Journal of Elementaria Edukasia
Volume 6, No. 2, June 2023 , 650-660
DOI: 10.31949/jee.v6i2.5259

p-ISSN 2615-4625
e-ISSN 2655-0857

Development of a Productive Disposition Skills Instrument for Elementary School Students

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ABSTRACT
Productive disposition is one of mathematical skill that is rarely discussed and researched in nowdays era. Even though this skill is as important as other math skills. This study aims to develop an instrument for measuring productive disposition skills for elementary school students. The research method used is research and development (R&D) with the stages of instrument development consisting of preliminary studies, design, validation, and trials. The research subjects consisted of 99 students in grades 4 and 5 in 4 elementary schools in East Java. For the sake of selection of respondents, purposive random sampling technique is used by the researcher. Furthermore, for data analysis, it used a descriptive quantitative approach. The results of the study show that the developed productive disposition skills measurement instrument is valid and reliable. The results of the reliability test showed a Cronbach's alpha coefficient of 0.85. The construct validity of the instrument has also been well tested through exploratory factor analysis and item response analysis. The instrument consists of 22 statements that measure productive disposition skills on 5 indicators namely enthusiasm, self-confidence, endurance, curiosity and willing to share. The implication of this research is that the developed productive disposition skills measurement instrument can be used as an evaluation tool in learning that focuses on developing productive dispositions in elementary school students.
Keywords *: Mathematical Proficiency, Willing to Share, Instruments, Productive Disposition*

Introduction

Mathematics is often used as a parameter of one's intelligence (Bahar, 2022) . A child who excels in mathematics will be labeled a smart child. This kind of labeling often does not apply to children who excel in other scientific fields. Apart from that, the general public often judges a person's intelligence in mathematics based solely on the ability to count (computation) and solve math problems (Elniati, 2020) . Is that correct? Of course this is a form of dwarfing mathematics and the great potential contained in this field. Mathematics is not just the science of numbers, but more than that mathematics is the science of reasoning which also involves problem solving, logical thinking and creativity (Afriadi, 2018; Akyıldız et al., 2021) . Therefore, someone who has a good sense of numbers cannot necessarily be said to be someone who is proficient in mathematics. There are several other skills that he must master in mathematics.

So is there a more precise parameter to measure proficiency in mathematics? Kilpatrick (Kilpatrick, 2003; National Research Council, 2001) and Findel formulated 5 threads known as mathematical prowess. These five skills are a logical consequence of learning mathematics properly and correctly. Mathematical proficiency is a common attribute possessed by someone who has good mathematical skills. This attribute consists of five interwoven threads, namely understanding of mathematical concepts, procedural abilities, strategic competencies, adaptive reasoning and productive dispositions. The five threads are not hierarchical, but

interact and influence each other in forming a complete mathematical ability (Irawan, 2018; Milgram, 2015) .

A person who has mathematical proficiency is able to understand mathematical concepts in depth, apply mathematical procedures appropriately, solve mathematical problems in a systematic and creative way, have adaptive reasoning, and will regard mathematics as something useful and beneficial (Astuty et al . , 2019; Firdiana et al., 2022; Lestari & Yudhanegara, 2017) . Mastery of these 5 skills will not only make a person a good mathematician, but will also become a competitive, constructive human being and have more chances of success in academic and professional life (Ozgen & Bindaka, 2011; Pradana et al., 2020) .As a parameter of proficiency in mathematics, mathematical proficiency can be used as a reference in determining the success of learning mathematics. The achievement of optimal mathematics learning is not only seen from the ability of students to work on math problems, but also the ability of students to understand mathematical concepts, communicate mathematical ideas well and their attitudes towards mathematics. Therefore, the development of mathematical proficiency instruments is very important to improve the quality of learning mathematics and help someone to achieve success in life.

Among the five strands of mathematical skills, productive disposition tends to be different from other mathematical skills. Productive dispositions are more related to affection or attitude, while other mathematical skills are more related to cognitive. Productive disposition is a productive or positive attitude in viewing mathematics as something logical, useful and useful (Farisyah, 2019; Woodward et al., 2018) . In other words, productive disposition is more related to a person's affective ability in viewing mathematics, while other mathematical skills emphasize more on a person's cognitive abilities in understanding and applying mathematical concepts. Some opinions state that a productive disposition is a logical consequence when someone is truly proficient in mathematics.

