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Fifth Grade Elementary Science Psychomotor Assessment Instruments

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ABSTRAK

Kurangnya variasi dalam penilaian ranah psikomotor pada pembelajaran IPA di SD serta dibutuhkannya instrument penilaian yang tepat padsa pembelajaran praktik via online. Tujuan penelitian untuk menganalisis kualitas pengembangan instrumen penilaian psikomototrik anak kelas V SD pada materi anggota gerak. Jenis penelitian yang dilakukan adalah penelitian pengembangan. Subjek penelitian ini adalah peserta didik kelas 5 SD sebanyak 87 siswa. Pengambilan data dengan lembar penilaian diri yang dilakukan menggunakan google form. Angket terdiri atas 10 butir pernyataan dengan empat pilihan jawaban. Teknik pengambilan sampel dengan purposive sampling. Kriteria yang digunakan dalam pengambilannya yakni: peserta didik kelas 5 SD dan sudah memperlajari materi anggota gerak. Pembuktian validitas isi menggunakan formula Aiken's V dan validitas konstruk menggunakan EFA. Perhitungan reliabilitas instrumen menggunakan rumus Alpha Cronbach. Hasil dari penelitian ini adalah instrumen penilaian ranah psikomotorik memiliki kriteria instrumen yang valid dan reliabel. Instrumen yang digunakan memiliki nilai validitas dengan kategori "Sangat valid" dan nilai reliabilitas dengan kategori "Tinggi". Dapat disimpulkan bahwa penggunaan penilaian psikomotor dengan sembilan langkah pengembangan untuk pembelajaran IPA SD dapat digunakan dengan baik.

ABSTRACT

The lack of variation in the assessment of the psychomotor domain in science learning in elementary schools and the need for appropriate assessment instruments in online practical learning. The study aimed to analyze the quality of the development of the psychomotor assessment instrument for fifth-grade elementary school children on limb material. This type of research is development research. The subjects of this study were 87 students in grade 5 elementary school. Retrieval of data with self-assessment sheets was carried out using the Google form. The questionnaire consists of 10 statement items with four answer choices. Sampling technique with purposive sampling. The criteria used in the decision were: 5th-grade elementary school students who had studied limb material. Content validity was verified using Aiken's V formula and construct validity using EFA. Calculation of instrument reliability using the Alpha Cronbach formula. The results of this study are that the psychomotor domain assessment instrument has valid and reliable instrument criteria. The instrument used has a validity value in the "Very valid" category and a reliability value in the "High" category. It can be concluded that the use of psychomotor assessment with nine development steps for elementary science learning can be used properly.

1. INTRODUCTION

Education is very important in developing attitudes, quality of human resources, and achievements in someone who will bring progress to the nation. Education can also be interpreted as a learning process to develop in terms of one's knowledge, skills, attitudes, and thinking abilities (Hidayat, 2017; U Rosidin et al., 2019). The world of education is very closely related to assessment activities. There are several types of assessment domains, namely the cognitive domain, affective domain, and psychomotor domain. These three domains were also conveyed by Bloom, namely that there are three types of intelligence namely affective, psychomotor, and cognitive (Hekmah et al., 2019; Mahendra, 2017) (Dettmer, 2005). Indonesia also has graduate competency standards contained in the Minister of Education and Culture Regulation Number 20 of 2016 which contains three dimensions of graduate competency standard components, namely attitudes,

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knowledge, and skills (Alawiyah, 2017; Undang Rosidin et al., 2019). These three aspects form a unified whole in graduate competency standards for students, especially for graduates of primary and secondary education. Based on these three domains in practice, teachers tend to focus on assessments from a cognitive perspective only. In learning activities, especially in science subjects, a person must have scope not only to understand but to be able to create or apply them in life daily.

One area that is often used in science subjects is applying the skills learned in life. Science learning can be very interesting and entertaining if it is done through simple practicums which can be called education. Interactions in learning activities in schools should be mutually connected, inspiring, fun, and motivating students to suit the abilities, interests, and development of each student (Lai et al., 2019; Maison et al., 2020; Sintema, 2020). Edutainment is a learning activity itself, and its implementation prioritizes fun and excitement in achieving learning goals. One of the learning materials is body action material which can be combined with action dolls/props to make stories more interesting. In simple practical activities, teachers can evaluate children's skills in making teaching aids. To assess this, a psychomotor assessment tool is needed in its activities (Pratiwi et al., 2018; Wanabuliandari & Ardianti, 2018). The psychomotor aspect is a person's skills or abilities in physical activities such as drawing, dancing, running, jumping, etc.

