of visual data elements as a part of mathematical literacy. This approach is very important because understanding graphs makes it easier for students to understand and analyze quantitative data, which is more relevant in real-world circumstances wherein frequently, charts are employed (Friel et al., 2001). Analyzed graphs help Iwan in not only resolving relationships between independent and dependent variables but also assist in identifying the key components of mathematics, such as scaled axis, patterns and specific coordinates. Friel et al (2001) posit that—graph literacy a subset of mathematical skills is one of the key pillars of numeracy and every student ought to have it as one of the prerequisite in order to participate actively in the assessment of learnt concepts.

In this case, Iwan supplemented the efforts put in the analysis of a graph with efforts towards Multiplication, addition, and subtraction to arrive at a solution. For instance, if Iwan is given a picture where the number of visitors to a theme park is the subject of discussion, he would conclude that the income is equal to the multiplication of the number of visitors in the park and the price of tickets, an indication that he has a holistic way of analyzing and computing views presented in graphs. The combination of visual comprehension and the solving of basic arithmetic problems is described by (Boaler, 2016) as more of a mathematical context which emphasizes flexibility by allowing for movement among various representations of information spaces e.g. graphs, tables and calculations in the aim of solving a particular task.

The combination of graph interpretation and arithmetic computations is consistent with the Mayer's principle of multimedia learning (2014) which states that people learn better when they can integrate graphics with words and numbers. Through both the graph and numerical operations, one is claimed to understand the Mayer's dual-channel principle where both verbal and visual aspects are employed simultaneously to enhance comprehension. This practice relieves cognitive burden and enables learners to perform more effectively particularly in multi-staged problem solving scenarios (Sweller, 2011).

On the other hand, these are the contemporary works in cognitive psychology that support Iwan's method of asking students to concentrate on substantial calculations and not to repeat the information depicted in the graph. According to Dunlosky et al. (2013), it is possible to increase cognitive delicacy by teaching students to carry out the important steps in the problem and avoid looking for additional copies which are not necessary. This phenomenon can be explained as the "selective attention" approach which helps the students focus on some computations at the expense of others and thereby reduce chances of making mistakes or increasing their cognitive load . Iwan's approach also helps in appreciating the role of quantitative reasoning in mathematics education. Quantitative reasoning is seen as making sense of numbers and their relationships in a given situation (Mayes, 2019). Iwan interprets the graph and uses math operations to determine values, thus practicing quantitative reasoning which is essential for the enhancement of the credibility of literate numeracy. This skill becomes especially necessary when solving problems in the world, interpretation and manipulation of facts are needed to reach a logical conclusion (Santos-Trigo, 2019).

Further, arithmetical activities alongside Iwan's graphic interpretation demands for the development of critical thinking skills as he has to look at graphical and perform arithmetical operations. The British Sociological Association (National Council of Teachers of Mathematics, 2014) defines critical engagement with numbers as involving analysis of data to provide meaningful interpretation, encompassing the evaluation of interrelations, and the integration of information that has a visual and quantifiable aspect. Iwan's methods reflect such principles, for he interprets the graph, seeks relevant quantities, and executes the relevant operations demonstrating understanding of the multiple causations for the numeracy problem at hand.

Overall, Iwan's skill of graph analysis fused with the skills of arithmetic operations clearly depicts high levels of comprehension towards following the numbers, incorporating use of skill in quantitative reasoning, critical thinking and cognitive efficiency. This approach is in line with research emphasizing the importance of teaching students to interpret, calculate, and apply quantitative data effectively. By developing such skills, students like Iwan are better prepared for numeracy challenges in both academic and real-world settings, highlighting the need for mathematics curricula that prioritize integrated data interpretation and calculation skills.