Instead of considering mathematics as something that is logical, useful and beneficial, most students do not like mathematics (Abbasi et al., 2013; Akin & Kurbanoglu, 2011) . A study shows that mathematics is the discipline most disliked by students. Students' attitudes towards mathematics ultimately affect their performance and learning outcomes in the field of mathematics (Abidin, 2021; Arnellis et al., 2020) . On this basis it is very important to develop productive disposition skills for students, especially at the elementary level. The development of productive disposition skills must also be accompanied by the development of this skill measuring instrument. Researchers have conducted many studies focusing on conceptual understanding (Bernard & Senjayawati, 2019; Schüler-Meyer et al., 2019; Ulfa &Puspaningtyas, 2020) , procedural fluency (Hopkins & O'Donovan, 2021; Inayah et al., 2020; Phuong, 2020) , adaptive reasoning, and strategic competence. However, there has not been much research on productive dispositions. Therefore, this study attempts to fill this void by developing instruments capable of measuring productive dispositional skills as an important part of student learning and achievement. Of course research on the development of productive disposition instruments has been carried out, but those specifically intended for the elementary school level in Indonesia have not been carried out. This research will focus on the development of productive disposition skills instruments for elementary school students in Indonesia.

Research methods

This study uses a quantitative approach and instrument development research design. The initial stage of instrument development was carried out by conducting a literature study to determine indicators of productive disposition skills that were relevant to elementary school students. After identifying several indicators of productive disposition skills stated by several studies, the researcher carried out a synthesis in order to obtain indicators suitable for elementary school students. After that, the instrument was developed and presented in the form of a list of statements. The statement items that have been prepared are validated by 2 experts in the field of psychometry and mathematics. Reviews from 2 experts were used as material for improvement in compiling statement items. After that, the 24 item statements that had been prepared were tested on students. The total number of respondents involved in this study were 129 students in grades 4 and 5 from 4 elementary schools in East Java. Furthermore, selection of respondents using purposive random sampling technique used in order to find a reliable data.

First trial was conducted on 99 students to determine validity and reliability . From the test results, information was obtained that the 13 statement items did not meet the predetermined criteria, so they had to be repaired or discarded . Based on the considerations of the experts, the researcher decided to improve the 11 statement items and discard 2 statements. 11 new items which are improvements from the next item were tested again involving 30 respondents. After conducting a series of tests, it was stated that there were 22 statement items in the productive disposition questionnaire.

The data obtained were analyzed using exploratory factor analysis and Cronbach's alpha reliability analysis. Exploratory factor analysis was used to determine the factor structure of the productive disposition skills instrument, while reliability analysis was used to determine the level of consistency of the instrument. The results of the exploratory factor analysis show that this productive disposition skills instrument consists of 5 factors or skills indicators, namely Enthusiasm, Confidence, Persistence, Curiosity, and Willing to share. In addition, the results of the reliability analysis show that this productive disposition skills instrument has a high reliability coefficient value, namely 0.87, which indicates that this instrument can be relied upon to measure students' productive disposition skills.

Table 1 of Respondents for Testing Productive Disposition Instruments Respondents for the validity and reliability of the Productive Disposition instrument

SCHOOL NAME	CLASS		GENDER		TOTAL
	Four	Five	F	M	
SDN Binangun 1 Tuban	20	18	23	15	38
SDN Binangun III Tuban	1	11	9	3	12
MI Al Muttaqin Nganjuk	32	-	19	13	32
SDI Suruwadang Blitar	17	-	7	10	17
Total	70	29	58	41	99

Results and Discussion

The preparation of productive disposition instruments begins with compiling research indicators. This step was made in order to obtain relevant indicators for students in elementary schools and the socio-cultural conditions of society in Indonesia. The initial stage in compiling indicators of productive disposition skills for elementary school students begins with conducting a literature review. In this stage, the researcher examines various research results related to productive disposition skills in mathematics at the elementary school level. The proficiency indicators that have been studied are then synthesized to develop new indicators that are in accordance with the characteristics of the respondents who will be examined in this study. (Kurniawan, 2021; Mawardi, 2019; Qomariyah & Setiawan, 2022) .

During the synthesis process, researchers take notice to the characteristics of elementary school students, the context of learning mathematics in elementary schools, and aspects of productive disposition that are considered relevant and important to be developed at that level. After the new indicators are formed, the next step is to validate these indicators through trials on a representative sample of elementary school students. Thus, this stage is important in developing indicators of productive disposition skills that can meet research needs and provide an accurate picture of the productive disposition of elementary school students.

The following are some research indicators that researchers have found.

