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Literature Review On Development Of Mathematics Higher Order Thinking Skills (HOTS) Assessment Instruments

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Abstract

Higher Level Thinking Ability (HOTS) is the ability of students to interpret their knowledge in solving a problem through the process of analysis, evaluation and creating ideas from the problems presented. This study aims to identify the development of a Mathematics Higher Order Thinking Skills (HOTS) assessment instrument. This review research uses bibliometric methods and a qualitative approach in reviewing journals in 2019-2023. Based on the results of the analysis, it shows that the development of the HOTS instrument was carried out based on the questions available at school which were less varied, the questions were still at the comprehension stage, teachers did not yet understand how to make HOTS questions, students' abilities. One form of assessment developed is test questions with multiple choice instrument types, descriptions and authentic assessments. The test questions developed pay attention to HOTS characteristics such as paying attention to HOTS indicators, KKO, mathematical problems and stimuli, as well as Bloom's taxonomy.

Keywords: HOTS; Assessment Instruments; Development

Introduction

21st century skills are abilities that are expected to be embedded in students in the era of the industrial revolution 4.0. These 21st century skills consist of three main abilities, namely the ability to think, the ability to act, and the ability to live(Marwan, 2020). As the era progresses, competition for the quality of human resources (HR) becomes increasingly stringent, so it is necessary to improve the quality of education (Akhsan, 2019). According to Law No. 20 of 2003, education is an effort by students to build learning conditions and an active learning process so that they can develop their potential.

However, the problem of education, specifically mathematics, is a very complex problem.OECD research results in 2019 stated that only 1 percent of Indonesian students mastered high-level skills, while the OECD average was 11 percent. This is a challenge for teachers and schools in improving the quality of learning and students' understanding of deeper mathematical concepts.To achieve this according to research(Supahar & Saputro, 2018)It requires changing the concept of initial knowledge to suit the actual situation. In order to change the concept of initial knowledge into long-term knowledge, a method called high-level thinking skills (HOTS) is needed.

Higher Level Thinking Ability (HOTS) is a student's skill in understanding knowledge which not only remembers but also teaches how to

connect the information held at a higher level of thinking to be able to analyze and create an idea.(Widyastuti, 2017). This identifies that with high level thinking skills you are expected to be able to obtain a solution to a problem (Ayumniyya, 2021). Karthworl and Anderson stated that in the revised Bloom's Taxonomy there are three cognitive levels that measure HOTS, namely C4 (ability to analyze), C5 (ability to evaluate), and C6 (ability to create).(Liana, 2018). Meanwhile, Schraw states that there are four HOTS components as in Figure 1. as follows:

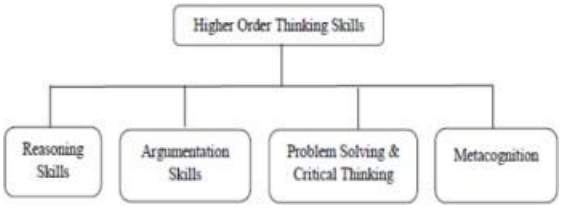


Figure 1. HOTS components
source:(Serevina, 2019)

Popham stated that educational success runs well if it is supported by good assessments and has an impact on the subsequent learning process. According to Minister of Education and Culture Regulation no. 69 of 2013, one of the four competencies that must be achieved is the core competency of knowledge. The HOTS assessment is an assessment that presents test questions at a high cognitive level to students so that they can improve their critical thinking and creative thinking skills.(Hidayah, 2018). The HOTS assessment has three main principles, namely (1) providing stimuli in the form of text or other forms, (2) providing new problems that have not been given in class, (3) providing questions with different types of difficulty and different cognitive levels. In formulating HOTS question indicators, operational verbs (KKO) are usually used based on Bloom's taxonomy to determine the dimensions of knowledge measured by the question.(Culture, 2019b).