Numerical Pattern Recognition

Iwan employed a method of comprehending numbers based on patterns in order to accelerate calculations. He elucidated that certain operations, such as multiplication by 1, 5, and 10, exhibit distinct patterns that can be readily utilized. Iwan stated that in order to expedite the computation process, students utilize memorized numerical patterns, see Transcription 2. For instance, multiplication operations involving the integers 1, 5, and 10 exhibit distinct patterns, requiring little calculation time.

Transcription 2.

Turn	Transcript	
1	Researcher	: do you have any specific techniques in calculation [multiplication]??
2	Iwan	: first, I have to understand that numbers are a pattern or a sequence. Especially in multiplication operations. Multiplication is a pattern of numbers, like easy multiplications are with numbers 1, 5, and 10 because multiplication with those numbers has a pattern. So, you should remember that in mathematics, many operations like multiplication and addition have patterns based on the numbers being multiplied or added.
3	Researcher	: Okay, okay. So, you just told me about calculation techniques in mathematics.
4	Iwan	: Yes. Actually, we can do simple calculations with scribbles on paper, but if we have to calculate many numbers from complex and simple numbers, simple calculations will take a lot of time. So, in my opinion, calculations with scribbling on paper should be done for complex calculations. Simple number calculations are memorized by understanding their patterns. Based on my personal experience, when I do calculations, I don't scribble for simple numbers, I only scribble for complex numbers because scribbling too much on paper makes the writing messy and wastes time.

For Iwan when doing numerical operations mainly with 1, 5 and 10, his focal point remains that of recognizing the numerical patterns which further aids him in performing a calculation. Essentially, this not only makes computations faster but also minimizes cognitive demands since familiar patterns are utilized. Arithmetic, as illustrated by Iwan, is the ability to learn through a succession of actions, allowing students to employ quick thinking instead of painstaking procedures. Rittle-Johnson and Schneider (2015) explain that there is a core relationship between building understanding and arithmetic skill towards several patterns and more specifically holes of young students through patterns, forming increasing number cognitive development.

Progressing in this area, Baroody (2003) also states that the ability to perform arithmeticverse operations is highly developed in students' understanding of the position that the elements of the arithmetic system can produce relations which enable immediate calculations. Recent studies continue to assert the above, with the studies depicting these studies are pattern based meanings that grate fruitful numeric problem solving in students with regard to step by step calculations (Rittle-Johnson & Schneider, 2015). Such techniques start to become common in resolving the problems of mathematics instruction by proving honest practice of numeracy and sustainability of cognitive problem solving (National Council of Teachers of Mathematics, 2014).

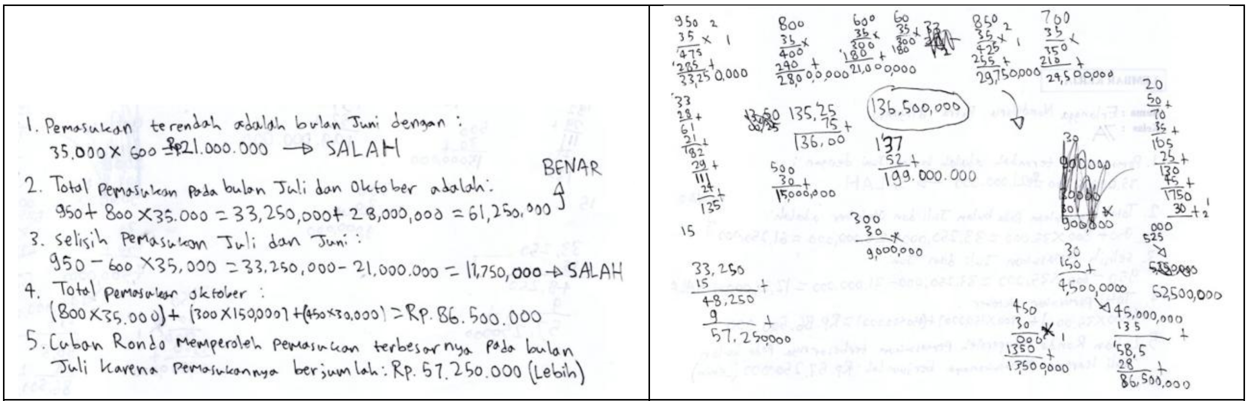
To conclude, when Iwan recognizes patterns, his decision-making speed can be improved through a number of recognizable patterns which is in a way consistent with the current trends on the relationship base arithmetic principles for numeracy. This method not only speeds up computations but also helps students develop a better and more natural understanding of mathematics which has important consequences for teaching aimed at the improvement of students' arithmetic abilities.