Table 2. Synthesis of Productive Disposition Proficiency Indicators

No.	(Merz, 2009)	(Haji et al., 2019)		
1.	Creativity	**Enthusiasm**	**Enthusiastic**	Interest and curiosity
2.	**Confidence**	**Confidence**	**Self-confidence**	Self-Confidence
3.	Interest	**persistence**	**Not giving up easily**	Persistence and perversion
4.	Flexibility	Attention	**have high curiosity**	Open-minded and flexible
5.	Value of Application	Curiosity	**Willingto share**	Monitor and evaluate (reflective)
6.	Inventiveness	Flexibility		
7.	Perseverance	Cooperation		
8.	Monitor and Reflection			
9.	Appreciation of the role of math in real life			

Based on the results of the synthesis analysis, several indicators of productive disposition skills were obtained. The synthesis process is carried out by selecting indicators which are referred to repeatedly in several studies, which are in accordance with the characteristics of students and learning in elementary schools. From this process, 5 indicators were obtained which were considered to represent productive disposition skills, especially for elementary school students, namely Enthusiasm, Confidence, Persistence , Curiousity , and Willing to Share.

The five (5) indicators are used as the basis for compiling instrument statement items. The following is a draft statement developed from each of the indicators that have been determined.

Table 3. draft statement developed from each of the indicators that have been determined

NO.	INDICATOR	STATEMENT
A	Enthusiasm	1. I listened intently to the math teacher's explanation
		2. I 'm trying to ask if there is an explanation in math lessons that I don't understand
		3. I always try to answer math questions from the teacher
		4. I like to participate in math games/ competitions/Olympics/champions
		5. I am very happy when I managed to find answers to math problems given by the teacher
		6. I feel that math lessons go fast (too short)
		7. I am always happy when there will be math lessons
B.	Self-confident	8. I always believe that the math assignments I do are correct
		9. I 'm sure I can always get good grades in math
		10. I always ready when asked to do math problems on the blackboard
		11. I 'm sure one day I can become a mathematician as long as I study hard
		12. I can explain the math material that has been studied to others
C.	Tenacity/Perseverance/ Not easily give up	13. I always try to solve math problems until I find the right answer
		14. I tried using another method when the method I used didn't work in solving math problems
		15. I regularly study math even though there is no homework or exams
		16. I still continue to study and try even though I once got a bad grade in math .
D.	High curiosity	17. I learn mathematics from books or sources other than those normally used in school
		18. I tried several new ways of learning mathematics
		19. I am always challenged to do difficult math problems
		20. I ask my teacher or friends when I have difficulty doing math problems
E.	Willing to share	21. I 'm always willing to help my friends who don't understand
		22. I really enjoy working in groups and sharing ideas with friends

	23. I feel very happy when I can explain the math lessons that I understand to my classmates 24. I am happy when my friends are also good at math

The next stage is the validation of the productive disposition skills instrument that has been compiled from experts to determine the suitability of the instrument with the research objectives and indicators that have been selected. In this case, the researcher chose experts from psychometric experts and mathematicians because the instrument covered dispositional and mathematical aspects. Experts will be asked to provide an assessment of the content of the instrument, the feasibility of the instrument, and the use of the instrument in the research context. Researchers will use the results of the assessment of these experts to develop instruments that are valid and reliable and in accordance with research needs.

The following are some review notes from experts regarding statement items in the productive disposition skills instrument for elementary school students that the researcher has developed. 1) Eliminate unfavourable items. Unfavorable items arranged in negative sentences will confuse the respondent. As it is known that this instrument will later be aimed at grade 4 elementary school students, who, based on Piaget's stages of cognitive development, are at the concrete operational stage (Ibda, 2015; McLeod, 2018) . 2) Eliminate several items that are considered overlapping and have the same meaning as other items. 3) Statements must be prepared specifically related to mathematics subjects. This is intended to avoid bias with other subjects.

The draft of the productive disposition skills instrument was improved based on suggestions and criticisms from the validators. Furthermore, the instrument was obtained which had been approved by expert validators for further testing (validity and reliability). In order to obtain the validity and reliability of the instrument, a test of the item statement of the instrument was carried out on 99 students in grades IV and V of elementary schools. Explanation of testing the validity and reliability of the instrument as follows. validityIn this study, construct validity tests were used to show how accurate the instrument used was in uncovering a trait or theoretical construct to be measured. Construction validity indicates the extent to which the score resulting from measurement using the instrument can reflect the theoretical construct that forms the basis for the preparation of the instrument. Construction validity test will be carried out by factor analysis.