Some time ago, when the Covid-19 pandemic spread to various corners of the world, it had an impact, including in the field of education (Al-Okaily et al., 2020; Edgar & Elias, 2020; Herwin et al., 2021). With the pandemic, all schools are closed and must be done online so that learning can continue. The existence of a pandemic that occurs requires teachers to be more creative in carrying out their duties both in learning activities and also in the assessments that must be carried out (Adeoye, 2019; Al-Hunaiyyan et al., 2021; Gay, 2016). Assessment in distance learning activities must be able to measure several aspects, not only from the affective aspect but all aspects (affective, psychomotor). Teachers need assessment instruments that are following the conditions and abilities of their students for assessment. The way that can be done is to develop an independent assessment instrument for students which can be done remotely. One example of a learning activity that requires an assessment instrument other than the cognitive aspect is science learning, which can be assessed from the psychomotor aspect.

Concerning the development of psychomotor assessment and its relevance to science learning, especially the puppet/movement media (props). One of the skills assessed psychomotor is the skill of making props or moving dolls during learning activities. The characteristics of dolls in children's lives are as manipulative play tools, suitable for channeling emotions and trying to solve problems. *Wayang* remains the teacher's choice as a learning medium because it is considered natural for telling stories. Some previous studies such as those conducted by previous study showed that the appropriate *wayang kulit* learning media, made of flannel and cotton, the size of a medium player's hand or a match, according to the needs of students and teachers has an attractive appearance (colored - colorful) (Sulianto et al., 2014). Also looked at the use of *wayang* as a creative simulation medium in elementary schools, and the findings show that *wayang* media can be applied and developed in everyday life through imitation (Agustin Mulyani, 2014; Karakaita Putri et al., 2019).

The result of previous research is that the use of multimedia is effective in improving science learning for class V SD, thus there is a need for innovation in learning activities such as the practice of making media on certain materials (Nur Jannah, 2020). Also researched the development of digital storytelling-based hand puppet media, and his findings used DST-based hand puppet media which had been developed to be feasible and effective in learning activities at school (Pranata, 2017). There is study concluded that puppets are more effective and efficient as learning media than other art media (Sukistono, 2008). Research conducted three assessment modalities to use performance assessment in learning physics, namely: student worksheets, evaluation sheets, and observation sheets (Putri & Istiyono, 2017) (Pinilih et al., 2013). There are still many problems regarding the psychomotor assessment of students, such as that the objective conditions for psychomotor assessment in science learning in grade V are still not optimal.

Previous research that is relevant to the research that will be carried out is the use of media as part of learning activities to help students learn. Based on some of these studies, it can be concluded that the activity of making motion dolls as teaching aids/learning media or as one of the assessment activities is very suitable to be carried out at the elementary level. Can it be used effectively and how to judge it in terms of skill in making it. The way to find out requires the right assessment instrument, namely an assessment of the psychomotor domain which we can categorize using Bloom's taxonomy.

Ideally in learning activities, assessment is not only from the cognitive aspect but from the affective and also psychomotor aspects it needs to be done. The positive thing about competency-based assessment in science learning is that it trains students to create works by applying the knowledge they have learned creatively and trains students to get used to meaningful learning activities instead of learning to memorize. The lack of existing assessment instruments makes the teacher not do well. So in this study, an assessment

was developed in the psychomotor domain for 5th grade elementary school students to assess science learning skills. In this study, the development of a psychomotor assessment instrument for 5th-grade elementary school students in natural sciences was carried out according to systematic development steps and was easy to do.

2. METHOD

The type of research conducted is development research with nine steps of instrument development. The development steps carried out include (1) determining the purpose of preparing the instrument, (2) seeking relevant theories, (3) compiling instrument item indicators, (4) compiling instrument items, (5) content validation, (6) revising based on suggestions from validator, (7) conducting trials, (8) analyzing the data obtained, (9) assembling the final instrument (Bolton & Lane, 2012). The subjects in this study were fifth-grade elementary school students. The sampling technique was purposive sampling with the criteria of fifth-grade elementary school students who had already received/learned limb material at school. In this study, the students involved came from four schools, namely two private schools and two public schools. Students already have experience in filling out questionnaires online so the distribution of instruments can be done easily. Media for data collection and research is carried out by utilizing Google Forms as the medium. The technique of giving a questionnaire is by distributing it to grade 5 teachers and distributing it to students. The instrument used was a self-assessment questionnaire consisting of 10 items (5 Favorable and 5 Unfavorable) using a Likert scale with 4 categories of choice (Istiyono, 2020). The research was conducted from April to May 2022. The validity test used was Aiken's V formula for content validity and EFA for construct validity. The reliability test used is using the Alpha-Cronbach formula. The validity and reliability test involved three assessors in the test. The use of analysis with the Aiken formula aims to see the validity of the instrument made based on the validator's assessment. The data used in the EFA analysis uses data from instrument trials that have been filled out by students.