Scribbling Technique

Iwan employed the "scribbling" method, which entails conducting preliminary computations on a separate sheet of paper. This method enables him to solve intricate mathematical problems involving complicated numbers and calculations without overcrowding the main answer sheet. Upon reaching the solution, he meticulously transcribes the answer onto the response sheet, see Transcription 3 and Figure 1.

Transcription 3

Turn	Transcript	
1	Researcher	: why do you have to write twice? Why do you have to write behind and in front of the paper? Why not just write on the front of the paper directly?
2	Iwan	: Because my way of calculating a number is very messy and difficult to understand. Consider the writing on the back of the paper as scribbles for me to calculate. I do this because my writing is not neat and structured. So, in my opinion, to make it easier to read every idea and numbers, I need to write it twice for formal and clear answers, as well as answers for scribbles.
3	Researcher	: But that takes more time. So, do you mind writing twice?
4	Iwan	: No, it's okay.
5	Researcher	: So, do you use this technique in regular math lessons?
6	Iwan	: Yes. But I don't always write down what's known in the problem. I directly write down what needs to be solved in the problem. For example, if asked to find the total income for a month, I immediately calculate it in the scribbles, then I copy it onto the answer sheet. It's simpler than writing down what's known and asked in the problem.



Formal answer	Scribbling technique

Figure 1. Iwan' scribbling technique and formal answer.

Iwan favors a straightforward and efficient approach to problem-solving. He refrains from openly restating or summarizing already established information from the graph. Instead, his attention lies on resolving the fundamental issue or computation asked, without replicating the data already available in the graph. Iwan's utilization of the "scribbling" technique, which involves conducting preliminary approximate calculations on a separate sheet before carefully transcribing the final solution, is a pragmatic approach that is consistent with contemporary pedagogical studies highlighting the advantages of employing such strategies for mathematical problem-solving.

Rittle-Johnson et al. (2017) conducted recent educational research that indicates that when students are given the opportunity to express their thoughts through rough work, it can enhance their problem-solving abilities by reducing cognitive load and promoting clearer thinking. Furthermore, a study conducted by Rittle-Johnson et al. (2017) emphasizes that employing these tactics might assist students in structuring their thoughts, a critical skill for approaching intricate computations and issues.

Problem Solving in a straightforward manner

Iwan executed a simple and effective plan. He placed himself at the core by solving the problem at hand, without transcribing or condensing any of the content in the graph, see transcription 3 (turn 6). Students focus on how to manage a situation or a calculation that has been presented to them without restating the content already represented graphically.

Iwan's strategy of straightforward answering, that is tackling the problem based on the material already known through understanding without repeating it, fits well within modern ways of teaching that value 'problem solving' and 'cognitive economy' in one's thought process. More recent work by Star and Rittle-Johnson (2015) has demonstrated that students' participation in mathematics increases when they solve the challenges posed, which in turn means better understanding of the ideas. It has been disclosed that students who first deal with the nontrivial calculations instead of rewriting the information already known operate more effectively and make fewer mistakes (Dunlosky et al., 2013).

Creating a Scale for Estimation

Iwan adopted a significant method of devising a scale for estimation when confronted with a graph that lacked specific data points. To address situations when the graph lacks specific data points within the range of 300 to 400, Iwan proposed the use of a reference scale consisting of points such as 300, 320, 340, 360, and 400, see Figure 2. This approach enables reliable estimation of values. By employing this method, he made informed conjectures and estimated numerical quantities when required.

