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Student's Perceptions of Numeracy Assessment in The Context of Children's Games for STEAM Education in Elementary Schools

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Abstract

Students' achievement of numeracy competency requires strengthening and modifying game themes that are relevant to daily activity situations. The purpose of this study is to explain the perception of students' numeracy context needs as a process in STEAM education in elementary schools. The research method used is descriptive qualitative through observation, interviews and questionnaires. The subjects of the study were 60 students of SDN Sidotopo Wetan V and SD Kyai Ibrahim Surabaya in 2023. Research data analysis using Miles and Huberman techniques in the form of data collection, data reduction, data explanation and conclusions. The results of this research are answers consisting of 10 questionnaire questions distributed regarding the need for numeracy questions in the context of games. The highest aspect of numeracy needs related to student needs is that numeracy assessment with a game context can attract students' interest and help the learning process with a score of 93.3% each. STEAM education can identify the elements that make up a numeracy problem to help students enjoy the learning content. Numeracy problems related to the fifth aspect of STEAM will fulfil and make it easier to understand the context of the questions by playing games for children.

Keywords: *numeracy assessments, games, STEAM.*

Abstrak

Capaian kompetensi numerasi peserta didik memerlukan penguatan serta modifikasi dari tema permainan gim yang relevan situasi aktivitas sehari-hari. Tujuan penelitian ini adalah untuk menjelaskan persepsi kebutuhan konteks numerasi dari peserta didik sebagai proses dalam Pendidikan STEAM di sekolah dasar. Metode penelitian yang digunakan adalah deskriptif kualitatif melalui observasi, wawancara, dan kuesioner. Subjek penelitian dilakukan oleh 60 peserta didik dari SDN Sidotopo Wetan V dan SD Kyai Ibrahim Surabaya tahun 2023. Analisa data penelitian yang digunakan menggunakan teknik miles and huberman berupa pengumpulan data, reduksi data, penjelasan data dan kesimpulan. Hasil penelitian ini merupakan jawaban dari sebaran 10 pertanyaan kuisioner mengenai kebutuhan persoalan numerasi konteks permainan gim. Aspek kebutuhan numerasi tertinggi mengenai kebutuhan peserta didik adalah asesmen numerasi dengan konteks permainan gim dapat membuat tertarik peserta didik dan membantu dalam proses pembelajaran dengan skor masing-masing 93,3%. Pendidikan STEAM dapat mengidentifikasi unsur pembentuk persoalan numerasi membantu peserta didik menyukai konten pembelajaran. Persoalan numerasi yang berkaitan dengan kelima aspek STEAM akan memenuhi dan mempermudah pemahaman konteks soal dengan permainan gim untuk anak-anak

Kata kunci: *asesmen numerasi, gim, STEAM.*

INTRODUCTION

The essence of quality learning hinges on creating an environment with a numeracy approach at the right phase of a child's growth and development. An environment that reinforces numeracy is similar to practices that adults would consider potentially constitutive of contemporary industrial society (Evans et al., 2017). Numeracy, when applied in various learning models in elementary schools, provides interdisciplinary learning achievements (Khoiriah, 2022).

A review of the numeracy material on mathematical concepts demonstrates the development of numeracy skills through experience, particularly when the activities are formal and present challenges for students (Girard et al., 2021). The challenge in comprehending students' numeracy skills lies in the absence of reliable documentation and grade-appropriate instruments (Gittens, 2015). Adhering to the curriculum that uses an assessment in numeracy requires an open module based on a reflective model that focuses on critical thinking to carry out evaluations (Rakhmawati & Mustadi, 2021).

Another supporting material for students' needs is an assessment which is used as a way to find out students' achievements in the learning process to be mastered as an important competency (Iman & Usman, 2021). Numeracy assessment is important because of the demands of an independent curriculum which is part of improving the quality of education nationally (Baharuddin et al., 2021). Numeracy assessments are included in the minimum competency assessment program which is carried out at all elementary, middle and high school levels (Rokhim et al., 2021).

