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Development of science chess media based on Higher Order Thinking Skill (HOTS) to increase the understanding of science concept in students

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Abstract. This research generally aims to develop science chess media based on Higher Order Thinking Skills that valid for students. The specific objectives of this research are (1) developing science chess media based on higher order thinking skills, (2) knowing the feasibility of developed learning media, (3) knowing student learning outcomes after participating in learning using science chess media based on Higher Order Thinking Skills, (4) determine the response of students after learning. The application of science chess in learning uses one group pretest-posttest design. The research method used is development research by following 4 phases of Plomp. There is problem, analysis, design & develop prototype, and evaluation and then continued with the application using the one group pretest-posttest design. Based on research, it can be obtained: 1) the feasibility of science chess media based HOTS in the aspects of content feasibility, presentation, language according to BSNP (National Education Standards Board), and contextual assessment are in the category of decent to use, 2) the increase of student's understanding on scientific concepts using science chess media based HOTS is 62.5, and 3) students gave a positive response to the science chess media based HOTS.
Keywords: *science chess, media, HOTS*

1. Introduction

Improving the results of learning science, teachers are required to be more professional in preparing learning tools to suit the conditions and circumstances of the student environment, so that the subject is easily understood by students. Based on the pretest results before learning, students' understanding of science concepts obtained an average value of only 65.7. Besides that, the students' ability in solving everyday problems involving science concepts is obtained 50.9 in the low category. The minimum score so they can past this subject should be 75. The low average score of these students shows that their ability to understand the concept of science is still low. This is due to several factors including the models, method, media, and the teacher's skills in learning. Learning math requires a creative, innovative and fun through students' engagement that is facilitated by the teacher in order that the students to find and solve problems [1]. This is in line with the students' belief of mathematical that the three main factors, belief in in their ability, the mathematical discipline and towards mathematical teaching and learning [2].

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The media has a very important contribution to the learning process. Science chess media is a media developed by researchers. In terms of appearance, this media has several advantages such as the appearance of images in three dimensions (3D) as well as chess and dip boards made to resemble various symbols in science. While in terms of substance, the strengths of science chess contain science concepts that help students carry out the process of analysis, synthesis, and creation to solve daily problems. This media is expected to help the process of learning science in the classroom, especially the delivery of material that the process cannot be seen directly by students. It is stated that mathematical connection ability is the ability to link or connect the internal and external relations of mathematics that involves concepts, connection with other discipline and connection with everyday life [3].

Entering the 21st century many things have changed in all aspects of life, including education. The acceleration of the development of science and technology, communication systems, and unlimited internet access became one of the characteristics of the beginning of the century. This also changes the educational paradigm. Schools are required to change competencies. The ability to think critically, solve problems, and collaborate becomes important competencies in entering 21st century life. However, the reality on the ground is often not in line with what we expect. Based on observations of students at STKIP Bina Insan Mandiri who were asked to solve problems that required 21st century competence, only 4 out of 10 students were able to solve them. This shows that their ability to solve problems is still low. Ariyati also mentioned that there are still many first-year students who cannot solve problems in daily life [4]. Therefore, we need a skill called higher order thinking skill (HOTS). HOTS is a cognitive operation that is needed in the thinking processes that occur in short-term memory. In relation between HOTS and mathematics, the difficulty of mathematics has become a stigma in the society hence it is vigorous to alter it though the implementation of HOTS [5], They added that students' attention in interest of mathematics can be attracted by using HOTS.

Based on the above reasons, researchers chose to develop science chess media based on HOTS to help students understand scientific concepts. The objectives of this study include: (1) developing science chess media based on higher order thinking skills have valid; (2) knowing the feasibility of developed learning media; (3) improve students' understanding of science concepts using science chess media; (4) knowing the students' responses after learning.

2. Research method

Design of this research uses One Group Pretest-Posttest Design [6]. The first step is to take measurements as a preliminary test, then subject to treatment within a certain period, then do the final test which can be described as follows:

$$\mathbf{O_1 \quad X \quad O_2}$$

The validation data were analysed descriptively qualitatively. In this study passing grade (acceptance limit) is the average score ($\overline{X}$) of the results of the validator's evaluation then the level of validity of the device developed by matching the learning instrument criteria according to Gronlund in [7] is as follows.

Table 1. The categorization criteria for learning tools assessment.