Transcription 4

Turn	Transcript	
1	Researcher	: do you have trouble reading graphs?
2	Iwan	: No.
3	Researcher	: But why did you ask about the graph multiple times earlier?
4	Iwan	: Well, because of the graph problem in July, ATV 300. I wasn't sure if it's exactly at 300 or more.
5	Researcher	: Okay. So, you didn't know that there was a gap from the number 300, which means the graph indicates more than 300?
6	Iwan	: Yes. But I wasn't sure about the specific number to calculate the revenue for the ATV ride in July. I knew the question didn't ask me to write a specific answer. So, I just read the graph in July, and I wrote more than 300 because it exceeded the number 300.
7	Researcher	: Okay, so your issue was not knowing the specific number between 300 and 400 indicated by the graph?
8	Iwan	: Yes.
9	Researcher	: But did you try to make a scale comparison line to estimate the number? Did you divide the line by one, two, three, four?
10	Iwan	: Yes.
11	Researcher	: Why didn't you divide the scale line into five parts? Like 300, 320, 340, 360, and 400.
12	Iwan	: Yes, but instead of having to divide the lines on the graph, I believe the graph should have a line/point to make it easier for us to know the specific number.
13	Researcher	: Okay, okay. Well, I think students can imagine it themselves.
14	Iwan	: Yes, but this is about scale, right? In digital files or images, each unit from 100 to 200 may be about 2 cm. But if transferred to a different scale, the size may not fit. So, in a digital file, it might be 2 cm, but if transferred to a different scale, it might become 3. So, I'm not sure about determining the scale ratio to determine the specific number in the range of 300 to 400, so I just concluded that the ATV ride in July is more than 300.

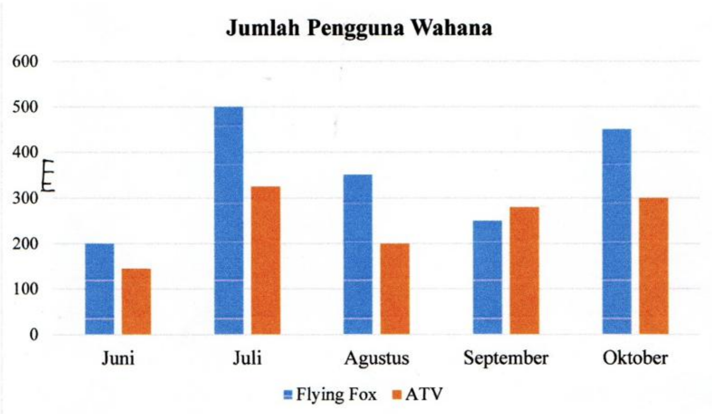


Figure 2. Estimating numerical quantities by scaling the graph.

Iwan's strategy is an example of determination estimation problem which is, according to mathematicians, one of the best strategies to develop in learners a number-hood sense and flexible problem solving abilities. As Van de Walle et al. (2013) explain estimation enhances the knowledge of students regarding the sizes of numbers and their use in mathematical contexts without having definitive figures. Likewise, estimation improves students' fluency in numbers enabling them to have functional values they can use for approximations in different settings (Vinogradova, 2013). It is in this principle of education that the technique demonstrated by Iwan is explained as enabling students to show how estimation is used to fill in the gaps among pieces of information, a skill that has an enormous practical utility.

So as to not only improve precision, to be incorporated in estimations but also improve the efficiency of the human brain while estimating, Iwan's estimation stratagem does the trick. It allows him to scale down the actual computations and retrieve required information in the least time possible while maintaining the accuracy of the message. Quite the opposite, training estimation abilities, as described in a National Council of Teachers of Mathematics (2014), allows a learner to reconsider the question aiming to approximate the answer and thus to enhance their efficiency in Five problem solving. This construct is compatible with Mayer's (2014) cognitive theory where she outlines the importance of being efficient both in time and space in terms of how much information space a learners brain can handle while trying to solve a problem.