Numeracy literacy is knowledge that consists of understanding counting, symbols and quantitative analysis of graphs, tables, images, infographics and symbols from mathematics. Numeracy literacy is knowledge that consists of understanding counting, symbols and quantitative analysis from graphs, tables, pictures, infographics and symbols from mathematics (King & Purpura, 2021). The numeracy literacy competency that will be

possessed is a positive future direction for national education to create superior human resources (Geiger et al., 2015). In relation to the goals of sustainable development in the global world explains that the gaming industry will become a force in terms of the economy (Lin, 2022). Teenagers around the world play a significant role in both physical sports and e-sports.

Research reveals that competency games are related to the numeracy abilities of students who understand the intelligence of mathematical material (Brezovszky et al., 2019). Apart from that, understanding of numeracy can be formed through students' experiences, especially in numeracy and mathematics through teaching from teachers (Forgasz et al., 2017). The experiences of students at the child's developmental level imply that playing in class or playing via smart devices has a way of supporting children's thinking patterns for the better (Budiyono, 2023). Research shows that children's traditional play experiences can also make students maintain their character better (Suprayitno et al., 2023). Furthermore, research learning in terms of numeracy through games improve sustainable mathematical concepts.

Through these problems it is revealed that this includes learning styles based on experience. According to Vygotsky's learning theory, children possess a proximal zone that captures understanding from past experiences (Yu et al., 2013). A game played provides new mathematical understanding if the previous experience is different from the current one. Game activities also have a positive impact on students who have done them, such as forming teamwork, concentration, English, speed of thinking, fun and reducing stress (Mertika & Mariana, 2020). The advantages that exist in the games played require an open learning design that accepts all the knowledge involved collaboratively (Ozkan & Umdu Topsakal, 2021). Considering the importance of gaming in the future, learning that can facilitate increased competence is necessary (Bin Amiruddin et al., 2022).

Measuring students' numeracy competency abilities is carried out by carrying out a numeracy assessment which is an independent curriculum policy program to compete with global education levels. Linking it to the current era of the 21st century, the curriculum seeks to adapt to education that provides a general space, especially the application of science and technology. By preparing competencies in everyday life it will have an impact on students. Previous research reveals that gaming activities have the potential to change social thinking, especially in multidisciplinary education. Research activities about games as a habitual need for students are often carried out in their lives through STEAM education, serving as a pathway to develop some of the creativity they have from the assessment process (Marin et al., 2021).

The numeracy assessment requirements provided are used to create an assessment formula. STEAM education provides an alternative as an interdisciplinary curriculum through the application of scientific, engineering, arts and mathematics technology to the learning space (Marín-Marín et al., 2021). STEAM education needs to be carried out considering that research shows that it can increase their career success in the industrial world (Belbase et al., 2022).

Game content-based numeracy STEAM pedagogy aims to reinforce art and design principles for teaching and learning mathematics, science, and engineering in the application of technology (Jolly, 2014). 21st century competencies using game activities will strengthen the context in numeracy from the perspective of students who will undertake national

assessments (Obenza-Tanudtanud & Obenza, 2024). The description of the numeracy questions incorporates elements of STEAM education, a learning process that is relevant to children's daily activities. This study has a primary focus on understanding the latest context of numeracy assessment in order to meet the needs of interactive and educational theme-based learning assessments (Iqbal et al., 2024).

METHODS

This research employs a combination of quantitative and qualitative methodologies. research that analyzes related explanations of data obtained from the instruments provided in the form of game-based numeracy assessment needs for students for STEAM education purposes. The aim of this research is to explain elementary school students' perceptions regarding the need for numeracy assessments based on play activities through STEAM education. This study was conducted on 60 fifth grade students from two different schools, namely SDN Sidotopo Wetan V and SD Kyai Ibrahim. Both schools have the same agenda in implementing the national numeracy assessment.

The research instrument used was a questionnaire that was given after they had worked on several questions regarding numeracy assessment. Questionnaires are used because they are used by students based on their experience and point of view in accordance with discussion and research needs (Peterson, 2019). Data supported by research are observations and interviews. In order to enhance the questionnaire results, the researchers conducted interviews with participants to understand their perspectives on the necessity of numeracy assessments for various gaming activities.