Interval Rating	Rating Category
$\overline{X} > 4.65$	Very decent
$3.45 \leq \overline{X} \leq 4.64$	Decent
$1.15 \leq \overline{X} \leq 3.45$	Medium
$0.35 \leq \overline{X} \leq 1.15$	Less
$\overline{X} \leq 0.35$	Low

The reliability of the questions was analyzed descriptively qualitatively using the Alpha formula, namely:

$$\alpha = r_{11} = \left(\frac{n}{n-1}\right)\left(1 - \frac{\Sigma S_i^2}{S_i^2}\right)$$

Note: n = number of items, ΣS_i^2 = number of variance scores for each item and S_i^2 = average score variance.

Table 2. Criteria for interpretation of device reliability degree.

Interpretation Reliability	Coefficient
r ≥ 0.80	Degree of high reliability
0.4 ≤ r < 0.80	Degree of moderate reliability
r < 0.40	Degree of low reliability

The level of difficulty of the questions are classified in the following stages:

P ≤ 0.3	hard problem
0.35 ≤ P < 0.70	moderate questions
0.70 ≤ P < 0.85	easy questions
P ≥ 0.85	questions are very easy

The sensitivity of the questions in this study were analyzed descriptively qualitatively using the formula

$$S = \frac{\Sigma\, S_{ses} - \Sigma\, S_{seb}}{N\,(S_{maks} - S_{min})}$$

Note: S = index sensitivity problem, N = number of students, ΣS_{ses} = number of subject scores after learning, ΣS_{seb} = number of subject scores before learning, S_{max} = maximum scores achieved by students, and S_{min} = minimum scores achieved by students.

Price sensitivity starts from 0 - 1. Price 0 is not sensitive while 1 is very sensitive. For analysis of understanding of science concepts in students using paired t test. Paired t test was used to determine the understanding of science concepts in students. This test is used to determine the difference between two data groups that are normally distributed. The t-paired test formula is:

$$t = \frac{\overline{X_1} - \overline{X_2}}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2} - 2r\left(\frac{S_1}{\sqrt{n_1}}\right)\left(\frac{S_2}{\sqrt{n_2}}\right)}}$$

Note: $\overline{X_1}$ = average sample before treatment, $\overline{X_2}$ = average sample after treatment, S_1 = standard deviation before treatment, S_2 = standard deviation after treatment, n_1 = number of samples before treatment and n_2 = number of samples after treatment.

Analysis of Student Responses. Student response questionnaire is used to find out students' opinions on the media developed, how to use them, and their benefits in helping students understand concepts. Student responses were analyzed descriptively quantitatively using the formula:

$$P = \frac{\sum R}{\sum N} x100\%$$

Note: P = percentage, ∑ R = number of responses and ∑N = total number of responses

3. Result and Discussion

3.1. Eligibility Results for the Science Chess Learning Media

Table 3. Results of validation of content feasibility aspects.

No	Rated Aspect	Scoring		Average	Category
		V1	V2		
A	The suitability of the material with basic competencies				
1.	Material Completeness	4	4	4.0	Decent
2.	The extent of the material	4	4	4.0	Decent
3.	Material depth	4	4	4.0	Decent
		12	12	4.0	Decent
B	Material Accuracy				
1.	The accuracy of concepts and definitions	4	4	4.0	Decent
2.	Data and fact accuracy	5	5	5.0	Very Decent
3.	The accuracy of examples and cases	4	4	4.0	Decent
4.	The accuracy of drawings, diagrams, and illustrations	4	5	4.5	Very Decent
5.	The accuracy of terms	5	4	4.5	Very Decent
		22	22	4.4	Decent
C	Material Updates				
1.	Images and illustrations in everyday life	5	4	4.5	Very Decent
2.	Use examples and cases in everyday life	4	4	4.0	Decent
		9	8	4.25	Decent
D	Encourage Curiosity				
1.	Encourage Curiosity	4	4	4.0	Decent
2.	Creating the ability to ask	5	4	4.5	
		9	8	4.25	Decent

Table 4. Results validation of presentation eligibility aspects.

No	Rated Aspect	Scoring		Average	Category
		V1	V2		
A	Presentation Techniques				
1	Conceptual coherent	4	4	4.0	Decent
		4	4	4.0	Decent
B	Supporting Presentation				
1	Examples of questions in each learning activity	4	4	4.0	Decent
2	The answer key to the practice question	4	5	4.5	Decent
3	Introduction to the material	4	5	4.5	Decent
4	Bibliography at the end of the material	4	4	4.0	Decent
		16	18	4.25	Decent

No	Rated Aspect	Scoring		Average	Category
		V1	V2		
C	Learning Presentation				
1	Student involvement	4	5	4.5	Decent
		4	5	4.5	Decent
D	Coherence and Mind Flowing				
1	Linkages between learning activities / learning sub-activities / paragraph	4	4	4.0	Decent
2	Integrity of meaning in learning activities/ learning sub activities / paragraphs	4	4	4.0	Decent
		8	8	4.0	Decent

Table 5. Results of validation of language feasibility aspects according to BSNP.