Furthermore, estimation skills contribute to adaptive reasoning—a critical component of mathematical proficiency. Adaptive reasoning is strengthened when students engage in practices like estimation that require flexible thinking (Stanford, 2022; Sternberg, 2021). By applying a scale for approximation, Iwan demonstrates adaptive reasoning, adjusting his approach based on the available information to reach a logical conclusion. This adaptability is vital for students in both academic and practical settings, where estimation often plays a role in quick, informed decision-making.

To conclude, it can be stated that estimation in Iwan's case is supported by the current educational trends which consider estimation a core component of numeracy. Such methods help to accurate judgement where information is absent and the strength of the closure isn't contradicted, which are operational features of real life mathematics. Iwan's strategy provides several effective numeracy practices such as the emphasis of making estimation a priority during teachings the metric concepts in mathematics.

Obstacle and its Impact in Numeracy Problem-Solving

Iwan's interaction with the graphical interpretation of values confronts the challenge of determining the balance between approximation and accuracy. According to Clements and Battista (1992), a useful skill is to interpret or estimate hidden values in data because this skill is also needed in real life. The quest for accuracy and approximation can sometimes greatly affect the ability to solve problems. For example, as noted by Zimmermann and Cunningham (1991), a common graphing error in students is in their bias to seek clarifications and in turn, they could interpret the information in a biased manner leading to erroneous conclusions and inefficient solutions.

Further, Iwan found it difficult to interpret scales as he had problems when it came to converting a readout from a screen into a real object this Infact, is a reflection of the students' problem with the understanding of mathematical representations. Goldin and Kaput (1996) explain that to switch from one format to another, one needs to know more than a sequence of steps, one has to understand the core ideas that the concepts revolve around. According to Lesh and Doerr (2003), incorrect scale use can lead to incorrect reasoning since scale use is one of the key elements in associating and making sense of mathematical ideas.

He also applying the convergence of scales towards themselves suggesting a placement of value at over specific areas of focus, which students applying this strategy resort to most likely seek for an accurate answer as their key objective. The reasoning behind Boaler's (2016) critique is that such methods might narrow students' cognitive abilities in solving complex real-life situations which may require more or less estimation. Certain findings suggest that lacking flexible thinking which can be crucial in addressing complex problems differs from failing to understand mathematics concepts and procedures. For example, Shaw et al. (2020)'s research shows students rarely have or use more than one problem solving strategy that has been taught to them, hinting that the ability to think flexibly comes with the view of multiple ways of addressing a problem.

Moreover, the challenges which Iwan confronted are clearly suggestive of the wider concerns which exist within the mathematics educative discourse. The lack of a coherent graphical representation or a smooth transition between scales, and increased attention to detail are likely to have a dramatic effect on the successful solving of mathematical tasks. It is important to address those mathematical issues because current mathematics education is apparently moving toward more analytic and creative approaches to problems. This, in turn, requires changes in the nature of the teaching approaches that should incorporate more creativity and conceptual understanding as envisioned by the National Council of Teachers of Mathematics (2000).

Potential Causes of Failure in Problem Solving

Iwan has a habit of placing certain target values ahead of guesses which severely obstructs him during problem-solving tasks, especially out in the real world, which often requires more than estimation due to unclear or partial information. Gaining benefits from these attributes in some situations, the 'surplus of focus' on accuracy may also impede the development of flexible thinking that is required to manage complexity and uncertainty associated with many mathematical or practical challenges. The balance of precision and estimation is described as important by Lesh and Doerr (2003). In particular, when faced with real world mathematical problems, such flexible problem solving skills would be desirable because many such problems do not lend themselves to clear or precise solutions.