Some questions that follow strengthening the need for game activity-based numeracy assessments for STEAM education are 1) how do you face a numeracy assessment with lots of context 2) How to solve several numeracy assessment problems with different levels of difficulty 3) Do you feel that the numeracy judgments found are based on your experience? 4) What are the difficulties faced in solving numeracy assessment questions? 5) What do you feel, the numeracy assessment you are facing is a mathematics question? (Daryanes & Sayuti, 2023).

The data analysis technique used for presenting the questionnaire results is then tabulated against STEAM education. Based on the data from interviews, a deeper understanding of the need for thinking will emerge (Wibowo, 2022). The results of the questionnaire are presented through a simple quantitative presentation to show some of the numeracy needs necessary for student preparation. The interview follows the qualitative analysis from Miles and Huberman which explains that there are research procedures carried out in the sequence in the figure 1.

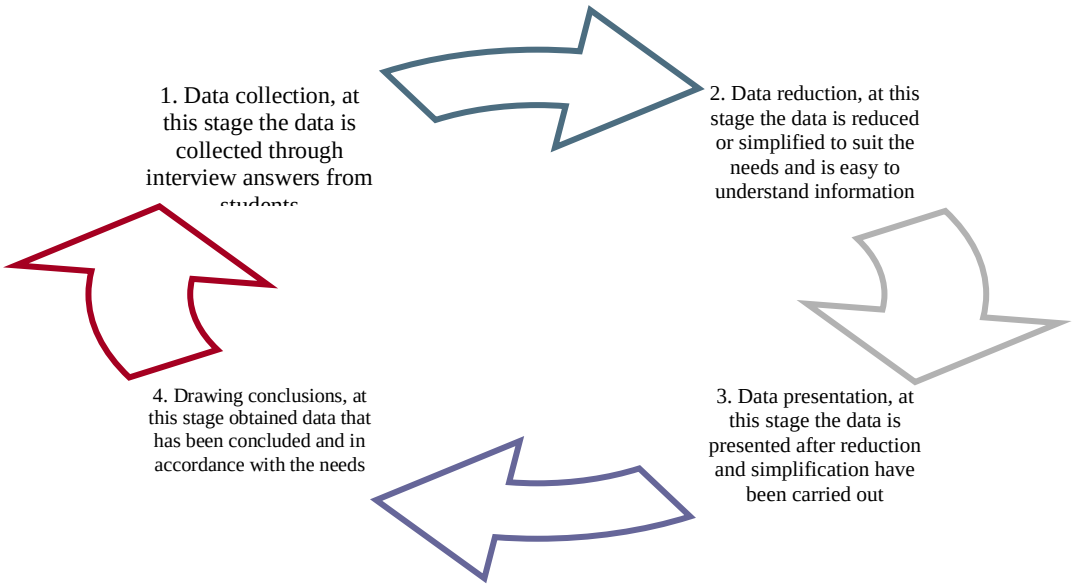

Figure 1. research procedures for data analysis by miles and huberman

RESULTS AND DISCUSSION

The research findings on the necessity of numeracy assessment in the context of game play stem from the distribution of questionnaires to 60 students from the two schools under study, which aimed to gather their perspectives on educational needs. Before being given the questionnaire, students who participated in the 2023 national assessment understood what numeracy was, the characteristics of numeracy questions, and how to answer math. In this section, the researcher presents a questionnaire and five questions to enhance the comprehension of numeracy issues among teachers as they prepare for national assessments. Of the ten questions given, the data will be displayed in the form of percentages calculated in table 1.