Barnett and Francis stated that giving HOTS questions can make students understand the material presented in more depth (Kusuma et al., 2017). In the context of assessment, HOTS questions can be used to measure (1) understanding skills between concepts, (2) integration and processing of information, (3) searching for connections between the information obtained, (4) the process of using information to solve problems (problem solving) and (5) the ability to find new ideas from this information(Culture, 2019b). Thus, the use of the HOTS assessment instrument can be used as a means of improving students' ability to understand the material and can be used by a teacher in evaluating their learning(Kusuma, 2017).

Based on the background that has been described, the aim of this study is to find out the reasons for developing higher order thinking ability (HOTS) assessment instruments, types of assessments and indicators for making questions.

Methods

This research on the development of conceptual understanding assessment instruments applies the literature review method. Literature review or literature study is a method that examines and analyzes several research results on similar problems, namely regarding the development of conceptual understanding assessment instruments in mathematics learning. The instrument in this research uses a human instrument, namely the researcher himself who acts as the research instrument. The population in this research are journals obtained online from Google Scholar regarding HOTS-based

assessment instruments in the last 5 years (2019-2023). This research uses a sample using a purposive technique because the samples taken are in accordance with the research theme. Data were analyzed using a qualitative descriptive design.

Results and Discussion

This research was conducted to look at the higher order thinking ability (HOTS) assessment instrument by examining and analyzing moderator variables. Data was obtained from journals that are relevant to this research and support conducting studies for each variable identified. Researchers collected data online from Google Sholar. The journals studied come from journals that are accredited and have ISSN.

Findings

With the aim of finding out the accuracy of data from 22 respondents regarding the influence of the cellphone confiscation policy during KBM (X) and the orderly KBM process at MAN 1 Jember (Y). So the test is carried out as follows:

1. Validity Test

In conducting research, a valid instrument is needed. A valid instrument means that the measuring instrument used is capable of precisely measuring what it is intended to measure, so that the data obtained is valid and reliable. According to Sugiono, validity is an instrument that can be used to measure between data that occurs on an object and data that can be collected by researchers (Sugiono. 2018). This validity test aims to ensure that the research instrument used can accurately measure the Mobile Phone Confiscation Policy (X) and the Orderly KBM Process (Y). Instrument validity testing was carried out on each statement item being tested. Which is assisted by the SPSS application. An instrument is said to be valid if $r$calculate equal to or greater than $r$table with a significance level of 5%, otherwise the instrument is declared invalid if $r$calculate less than $r$table.

The following are the results of the validity test for variables X and Y:

- Policy

No	Rhitung	Rtabel	Keterangan
1.	0.543	0.4227	Valid
2.	0.577	0.4227	Valid
3.	0.453	0.4227	valid

From the results of the validity test of the variable influencing the cellphone confiscation policy during KBM, it was found that all the question items used to measure the orderliness of the KBM process at MAN 1 Jember were declared valid. This indicates that the instrument used is capable of measuring perception accurately.

- Orderly

no	R hitung	R tabel	keterangan
1.	0.479	0.4227	Valid
2.	0.704	0.4227	Valid
3.	0.818	0.4227	Valid
4.	0.851	0.4227	Valid

From the results of the validity test of variables measuring the orderliness of the KBM process at MAN 1 Jember, it was found that all the question items used to test the effect of the cellphone confiscation policy during KBM were declared valid. This indicates that the

instrument used is capable of measuring perception accurately.

2. Reliability Test

According to Anwar Hidayat (2016), a reliability test measures the extent to which a measurement instrument (for example a questionnaire) is consistent and reliable in measuring certain variables. In quantitative research, instrument reliability is very important because it ensures that the data collected is consistent and reliable. This affects the validity of research findings.

A questionnaire is considered reliable or reliable if the answers given by someone to the statements in the questionnaire are consistent or stable. In this research, the reliability test uses the Cronbach's Alpha method for the HP Confiscation Policy (X) and Orderly KBM Process (Y) variables. Mark A high Cronbach's Alpha indicates that the research instrument has consistency
good internals. The following are the results of the reliability test:

Variabel	Cronbach alpha	r	keterangan
Kebijakan (X)	0.181	0.60	Reliabel
Tertibnya	0.671	0.60	Reliabel

3. Classic assumption test

a. Normality test

According to Anwar Hidayat (2024). The normality test evaluates whether the data follows a normal distribution. The normal distribution is important because many statistical methods require it. In regression analysis, the assumption of normality is often checked to ensure accurate results.