Iwan's difficulty regarding scale reading and especially the transitions between physical and electronic forms highlights the most crucial problem area within mathematical pedagogy: the command over several representational systems focused onto a single problem. Without being proficient in this skill, students will find it hard to cope in the increasingly digital and information-rich contexts that they will encounter. The problems that Iwan encounters in regard to mathematical education are an illustration of two significant areas of pedagogic practice and study that have been identified in educational research over the last few years.

According to the National Council of Teachers of Mathematics (2014) the overemphasis placed on precision is detrimental since it impairs the ability to estimate. Estimation is a very relevant skill in real life situations where data is not easily available in exact forms. Overemphasis on precision at the cost of estimation may limit students' flexibility to handle and solve realism problems. Additionally, the problem that Iwan had of interpreting digital scales into the physical world forms part of a major problem of interpreting mathematics which, according to the National Council of Teachers of Mathematics (2014), is one of the foci areas. Scale changes are absolutely of great importance and are among the most fundamental educational skills and become more necessary in the changing world with technology. These skills are quite relevant for the teaching of mathematics in this 21st century as they have great implications on the methods used to teach that focus on the combination of estimation and accuracy and stress on the ability to use several types of representations.

Iwan's problem-solving obstacles highlight other educational issues which if not well handled, would impede the students' mathematics and problem-solving capabilities. In dealing with these problems, there is need to adopt educational strategies that emphasize conceptual knowledge, flexible mental models, and the ability to interpret different representations which have been advocated by the National Research Council and the National Council of Teachers of Mathematics.

Recommendation

As noted by Iwan, if the student's mathematical fluency is to be improved, it is essential to stress pattern recognition and estimation as suggested by National Council of Teachers of Mathematics (2014). In simple terms, mastering this approach will improve, in particular, students' understanding of mathematics through recognizing patterns that serve as the simplest building blocks of mathematics. This, aside from basic comprehension, is crucial in applying mathematics to real-life problem-solving especially when complete and accurate measures are not provided. In his work, Boaler (2016) also insists that the incorporation of the scribbling technique into the teaching of learning environment enhances the students' understanding of concepts. This approach makes it possible for learners to do complex calculations in a less, more intelligent and motivated way and understand that mathematics is more than procedural skills. These guidelines are meant to encourage a more wholesome and flexible attitude to the teaching of mathematics so as to develop skills that are relevant in theory and practice.

CONCLUSION

This case study investigates the problem-solving skills involving numeracy of a gifted student labeled Iwan. It provides an in-depth investigation of the mental processes and the patterns of behavior that are characteristically outstanding in gifted persons while dealing with particular mathematical situations. The method employed by Iwan employs fusion techniques that involve times multiplication, addition, and even graph analysis to tackle complex numeric problems. Iwan employs a complex approach that is consistent with forms of research that demonstrate that numeracy and other mathematics skills are comprehensive in getting the full grasp of numeracy. In addition, the case also demonstrates possible problems in Iwan's problem-solving processes, the issues of accuracy versus estimation when interpreting graphs, and the difficulty of switching scales from one graph to another, whether in a digital or physical form. These problems highlight broader curricular issues in the teaching and learning of mathematical concepts and the necessity for teaching approaches that integrate estimation and accuracy alongside multiple representations. The results of the study provide distinctive qualitative and quantitative contributions to the theory and practice of mathematics education. They give practical meaning to the effective strategies of teaching and extend the knowledge of how gifted children deal with numerical challenges.

However, the study does have certain limitations and challenges, especially the methodological ones. The focus on a single participant, while being exhaustive, limits the generalizability of the findings. Future research may increase the number of participants enrolled or examine similar research approaches in different educational settings. In addition, longitudinal studies seem to be able to provide some perspectives on the changes and development of problem-solving strategies over time and their effect on general academic achievement in mathematics over time. This investigation provides grounds for further exploration of effective instructional practices for gifted students in mathematics with particular concern for the aforementioned problems and the development of higher-order problem-solving skills.

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