No	Rated Aspect	Scoring		Average	Category
		V1	V2		
A	Straightforward				
1	The accuracy of sentence structure	4	4	4.0	Decent
2	The effectiveness of sentences	5	4	4.5	Decent
3	Formal standard term	4	4	4.0	Decent
		13	12	4.2	Decent
B	Communicative				
1	Understanding of messages or information	4	4	4.0	Decent
		4	4	4.0	Decent
C	Dialogical and Interactive				
1	The ability to motivate students	4	5	4.5	Decent
		4	5	4.5	Decent
D	Conformity with the Development of Students				
1	Conformity with the intellectual development of students	4	4	4.0	Decent
2	Conformity with the level of emotional development of students	4	5	4.5	Decent
		4	9	4.25	Decent
E	Conformity with Language Rules				
1	Grammar accuracy	4	5	4.5	Decent
2	Spelling accuracy	4	4	4.0	Decent
		8	9	4.25	Decent

Table 6. Results of validation of contextual assessment aspects.

No	Rated Aspect	Scoring		Average	Category
		V1	V2		
A	Contextual Nature				
1	The relationship between the material taught by the real world situation of students	4	5	4.5	Decent
2	The ability to encourage students to make connections between the knowledge possessed	4	4	4.0	Decent

No	Rated Aspect	Scoring		Average	Category
		V1	V2		
	by students and its application in everyday life	8	9	4.25	Decent
B	Contextual Components				
1	Analyze	5	4	4.5	Decent
2	Distinguish	4	5	4.5	Decent
3	Organize	5	4	4.5	Decent
4	Connect	5	4	4.5	Decent
5	Evaluate	5	4	4.5	Decent
		24	21	4.5	Decent

From table 6 shows the average contextual assessment scores of two validators for the contextual nature assessment indicators and contextual components obtained values of 4.25 and 4.5 in the feasible category

3.2. Student Learning Outcomes During Implementing Learning Using Media Science Chess

Table 7. Student pretest and posttest results.

No	Student Names	Pretest	Posttest
1	ADA	20	85
2	EIM	15	80
3	SAS	25	80
4	AA	20	75
5	NW	30	90
6	ANH	10	75
	Average	18.3	80.8

Based on table 7 it can be seen that during pretest student grades very low. Then after learning by using science chess media and given a test post, their scores have increased. The increase occurred by 62.5 or around 77%. So it can be concluded that there are significant differences in learning outcomes between before and after learning. This indicates that science chess media based on higher order thinking skills (HOTS) developed by researchers can improve students' understanding of photosynthesis material

3.3. Student Responses to HOTS-Based Science Media Chess

From the data in table 8, it can be seen that students have responded positively to the chess learning media developed. The use of media in learning process plays an important role especially the learning process that applies HOTS. Implementation of higher order thinking skill of students will enhance students' skill in problem solving strategies [8]. Using media that facilitate HOTS in the learning process was carried out to get a maximal learning achievement. In line with this, there are studies proved that social group activities like group projects or other collective problem solving enables HOTS to be established [9].

The use of media *science chess* proved to be helpful for the students. This media encouraged the students to be engaged in the learning. Sumarmo [10] stated that interaction among students with their peers or teachers can be optimized by involving the students' engagement and this is can be gained with critical and creative thinking. Also, socially, the students interact among themselves, practice to share, to improve social tolerance, and actively learning to give social contribution for their group

Table 8. Student responses to chess-based science learning media.

No	Question	Appraisal			
I.	Format	Very Good (%)	Good (%)	Less Good (%)	Not Good (%)
	1. The attractiveness of images in learning media	83	17	0	0
	2. Appropriate picture size in learning media	67	33	0	0
	3. Ease of use of learning media	83	17	0	0
	4. The ability of the media in explaining learning material	67	33	0	0
II.	Content	Very Good (%)	Good (%)	Less Good (%)	Not Good (%)
	1. The Suitability of title with content	33	67	0	0
	2. The suitability of the material with the learning objectives	100	0	0	0
	3. Completeness of material in the learning media	83	17	0	0
	4. Generating student interest in learning	83	17	0	0
III	Language	Very Good (%)	Good (%)	Less Good (%)	Not Good (%)
	1. Spelling ease of writing to read	100	0	0	0
	2. The language used is according to EYD	100	0	0	0
	3. Ease of language to understand	83	17	0	0
	4. Encourage user interest in reading	83	17	0	0
	5. Clarity of meaning of sentences in learning media	83	17	0	0