table 4. construct validity of the instrument

Questionnaire data analysis table

No	Sig. 2 tailed	Interpret ation	Pearson Correlation	Interpretatio n	Conclusion
1	0.000	Valid	0.637	Tall	worn
2	0.007	Valid	0.267	Low	Fixed/removed
3	0.000	Valid	0.422	Enough	worn
4	0.001	Valid	0.318	Low	Fixed/removed
5	0.000	Valid	0.659	Tall	worn
6	0.010	Valid	0.259	Low	Fixed/removed
7	0.054	Invalid	0.194	Very low	Fixed/removed
8	0.004	Valid	0.283	Low	Fixed/removed
9	0.003	Valid	0.299	Low	Fixed/removed
10	0.000	Valid	0.473	Enough	worn
11	0.001	Valid	0.340	Low	Fixed/removed
12	0.000	Valid	0.545	Enough	worn
13	0.000	Valid	0.419	Enough	worn
14	0.000	Valid	0.466	Enough	worn
15	0.000	Valid	0.398	Low	Fixed/removed
16	0.000	Valid	0.377	Low	Fixed/removed
17	0.134	Invalid	0.152	Very low	Fixed/removed
18	0.000	Valid	0.491	Enough	worn
19	0.001	Valid	0.324	Low	Fixed/removed
20	0.361	Invalid	0.093	Very low	Fixed/removed
21	0.000	Valid	0.562	Enough	worn
22	0.000	Valid	0.474	Enough	worn
23	0.000	Valid	0.472	Enough	worn
24	0.062	Invalid	0.188	Very low	Fixed/removed

Based on the validity test, it is known that there are 13 statement items that are considered not eligible to be used. The researcher decided to discard some of these items and improve others. In total there were 11 items that were repaired and 2 other items were removed. The following are statement items that have gone through the stages of improvement.

Researchers again tested the reliability and validity of 11 new instruments that replaced old instruments that did not meet the criteria. The trial was conducted on 30 grade 4 and 5 students from 2 different schools. The results show that the developed productive disposition skills measurement instrument has high reliability with a Cronbach's alpha coefficient of 0.85. The construct validity of the instrument has also been well tested through exploratory factor analysis and item response analysis.

Table 5 construct validity of the instrument

	INDICATORS	STATEMENT
A.	Enthusiasm	1. I listen to the math teacher's explanation seriously 1. 2. I try to ask if there is a math lesson that I don't understand 2. 3. I always try to answer math questions from the teacher 3. 4. I am very happy when I manage to find answers to math problems given by the teacher 4. 5. I like it when there is a math lesson
B.	Self-confident	1. I am sure I can solve this math problem well because I have practiced and understood the concepts being taught 5. 2. I am sure I can get good grades in math as long as I study hard 6. 3. I am willing and ready when asked to do math problems on the blackboard 7. 4. I can explain math material that I understand to others
C.	Tenacity/Perseverance/ Not easily give up	1. I try to solve math problems until I find the correct answer 8. 2. I tried to use another method when the method I used didn't work in solving math problems 9. 3. I study math even though I don't always have homework or exams 10. 4. I would look for an easier and more fun way to learn math
D.	High curiosity	1. I ask my teacher or friends when I haven't succeeded in solving math problems 11. 2. I try several new ways of learning mathematics 12. 3. I am challenged to do difficult math problems 13. 4. I am curious about how mathematics can be used in everyday life 14. 5. I did math practice questions even though I was not instructed by the teacher
E.	Willing to Share	1. I am willing to help my friends who don't understand 2. I really like working in groups and sharing ideas with my friends 3. I feel very happy when I can explain mathematics that I understand to my friends 4. I feel happy when my friends ask me about how to do math problems

The instrument consists of 22 statements that measure productive disposition skills on 5 indicators namely enthusiasm, self-confidence, endurance, curiosity and willing to share .The results of research on the development of productive disposition skills instruments can complement previous related research. For example, in terms of indicators of productive

disposition skills. Researchers do not differ much in defining productive dispositions, but there are slight differences in terms of the indicators that make up these skills. Some studies only differ in terms of the terms used, for example the "persistence" indicator which in other studies is called "not giving up easily " (Haji et al., 2019 ; Merz, 2009) . A quite striking difference between this study and other studies is the use of "willing to share" as an indicator. Although it must be admitted that the synthesis carried out in this study only uses very limited sources. This is one of the limitations in this research. The author hopes that in the future there will be researchers who will again develop productive disposition skills instruments for elementary school students in Indonesia, but by using indicators obtained from the synthesis of more sources.

Conclusion

Based on the results of this study, it can be concluded that the productive disposition skills instrument developed for elementary school students consists of 22 statement items consisting of 5 proficiency indicators namely Enthusiasm, Confidence, Persistence, Curiosity, and Willing to share which are valid and reliable. In testing the validity and reliability, this instrument shows good results, with a high reliability coefficient value and validity test results that support. This shows that this instrument can be relied upon to measure students' productive disposition abilities in mathematics. In addition, these findings also show that students' productive dispositions can be developed through proper mathematics learning, and the development of productive dispositions can help students to become more independent and creative in solving mathematical problems. Therefore, the implementation of this productive disposition skills instrument is expected to assist teachers in developing students' mathematical abilities holistically and help students achieve optimal mathematical skills.

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