Table 1. Student responses to numeracy assessments through game activities

No.	Question	Yes	No
1	Numeracy assessments with general context in everyday life make you feel like you understand the problem?	72,4%	27,6%
2	The context of daily life activities such as playing games provides the motivation to carry out numeracy assessments?	76,7%	23,3%
3	Would you be interested if the game content challenged you in solving arithmetic problems?	80,76%	13,3%
4	Do you feel that the game content makes it easier to think in a simple way ?	73,3%	26,7%
5	When playing games there are elements of numeracy about numbers, algebra, geometry and data analysis	70%	30%
6	I feel like playing games makes me more skilled and masterful	74,6%	25,4%
7	Do activities regarding numeracy assessment with a game theme make you prefer it?	93,3%	6,8%
8	Have you ever tried game types such as puzzles, simulation games, strategy, logic, MOBA or first person shooter ?	74,6%	25,4%

9	Have you ever done a numeracy assessment with a game story?	83,1%	16,9%
10	I like learning in the context of playing games in class by the teacher	93,3%	6,8%

The results of research regarding students' perspectives on meeting national assessment needs provide data that has been distributed via online Google forms. The filling stage is carried out by students who receive additional learning to prepare for the computer-based national assessment. The data analysis carried out was accumulated in percentages of yes and no scores. All of the students who completed the numeracy assessment needed a questionnaire based on the game context received positive answers that were more dominant than negative answers. This supports the perception of future learning needs for elementary school students in relation to competency assessments regarding numeracy in the required context of game play (Aunio & Mononen, 2018; Gasteiger et al., 2015).

Based on Table 1, it is evident that students responded affirmatively to two questions, which were related to numeracy assessment activities with a game theme. This approach encourages students to prefer and enjoy learning within the context of games in class, as demonstrated by the teacher who awarded the highest score. These two questions gave a score of 93.3% or 55 children answered yes based on their experience. Game play activities, when applied as a learning context for assessment and learning in the classroom, hold a unique interest for students (Bertrand & Namukasa, 2020; Granberg et al., 2021).

Aspects regarding game play are of interest to students, although in teacher learning in class and in try-out assessments, questions with these specifications rarely arise. Therefore, 83.1% of students express a desire to carry out a numeracy assessment based on the game's context. The activities of students who carry out numeracy assessments on their experiences have challenges for each student to solve the problems given, This was answered yes with a percentage of 80.76%. Exploring in-depth perceptions regarding the need for numeracy assessments provides encouragement for students to complete their work independently (Sari et al., 2021).

Examples of numeracy assessment questions provided by students, or their experiences receiving assessments using this type of game, resulted in a 76.7% yes response. The game aspect makes students skilled and students who tried various games on smartphones answered yes by 74.6%. Numeracy assessment is something that needs to be tried as an evaluation of student competence because the context of the game is simple for students to find.

Complex multiple choice type questions.
Check out the game data screenshot below with the user "RH-CUTE". This game is a mobile legend game with a final report of the game results of the 5 vs 5 ranked mode.
Which player is the most valuable player in the win and lose conditions below?.
1) Has accumulated damage, tower, takes the most damage
2) major battle participation

Answer options
- ☐ prilly latucon with hero rafaela
- ☐ RH-cute with hero pharsa
- ☐ -_-A-_- with hero argus
- ☐ pen with hero irithel
- ☐ breadfredy08 with hero diggy
- ☐ Nagisa with hero Hilda

Answer key
- ☐ prilly latucon with hero rafaela
- ☐ RH-cute with hero pharsa
- ☐ -_-A-_- with hero argus
- ☐ pen with hero irithel
- ☐ breadfredy08 with hero diggy
- ☐ Nagisa with hero Hilda

During the additional learning period for students to improve their understanding of arithmetic related to numeracy, through questions with a general context used to facilitate students' understanding in solving problems, the answer showed a percentage of 72.4%. Meanwhile, from the questions given, it can be seen that the aspects of the questions regarding playing games contained elements of numeracy regarding numbers, al-gebra, geometry and data analysis showing a score of 70% or around 42 students answered yes. Efforts to fulfill numeracy assessment needs can be achieved well if supported by a multidisciplinary scientific process that cannot be separated from numeracy literacy (Tumasheva et al., 2020). Classroom learning carried out by teachers can be achieved according to learning activities in worksheets or formative evaluations regarding the context of game play. Numeracy assessment in question has problems that can be solved using various applicable scientific disciplines, one of which is the application of STEAM education. The following is an example of a numeracy problem presented to students as a space for assessing student competency in facing national assessments in Figure 2.