3. RESULT AND DISCUSSION

Result

Based on the results of the research following the stages of instrument development starting from the stage purpose of preparing the instrument to assemble the final instrument, the following is a description of each existing stage. The first stage determines the purpose of developing a psychomotor assessment instrument for grade 5 students in science learning. The purpose of developing a psychomotor assessment instrument is that with a psychomotor assessment instrument in science learning, it is expected to be able to know more about how far students understand the material being studied and apply it to everyday life. In addition, the need for a psychomotor assessment to be carried out for science learning in elementary schools is also one of the backgrounds to develop the instrument. The importance of psychomotor assessment in elementary science learning emphasizes project/practice-based learning so that appropriate psychomotor assessment instruments are needed. Psychomotor assessment can be used to measure students' skills after getting the material/learning done. The next stage is to look for relevant theories related to psychomotor assessment. Psychomotor assessment has operational verbs that are different from operational verbs in the cognitive aspect. At this stage, the researcher searches for and reads about the realm of Bloom's taxonomic psychomotor assessment which will be used in developing the instrument as well as reading and understanding the steps in developing an instrument by standard procedures. Next stage is developing indicators, at this stage, the product in the form of an instrument grid began to be developed. Indicators are developed based on the sub-aspects and material to be measured. The use of language in instrument development needs to be adapted to language development that is suitable for students so that it is easy to understand.

After compiling indicators that are considered sufficient to measure the desired skills, the next step is to develop instrument items. The number of items in the instrument made is 10 items with two categories namely favorable and unfavorable. Each indicator consists of 2 statements with two categories. The instrument development table can be seen in Table 1.

Table 1. Instrument Development

Sub Aspect	Indicator	Statement		Item
		Favorable	Unfavorable	
Take	Able to follow examples / instruction given	In making the mooting doll assignment I followed the same as in the example	In making a m ing doll assignment, I did not follow the example given	1 & 6

Sub Aspect	Indicator	Statement		Item
		Favorable	Unfavorable	
Create	Able to make / work on something assigned	I made the tasks of moving dolls according to the provisions given by the teacher	I made the dummy work as much as I wanted	2 & 7
Complete	Able to make / work on something assigned	I complete the task given to the best of my ability	I made the task of moving dolls just sober	3 & 8
Modification	Have creativity in completing task	I modified the work of making dolls using a more durable material used	I designed my dolls to be moved in such a such a way that they can explain the subject matter well	4 & 9
Designing	Have a creative imagination in doing the task	I designed my dolls to be moved in such a way that they can explain the subject matter well	I design my motion dolls to be moved in ways that make me feel good	5 & 10

Content validation stage will discuss the validation of the instruments that have been made to get feedback from the validator for improvement before the instruments that have been developed are used for research. After developing the instrument, the next step is validation. This validation is expected to find out whether the designed product requires revision or not. The first test is content validation and readability. This validation aims to assess whether the product is good or not in terms of readability and content. The scale used is 1-5 with the following information: 5) Very good, 4) Good, 3) Fair, 2) Not good 1) Not good. The validation used is Aiken's V formula with the following categories. The validity categories is show in Table 2.

Table 2. Validity Categories

No	Validity Coefficient	Validity Level
1	0.80-1.00	Very valid
2	0.40-0.80	Moderate
3	≤ 0.40	Deficient

The validation results carried out with Aiken's V by the three raters is show in Table 3.