Tests of Normality

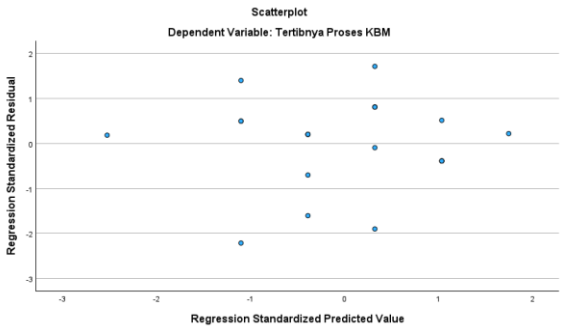
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Kebijakan	.172	22	.088	.936	22	.162
Tertibnya Proses KBM	.211	22	.012	.926	22	.099

Based on the analysis results from the table above, the obtained significance values for Y (0.099) and X (0.162) are both greater than 0.05. Therefore, we can conclude that the data above follows a normal distribution.

b. Heteroscedasticity test

In the opinion of Marwan Effendy (2009), heteroscedasticity is if the observed error or residual does not have a constant variance. Heteroscedasticity conditions often occur in cross-action data, or data taken from respondent data at a certain time. To detect it, the LM (Large Multiplier) test can be used with the formula LM = R2 x N. Where R2 is obtained from regression against Y estimates where N is the size of the observation. If R 2 x N is smaller than 9.2 then the standard error (e) does not experience heteroscedasticity. On the other hand, if R 2 x N is greater than 9.2 then the error experiences heteroscedasticity.

- First step



Based on the results of the graphic analysis above, it shows that there is no clear pattern, such as points spread above and below 0 on the Y axis, then heteroscedasticity does not occur.

- Second Way

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	1.744	1.262		1.382	.182
	Kebijakan	-.081	.109	-.164	-.744	.465

a. Dependent Variable: Abs_res1

Based on the results of the analysis of the table above, the sig X value (0.465) > 0.05 is obtained, so it can be concluded that there is no heteroscedasticity problem.

c. Multicollinearity Test

According to Alawiyah, et al (2019), the multicollinearity test aims to test whether the regression model finds a perfect correlation between independent variables. A good regression model should not have perfect correlation between independent variables. One way to detect multicollinearity is to look at the tolerance or variance inflation factor (VIF). If the tolerance is < 0.1 or the VIF value is > 10 then multicollinearity has occurred.

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	.182	2.000		.091	.928		
	Kebijakan	1.327	.172	.865	7.714	<.001	1.000	1.000

Dependent Variable: Orderly KBM Process

Based on the results of the analysis of the table above, the tolerance value X (1,000) is > 0.100, while the VIF value

4. Hypothesis testing

a. Coefficient of Determination Test

The coefficient of determination is a statistical measure that shows the extent to which the contribution of the independent variable in the regression model is able to explain variations in the dependent variable. In regression analysis, the coefficient of determination is expressed in the R-square (R^2) value which can be seen through the Model Summary table in the statistical analysis output. According to Ghozali (2016), a small coefficient of determination value indicates that the ability of the independent variable to explain the dependent variable is very limited. Conversely, if the R^2 value is close to 1 and away from 0, this indicates that the independent variable has a high

ability to provide the information needed to predict the dependent variable.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.865[a]	.748	.736	1.107

a. Predictors: (Constant), Policy

Based on the results of the analysis above, the percentage of variation in the orderly teaching and learning process variable (Y) that can be explained by the Policy variable (X) is 74.8%, while the remaining 25.2% is explained by other variables outside the regression model.

b. Multiple Linear Regression Test

Regression analysis needs to be tested for normality because the initial requirement to be able to assess the goodness of a regression equation is normality of error. The normality test is needed to answer the question of whether the requirements for a representative sample are met or not, so that the research results can be generalized to the population or can represent the population (Hadi, 2001). If data has an abnormal distribution, treatment can be done to make the data normal in various ways. Some of these methods include adding the amount of data to the dependent variable (Y), removing data that is considered to be the cause of data abnormalities (outlier data), carrying out data transformation.