[11]. The science chess media applied encouraged the students to play their parts. In the games, students can also play their role in relation to their genders or their role in their play groups [12]. This indicates that the

HOTS-based chess learning media developed was well received by students. Thus the chess learning media HOTS-based can improve student learning outcomes in photosynthesis material. This research is in line with [13] which states that HOTS is the ability to complete tasks where no algorithm has been taught, which requires justification or explanation and may have more than one possible solution. High level thinking occurs when someone takes new information and information stored in memory and reconnected or rearranging and expanding this information to achieve goals or find possible answers in confusing situations. Moreover, HOTS is applied in learning through media. The results of studies conducted by [14] revealed that, 90% of what students learn comes from what we say and do, 70% of what we say, 50% of what we see and hear, 30% of what we see, 20% of what we hear, and 10% of what we read. This shows that if students learn from what they see and feel directly, that means using the media, it will obtain maximum results. Therefore, it can be concluded that scie chess media based on HOTS can improve student learning outcomes in photosynthesis material. An act of drawing conclusions, connecting with other facts and concepts, manipulating, categorizing, combining with new ways, and applying them to find new solutions for new problems is more than an act in HOTS [15].

4. Conclusion

Based on the results of the study the following conclusions are obtained that the feasibility of HOTS-based chess learning media in the aspects of the feasibility of content, presentation, language according to BSNP, and contextual assessment are in the proper category to be used. There is an increase in understanding of students' science concepts using HOTS-based chess learning media at 62.5 point. Students give positive responses to the chess learning media HOTS-based science.

References

[1] Kusmaryono I 2014 *Proc. Int. Conf. on Mathematics, Science and Education (Semarang)* vol 1 (Semarang: UNNES) p 36
[2] Yunita P, Zulnaidi H and Zakaria E 2018 *PLoS ONE* **13** 20 https://doi.org/10.1371/journal.pone.0204847
[3] Maharani R, Ammatillah N, Muhammad G, Hidayat A T, Zainuddin A, Al-Anshori J and Subroto T 2017 *Proc. Conf. Mathematics, Science, and Computer Science Education (Bandung)* vol 1848 (New York: AIP Publishing) p 2 https://doi.org/10.1063/1.4983938
[4] Ariyati E 2015 *Proc. Seminar Nasional Pendidikan Biologi (Malang)* vol 1 (Malang: Universitas Muhammadiyah Malang) p 346-50
[5] Abdullah A H, Mokhtar M, Halim N D A, Ali D F, Tahir L M and Kohar U H A 2017 *Eurasia Journal of Mathematics, Science and Technology Education* **13** 3-17 https://doi.org/10.12973/eurasia.2017.00601a
[6] Tuckman B W 1986 *Conducting Educationa Research Second Edition* (Orlando, FL: Harcourt Brace Jovanovich Publisher) chapter 2 pp 25
[7] Arikunto S 2006 *Dasar-dasar Evaluasi Pendidikan* (Yogyakarta: PT Bumi Aksara) pp 17
[8] Pratama G S and Retnawati H 2018 *Proc. Int. Conf. on Research, Impelemantation and Education of Mathematics and Science (Yogyakarta)* vol 1097 (Bristol: IOP Publishing) p 1-8 http://doi:10.1088/1742-6596/1097/1/012147
[9] Setyarini S, Muslim A B, Rukmini D, Yuliasri I and Mujianto Y 2018 *Indonesian Journal of Applied Linguistics* **8** 191 https://doi.org/10.17509/ijal.v8i1.11480
[10] Sumarmo U, Hidayat W, Zulkarnain R, Hamidah and Sariningsih R 2012 *Jurnal Pengajaran Matematika Dan Ilmu Pengetahuan Alam* **17** 20 http://dx.doi.org/10.18269/jpmipa.v17i1.228
[11] Dhayanti D, Johar R and Zubainur C M 2018 *JRAMathEdu* **3** 26 http://doi.org/10.23917/jramathedu.v3i1.5618
[12] Suyatno (2008, September 9) *Mengajar dengan Permainan* Retrieved from https://www.sabda.org/publikasi/e-binaanak/402/?kata=otoritas
[13] Trisnawaty W, Citrasukmawati A and Thohir M A 2017 *Journal of Education and Learning* **11** 446-52 http://dx.doi.org/10.11591/edulearn.v11i4.6456
[14] Magnesen V A 1983 *Innovation Abstracts* **5** 1-4
[15] Yuliati S R and Lestari I 2018 *Perspektif Ilmu Pendidikan* **32** 181 https://doi.org/10.21009/PIP.322.10

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