Table 3. Aiken Calculation Results

Item	Rater			S1	S2	S3	∑S	n(c-1)	V	Explanation
	1	2	3							
1	3	4	4	2	3	3	8	9	0.89	Very valid
2	4	4	4	3	3	3	9	9	1.00	Very valid
3	4	4	4	3	3	3	9	9	1.00	Very valid
4	4	4	3	3	3	2	8	9	0.89	Very valid
5	4	4	3	3	3	2	8	9	0.89	Very valid
6	3	4	3	2	3	2	7	9	0.78	Moderate
7	4	4	4	3	3	3	9	9	1.00	Very valid
8	3	4	4	2	3	3	8	9	0.89	Very valid
9	4	4	3	3	3	2	8	9	0.89	Very valid
10	4	4	4	3	3	3	9	9	1.00	Very valid

Based on the calculation results show in Table 3, it can be seen that each questionnaire item has a "Very valid" validity and there is only one item, namely item 6 which has "Moderate" validity. Validity analysis used Aiken's V validity with three raters. The research instrument developed as a whole has good quality with valid items based on the assessment by the three assessors. In revising stage of the validator's suggestions is useful as an instrument for improvement before it is used for research. Based on the results of the validation that has been carried out, no suggestions for improvement were found from the validator for the instruments that have been made. Thus the next step can be taken in developing the instrument,

namely the stage of conducting trials. At the trial stage, the researcher prepares everything that is used for the trial. Researchers prepared instruments that had been made by packaging them in the form of a Google form. The assessment instrument will be used for fifth-grade elementary school students in science subjects. Before giving the developed instrument, the researcher asked the guardian/class teacher whether the class to be addressed had studied the material being taught or not. If the research subject meets the criteria, the next step is for the researcher to ask for permission and assistance from the class teacher/guardian to distribute the questionnaire to the children and fill it in according to each student's honesty. Based on the results of the instrument trials developed and analyzed using EFA, the results of the study can be seen in Table 4.

Table 4. KMO Results and Bartlett's Test

Statistics	Value
Kaiser-Mayer_Olkin Measure of Sampling Adequacy	0.710
Bartlett's Test of Sphericity (Sig)	0.000

Based on Table 4 show the results for the Kaiser-Meyer-Olkin Measure of Sampling Adequacy section, there is a value of 0.710, meaning that the sample we used in this study is sufficient because the Kaiser-Meyer-Olkin Measure of Sampling Adequacy value is > 0.5 so that it is fulfilled. Bartlett's test aims to find out and see whether there is a correlation between variables. We can see that if the p-value on Bartlett's test is 0.00 <0.001, the p requested in this test is p <0.005, meaning this assumption has been fulfilled. Total variance calculation results explained is show in Table 5.

Table 5. Total Variance Calculation Results Explained

Factor	Total	Initial Eigenvalues % of Variance	Cumulative %	Extraction Total	Sums of Squared % of Variance	Loading: % Variance	R Total	Sums of % Variance	Squared Loading Variance %
1	3.240	32.396	32.396	1.938	19.378	19.378	1.785	17.849	17.849
2	1744	17.465	49861	1.898	18.985	— 38.263	1.59	15.904	33.753
3	1.092	10.918	60.759	1.010	10.096	48.459	1.303	13.033	46.786
4	1.028	10.283	71.042	0.452	0.4523	052.982	620	6.196	2982
5	705	7.051	78.093						
6	632	6318	84.411						
7	481	4810	89.221						
8	AMS	4477	93.698						
9	339	3392	97.090						
10	291	2910	100						

Base on Table 5 the number of factors that exist in the development of the instrument. We can see in the picture above, there are inflection points after the 4th dimension so that we can find out if there are four dimensions in the psychomotor assessment instrument that was made. In the total variance explained table, we can also see that there are four dimensions in the created instrument. The four existing dimensions turned out to have a value of 52.982%, which means that the instrument created can explain the four existing dimensions of 52.982%. In addition, a good instrument must be valid and reliable. The next step is to carry out a reliability test using the Alpha-Cronbach formula, the results of the reliability calculation for each item can be seen in Table 6.

Table 6. Item-Total Statistics Calculation Results

Item	Cronbach's Alpha
Item_1	0.709
Item_2	0.716
Item_3	0.709
Item_4	0.714
Item_5	0.719
Item_6	0.738

Item	Cronbach's Alpha
Item_7	0.734
Item_8	0.749
Item_9	0.702
Item_10	0.752

Table 7. Total Reliability Calculation Results

Reliability Statistics	
Cronbach's Alpha	N of Items
0.745	10

From the calculation as show in Table 7, it can find out the reliability value of each item made. The following is a reliability classification table as show in Table 8.