Y= a+ b1X1+.....+baXa

Information:

Y: Orderly KBM process

a : Constant (Fixed Value)

b : Regression Coefficient (Estimation Value)

X : Policy

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	.182	2.000		.091	.928
	Kebijakan	1.327	.172	.865	7.714	<,001

a. Dependent Variable: Orderly KBM Process

Y= 0.182+ 1.327X1

- The constant is 0.182, this shows that if X has a value of 0, then the value of Y remains 0.182
- Based on variable X (Policy), the results of the regression test show that variable

c. F Test

The F test or simultaneous test is a statistical test used to determine whether the independent (free) variables together (simultaneously) have a significant effect on the dependent (bound) variable in a regression model. (Vivi and Hamidah, 2017).

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	72.971	1	72.971	59.499	<,001[b]
	Residual	24.529	20	1.226		
	Total	97.500	21			

a. Dependent Variable: Orderly KBM Process

b. Predictors: (Constant), Policy

Based on the results of the analysis of the table above, the calculated f value (59,499) > f table (4,381) and sig (0.001) < 0.05, it can be concluded that there is a positive and significant influence of variable X simultaneously on Y so that Hi is accepted and H0 is rejected.

d. T Test

The T test (T test) is a statistical test used to test the truth or falsity of a hypothesis which states that between two sample means taken randomly from the same population, there is no significant difference (Sudjiono, 2010)

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	.182	2.000		.091	.928
	Kebijakan	1.327	.172	.865	7.714	<,001

a. Dependent Variable: Orderly KBM Process

Based on the results of the analysis from the table above, the calculated t value (7.714) > t table (1.725) and significant (0.001) < 0.05, it can be concluded that the policy has a positive and significant effect on the orderly teaching and learning process at MAN 1 Jember, H0 is rejected while Ha accepted.

Research Discussion

In law no. 141 2005, article 1, point 1 concerning teachers, what is called a teacher is professional education whose duties are to educate, guide, teach, direct, train, assess and evaluate students in early childhood in formal education, basic education and education. intermediate (Kinesti. 2021) Student learning discipline is an effort to continuously foster student awareness in learning so that they can learn well in accordance with their functions as part of an organization and comply with existing rules. (Erni Novianti. 2021) This is in line with the number of MAN 1 teachers who took part directly in the policy of confiscating cellphones during teaching and learning activities. Of the 22 respondents, 19 teachers had experience in this policy. More precisely, during the teaching and learning process there are students who play cellphones. In fact, according to regulations that have become school culture, during teaching and learning activities, all cellphones must be collected in the lockers provided in each class.

Advances in technology and information have experienced rapid development in the current era. Gadgets are a form of advancement in technological devices that are easy, practical and have many functions, namely as a means of communication, a source of information, social networking, a tool for accessing the internet, entertainment media, playing games, shopping, data storage, business facilities and so on. (Khalvani, 2019). Gadgets are modern technological devices

that utilize advanced technology with various features that function to meet human needs (Hermiati, 2019). Meanwhile (Marinding, 2020) stated that gadgets are electronic devices that combine practical functions with attractive designs and are designed to help humanity in various aspects of life such as communication, entertainment and productivity. The various functions of this gadget have resulted in the gadget becoming one of the technological devices that is widely used in everyday life. Research company Data Reportal (GSMA Intelligence) revealed that the number of Indonesian gadget users reached 370.1 million people in January 2022. The number of Indonesian people using these gadgets increased by 13 million or 3.6 percent from the same period in the previous year. Based on Newzoo data in dataindonesia.id in 2022, Indonesia will be in the fourth position with the most gadget use in the world after China, India and America.