Figure 2. Numeracy assessment problems in the context of game play

The exercises include the numeracy problem from Figure 1, along with additional learning activities to enhance students' numeracy knowledge. The form of questions given to students such as displays are arithmetic questions, which have scientific content, a game context, a class 5 material number domain with a medium level of difficulty, and the answer pattern determines one of the multiple choices.

The answer key to the number question is -_-A-_- with the hero Argus and Nagisa with the hero Hilda. The question presents the highest requirements for the most valuable player, Argus. Answering number questions does not need to be complicated or complicated but it directs the reader to understand the context of the question and solve it. Researchers provide interactive contexts through popular game worlds to stimulate students to solve the problems presented.

The creation of types of questions given as numeracy assessment exercises based on the context of game play for students can be translated across STEAM education. The knowledge seen in the form of this questionnaire is the competence of comparing and measuring through collecting data from several players who got scores at the end of the game. The technological element seen in this type of game is the massive use of gaming industry technology played by several children or students. The element of Art as art can be seen in the context of games apart from games which are included in entertainment, the display of images in each of them attracts the attention of students. The engineering element is the engineering of a game play which is displayed at the end of a game with the data displayed. Mathematical elements are numbers in the form of numbers that provide orders for problems that must be solved in finding the hero or player with the best gameplay.

Following up on the need for numeracy assessment based on the context of children's play, researchers explored the role of teachers in improving the numeracy process through classroom teaching. To meet the demands of the wide-ranging context of game play and its diverse elements, an approach based on STEAM education provides a solution to this issue. STEAM education is a way that can be done on various sciences that can be learnt through the context presented (Ke & Lin, 2022). The focus in STEAM education is how the steps taken can utilize students' understanding of learning in class so that learning achievement calculated through student assessments can be achieved above the threshold value (Quigley et al., 2020). Classroom teachers were given interviews that were provided as a way out of the process of

increasing understanding of game play contexts through STEAM education. So the implementation of STEAM education in the classroom can be measured through the views of class teachers who receive the quota program for increasing the number of students.

Numeracy competence can be improved through the role of science, technology, economics, art and mathematics in the classroom by adjusting learning designs and student worksheets according to the context of the game (Yuliandari & Hadi, 2010). Through STEAM education, achievement in numeracy assessments becomes a way for learning outcomes to be relevant to students' future competencies. STEAM education from the teacher's perspective is related to students' life experiences because outside of class learning hours, playing games becomes their habit which directly shapes students' competencies. (Nuragnia et al., 2021).

The STEAM concept also needs to be noted that counting is not the dominant element in mathematics. In its application in life, individuals who think mathematically often use mathematical knowledge. Numeracy is an individual skill in understanding problems from various cross-disciplinary fields in a balanced manner both in terms of science, technology, art and mathematics. Several numeracy assessment contexts can be developed through worksheet activities in learning or assessment activities at the end of learning, mid-semester exams, final semester exams or national scale exams regarding computer-based numeracy assessment.

CONCLUSION

Implementing numeracy assessments as student competency reports is crucial. A national-scale examination program that implements numeracy assessments is a benchmark for schools to improve the quality of students. Numeracy assessments in the context of gaming are necessary to prepare students for exams. The views of students after being given practice on counting questions in the context of the game gave two aspects of high value. Regarding numeracy based on the game context in assessment and learning is liked by students. To support better numeracy assessments, STEAM education is needed as a learning platform. From the numeracy questions presented in the context of the game, there are five interrelated disciplines, namely science, technology, engineering, art and mathematics. STEAM education as a means of increasing student numeracy can be done through learning design and the use of worksheets. Therefore, STEAM education which is taught through teachers during learning and applied to students during assessment activities answers the need for an assessment pattern that has elements that build student competency.

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