Table 8. Reliability Categories

No	Reliability Coefficient	Reliability Level
1	0.80-1.00	Very high
2	0.60-0.80	High
3	0.40-0.60	Moderate
4	0.20-0.40	Low
5	0.00-0.20	Very low

Based on Table 8 calculation and classification the reliability value on each item of the instrument that has been made and the overall reliability value with 87 respondents is at a "High" level of reliability. So it can be said that the instrument has a high level of constancy with an average score of 0.745. This means that the instrument that has been made is good because it is proven by valid and reliable calculations. After conducting validation tests and product trials, no problems were found in its use. Students can understand the statement items well so that the instrument being tested is the final product of this study. This is supported by the results of validation by experts with valid and reliable results without revision. The result of this study is a psychomotor assessment instrument for class V students in science subjects with a total of 10 statement items consisting of two categories (favorable and unfavorable). Thus the results of this study can be used by teachers or facilitators to assess student activities by the science material about limbs properly. The use of media in this study is internet-based using a Google form, but this can be adjusted to conditions in the field (can use paper and pencil). The use of Google Forms is due to the Covid-19 pandemic which requires students to still do online learning. In its implementation, there is a need for assistance from teachers and parents so that the data obtained is following reality.

Discussion

This research was conducted based on the need for assessment to determine children's psychomotor skills in learning and expressing their creativity. It is common to find children who have deficiencies in psychomotor skills in early childhood and elementary school, especially those who lack activities outside of school (Michalski et al., 2019; Zeng, 2017). Thus, it is necessary to assess the psychomotor aspects of children which can be carried out in school activities, but this must also be supported by the school and the students themselves. Assessments that involve students directly will be easier to do than performance assessments (Munandar et al., 2020; Riddell, 2015).

The development of psychomotor assessment instruments specifically tailored for fifth-grade elementary science signifies a crucial step towards comprehensive evaluation in science education. This initiative addresses the importance of assessing not only cognitive but also psychomotor skills, recognizing the integral role these skills play in scientific inquiry and application. The design and implementation of such instruments can potentially enhance the precision and validity of evaluating students' hands-on abilities, coordination, and manipulation in the context of scientific practices (Maryati et al., 2019; Nugraha & Wahyono, 2019). Additionally, the development process provides an opportunity for educators and researchers to align assessment tools with specific learning objectives and performance expectations for fifth-grade science.

This focused approach ensures that the psychomotor assessments are not only age-appropriate but also reflective of the skills deemed essential for a holistic understanding and application of scientific

principles. However, challenges may arise in creating instruments that effectively capture the diverse range of psychomotor skills inherent in science education and ensuring that the assessments are fair and unbiased (Maryati et al., 2019; Renganayagalu et al., 2021). It is imperative to strike a balance between standardization and flexibility to accommodate variations in learning styles and individual capabilities among fifth-grade students. Overall, the development of these assessment instruments reflects a commitment to a more comprehensive and nuanced evaluation of students' scientific proficiency, recognizing the multifaceted nature of learning in the field of science.

This research was conducted with several limitations so that in future research more in-depth research could be carried out on psychomotor aspects for elementary school students. After conducting research and obtaining results regarding learning activities on the psychomotor aspect, it can be concluded that in learning activities at school, teachers have involved children's skills in the learning process. Evaluation of activities by conducting assessments is felt to be less effective because the assessments carried out cannot be monitored directly by teachers and parents so children tend to fill in according to what they think is good. The instruments in this study were used in the Covid-19 pandemic emergency learning activities which were carried out remotely to monitor the learning activities and achievements being carried out. The data obtained from this study include validity, reliability, and limited trials to determine the quality of the instruments developed for emergency remote assessment activities.

Things that can be developed in further research include testing carried out more broadly by developing better instruments by paying attention to various aspects of the field such as students' skills and so on. Assessment skills require collaboration with parents for the transparency of student assignments given by the teacher so there is a need for coordination between teachers and parents in conducting assessments. The research conducted by previous study the conclusion that remote assessment of children's (psychomotor) skills can be carried out by sending photos or videos via online media (WhatsApp, zoom, google classroom) taking into account the condition of students (Ambarwati et al., 2022). This research is also relevant to research that has been done, namely conducting psychomotor assessments through a distance which is distributed through online media (Google Forms) (Nduru, 2022). The use of this media makes it easier for researchers to distribute research instruments and makes it easier to monitor and collect assessment sheets.

4. CONCLUSION

Based on the research that has been done, the quality of psychomotor assessment instrument developed has good quality, namely valid and reliable. The instrument developed can also measure children's skills which are carried out online, namely by self-assessment. The use of language and the level of assessment results are adjusted to what is to be measured and adjusted to the abilities of students. The instruments in this study is suitable used in the Covid-19 pandemic emergency learning activities which were carried out remotely to monitor the learning activities and achievements being carried out.

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