Gadgets are not only used by adults, but are also often found among students. The results of research conducted by (Ratnayani, 2022) revealed that the use of gadgets among high school students during weekend study hours, namely 2-4 hours/day, was 50.6%. Meanwhile, student use of gadgets outside of study hours on weekends, namely 2-4 hours/day, is 42.5%. Gadget use on weekends increased to more than 4 hours/day with 54% of respondents. Apart from that, survey results from the Indonesian Internet Service Providers Association (APJII) revealed that the level of internet penetration with gadgets in the 13-18 year age group reached 99.16% in 2021 to 2022. This shows that the role of gadgets is increasingly dominating everyday life. day. The use of gadgets among students raises considerable concern, because it can affect aspects of their education, health and social behavior.

There is one secondary school in Malang district that cannot be separated from the use of one type of gadget, namely cellphones. This school is an educational institution that provides education with a focus on developing students' academics and religiosity. This school is also a school that has utilized gadget technology as a tool to help provide education for students. However, the level of cellphone use among students, even though through supervision, many students lack focus when studying, pay less attention to the teacher, cannot be separated from cellphones, are difficult to talk to when given the opportunity to use cellphones, use cellphones for things that are not related to learning goals such as live Instagram, playing Tik-Tok, and opening Twitter. This causes learning activities to be unconducive, which causes students to become difficult to manage, students' understanding of the subject matter is less than optimal, and learning outcomes decrease. If this incident occurs continuously, it can reduce learning concentration, reduce learning motivation, and be slow in doing school assignments and assignments outside of school which are obligations for students (Laka, 2018). The results of other research show that 121 respondents (58.5%) have a poor percentage of cellphone use, 112 (54.1%) have a low level of cellphone dependency, 107 (51.7%) mostly have good social interactions. (Muflih, 2017). This research shows that excessive use of cellphones can reduce students' social interactions. Apart from that, excessive use of cell phones can cause students' character to become negative in the form of being selfish,

arrogant, unstable and withdrawn (Lismayanti, 2019, which is still not widely known and studied comprehensively.

Based on the results of the author's observations of students, it can be seen that the use of cellphones is only carried out when necessary as a means of learning through assistance from teachers, staff or other people concerned in student teaching and learning activities. However, even with supervision, many students lack focus when studying, pay less attention to the teacher, cannot be separated from their cellphones, find it difficult to talk when given the opportunity to use a cellphone, use cellphones for things that are not related to learning purposes such as live Instagram , playing tik-tok, and opening twitter. This causes learning activities to be unconducive, causing students to become difficult to manage, students' understanding of the subject matter is less than optimal, and learning outcomes decrease. If this incident occurs continuously, it can reduce learning concentration, reduce learning motivation, and be slow in doing school assignments and assignments outside of school which are obligations for students (Laka, 2018). The results of other research show that 121 respondents (58.5%) have a poor percentage of cellphone use, 112 (54.1%) have a low level of cellphone dependency, 107 (51.7%) mostly have good social interactions. (Muflih, 2017). This research shows that excessive use of cellphones can reduce students' social interactions. Apart from that, excessive use of cell phones can cause students' character to become negative in the form of being selfish, arrogant, unstable and withdrawn (Lismayanti, 2019).

Based on research results, the impact of the policy of confiscating cellphones during teaching and learning has a positive influence on students. This is in accordance with the research results, namely that 54.5% of class teachers have the same thought that the impact of this policy is very positive in creating student learning effectiveness. Students who violate the rules in the sense of using cell phones during class can disrupt learning concentration for both the students themselves and other students which has a negative impact on student development. This was explained by Wijarnarko (2017) that the habit of using cell phones has an impact on reducing students' concentration. affects development and causes difficulties in communicating, less responsive when talking to parents, and less active at school. Judging from previous research by Dewi Soleha (2017), it is stated that operating a cellphone during class will increase the number of cheating carried out by students, especially when taking exams.

Based on research results, discipline has a significant influence on student learning concentration. The more disciplined a student is, the greater his ability to focus on his studies, which can ultimately improve his academic performance. In this study the author was able to obtain a result of 54.5%, which percentage results influenced the learning concentration of MAN 1 Jember students. This policy can help them get used to a good study routine and make it easier to fully concentrate on studying. On the other hand, students who lack discipline tend to be more easily distracted because they do not have a regular study pattern. Additionally, discipline helps students take more responsibility for themselves. They

are more motivated to study seriously and avoid things that can disturb their concentration. Judging from previous research by Yati Navia and Putri Yulia (2017), it is stated that there is a positive and significant relationship between learning discipline, learning focus and learning achievement. This shows that the higher the student's learning discipline and concentration, the better the academic results. Then, based on research conducted by Mayang P (2023), to maintain and improve classroom discipline, it is necessary to give students a strong understanding of the importance of the teaching and learning process in accordance with the objectives, provide real punishment for violations of discipline and good teacher-student relationships, but with maintain and improve class discipline.

The policy of confiscating cellphones to create orderly teaching and learning is a step taken to ensure the smooth learning process and reduce disruptions that can arise due to the use of cellphones in the school environment. Cell phone confiscation can be carried out as a disciplinary action against students who violate the rules regarding cell phone use at school. This aims to create a focused learning environment, avoid external distractions, and increase student concentration during the teaching and learning process. Confiscating cellphones can also be a preventive measure to reduce the potential for leakage of exam information, misuse of cellphones during class hours, as well as minimizing social and security disturbances that may arise due to the use of cellphones in the school environment. By implementing a clear and consistent cellphone confiscation policy, it is hoped that it can create a more orderly and productive learning environment. It is important to note that this policy must be drafted carefully, transparently and fairly, and must take into account students' rights in using technology wisely. Apart from that, a holistic and educational approach also needs to be applied to provide students with an understanding of the importance of using cellphones responsibly and in accordance with the rules that apply in the school environment. When the determination of indiscipline is based on the written rules that apply at the school, whatever the unwritten rules are, such as the form of guidance and actions taken by the BP/BK provided when a violation occurs. There are provisions regarding these unwritten rules and regulations which make the form of guidance carried out by BP/BK teachers, Class Teachers, Study Teachers, Deputy Principals different from each other. The determination of indiscipline differs from one another because teachers' perceptions regarding indiscipline and the rules and regulations that exist in schools differ from each other so that the disciplinary mechanisms carried out by each teacher are different. In determining indiscipline, the role of rules and regulations is very important as a reference, but it is not uncommon for school officials to understand these rules optimally. The rules designed by the school are rules that are revised if there are changes at an uncertain time. Design by student representatives and BP/BK with approval from the Principal. The draft rules and regulations will be discussed in school environmental outreach activities. The meeting was attended by all parents of new students after the MPLS (Introduction to the School Environment) activity took place. One of the socialization activities

was explaining the activities that would be carried out along with an explanation of the school's rules and regulations and discussions regarding tolerance and forms of punishment or sanctions imposed on students who violated school rules. The rules and regulations will be agreed upon jointly by the school and the students' parents.

Conclusion

Based on the research results presented above, it can be concluded that there is a significant relationship between the influence of the cellphone confiscation policy and the orderly KBM MAN 1 Jember process. This is in line with the decision to compare the significant values of the SPSS data processing table with a value <0.05. Based on the results of the t test, the calculated t value for the Orderly Learning Process variable is7,714, with a significance value (Sig.) of less than 0.05, it can be concluded that the cellphone confiscation policy variable has a positive and significant influence on the creation of the KBM process. This means that the null hypothesis (Ho) is rejected and the alternative hypothesis (Ha) is accepted. Therefore, it can be stated that the cellphone confiscation policy has an influence in creating an orderly KBM process.

In order to create an orderly teaching and learning process, there needs to be an ongoing policy, one of the policies used by MAN 1 Jember is the confiscation of cellphones during the teaching and learning process. This policy does not apply to teachers who use learning media that use cellphones. The benefits of this policy include creating student discipline, making it easier for students to concentrate, during lessons students pay more attention to the teacher, there are no incidents of students opening prohibited sites, encouraging students not to think about cyberspace and focus on lessons. With this policy, apart from creating an orderly learning process, it can also build student ethics.

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