THE DEVELOPMENT OF THE SNAKE AND LADDER GAME AS A MEDIUM FOR PRACTICING HIGH SCHOOL PHYSICS QUESTIONS ON THE TOPIC MECHANICS AND FLUIDS

A. H. Permana[a], D. Muliyati[b], J. O. Halim[c]

Department of Physics Education, Universitas Negeri Jakarta, Rawamangun Muka Road Jakarta 13220, Indonesia

Email: [a]handjoko@unj.ac.id, [b]dmuliyati@unj.ac.id, [c]joelongkohalim@gmail.com

Abstract

A joyful learning approach is able to generate student learning motivation which in turn can improve student learning outcomes (M Kamelia et.al, 2017). One of joyful learning approach is the use of educational games. This study developed a game of snakes and ladders as a medium for practicing Physics questions. This study used the 4D development method. The developed game was assessed by experts (evaluation experts, media experts, and software engineering experts) using a Likert scale quessionnaire. The results of the validation of the developed game were obtained 93,18 % by evaluation experts, 100% by media experts and 87,5% by software engineer experts. While the results of trials on high school teachers and students reached 76,04 % and 83%. From these results it can be stated that the game developed is very suitable for use in learning activities and is beneficial for teachers and students.

Kata-kata kunci: Ladder game, Topic Mechsnics, fluids.

INTRODUCTION

In 20th century, it's enough to master 3R (reading, writing, arithmetic) [3]. In 21st century, student have a new needs. There's a new demand from routine work to non-routine, analytic, and interactive [2]. The new needs are called 4C, abbrevation of Communication, ability to communicate effectively, Collaboration, ability to work in team and leadership, Critical Thinking, ability to reasoning and make a hard choice, and Creativity, ability to develop an idea.

Technology in education may develop a compation medium for learning process. Technology used might enables fun learning. The model used is called PAKEM, abbrevation of *Partisipasi* (Participation), *Aktif* (Active), *Kreatif* (Creative), *Efektif* (Effective), *Menyenangkan* (Joyful). The use of PAKEM model in elementary school increase students concentration [10]. PAKEM also increase the interest in learning mathematics for high school students [9]. In another study, learning using PAKEM model increase student motivation to study [8].

Joyful learning might helps students acquire and hone 21st century competencies [7]. One of many joyful learning approach is the use of educational games. Educational games could benefits students as in enchanced decision making and problem-solving skills, improving collaboration and communication, high self-esteem, and rewarding feeling of progression and achievement [1]. An enggaging game could.

A research using educational games for Work and Power in Physics deemed feasible for use and have a positive impact towards students learning motivation [5]. Another case using educational games found students grasped the mathematical concept better with increased interest and motivation [4].

The development of educational games can also be used as a medium for practice or students comprehension. Test in school is a tool to measure the ability of a person or group [6] and so practice the test is the least student can do to excel it. Game as a practice medium can attract user's interest and produce curiousity about the material in question.

The development of games that combine play and practice is expected to make the process of practicing questions fun to have a positive impact and motivating. Feels important to develop a practice medium which can be used in learning Physics.

METHODOLOGY

This research is a R&D (Research and Development) that aims to produce a product. This research use 4D model with the flowchart like in FIGURE 1.
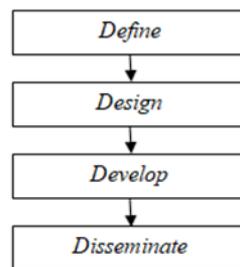

FIGURE 1. 4D Model

In the process of designing the game, appropriate tools and materials are needed. This development uses the basic of the Snake and Ladder game which will be modified to raise questions when touching the foot of the ladders or the tail of the snakes. The answer to the questions will determine the position of the player's pawn: either put the pawn closer or farther away towards the end square.

This modification by adding a feature was done to an already existing Snake and Ladder game found in link listed on video from 'Teatime Coder' Youtube channel (https://www.youtube.com/watch?v=d63eLVTEXRk). Source code found was a Snake and Ladder game made for smartphone using Unity application with C# as the programming language.

There are 2 types of questions used in the modified Snake and Ladder: multiple choice and complex multiple choice. In multiple choice, students had to choose the correct answer out of 5 given choice 'ABCDE'. In complex multiple choice, students had to choose all the correct statements given, '1234'. Each complex multiple choice have one or more correct statements. Some of the questions used High Order Thinking Skills (HOTS) to fulfill students needs of critical thinking.

High school Physics material used for Mechanics and Fluids topics that mentioned are the odd semester high school Physics material for XI grade. In curriculum thirteen, the odd semester high school Physics material for XI grade covers material as mentioned:
- Balance and Rotational Dynamics
- Elasticity and Hooke's Law
- Fluid Statics
- Fluid Dynamics
- Temperature, Hear and Heat Transfer
- Kinetic Theory of Gases

Respondent for this research are evaluation experts, media experts, software engineer experts, physics teachers and students. Evaluation experts, media experts, and software engineer experts were given feasibility test while physics teachers and students were given perception test. Instruments for

experts feasibility test and physics teachers and students perception test can be seen in the next tables.

TABLE 1. Evaluation Experts Feasibility Test Instruments

Aspect	Indicator	Item Questions	Number of Items
Content	Competence	1, 2, 3	3
Appearance	Communicative	4	5
	Language	5, 6	
	Text readability	7	
	Image resolution	8	
Questions	Contextual and Questions Variety	9, 10	3
	Question presented	11	

TABLE 2. Media Experts Feasibility Test Instruments

Aspect	Indicator	Item Questions	Number of Items
Software	Effective	1	6
	Reliable & Reuseable	2, 3	
	Maintainable and compatibility	4, 5	
	Usable	6	
Learning Design	Learning objectives and the curriculum	7	3
	Presentation of media content with learning objectives	8	
	Learning motivation	9	
Communication	Communicative	10	6
Audio Visual	Creative	11	
	Audio visual quality	12, 13, 14, 15	

TABLE 3. Software Engineer Experts Feasibility Test Instruments

Aspect	Indicator	Item Questions	Number of Items
Ease for Use	Media program effectiveness and efficiency	1	6
	Media management and use	2, 3	
	Media program usabiliy	4	
	Smooth running the media program	5	
	Suitablity for the targeted device	6	
Software Engineer	Animation control	7	4
	Media navigation	8	
	Placement suitability	9	
	Media and user interactions	10	
Appearance Audio Visual	Sound and music	11	4
	Text readability	12	
	Screen display	13	
	Image quality	14	

TABLE 4. Teachers Perception Test Instruments

Aspect	Indicator	Item Questions	Number of Items
Content	Competence	1, 2, 3, 4, 5, 6, 7	7
Questions	Contextual	8	1
Perception	Perception	9	1
Display	Language	10, 11, 12	3

TABLE 5. Students Perception Test Instruments

Aspect	Indicator	Item Questions	Number of Items
Use	Ease to use	1, 2	2
Display	Audio visual	3, 4	3
	Placement	5	
Game	Game	6, 7, 8, 9	4
Perception	Perception	10	1

This research uses a continuum scale of four with the interpretation shown in TABLE 6

TABLE 6. Percentage Interpretation Table

Percentage	Interpretation
≤ 25%	Strongly Not Feasible
25% < x ≤ 50%	Not Feasible
50% < x ≤ 75%	Feasibile
75% < x ≤ 100%	Strongly Feasible

RESULT AND DISCUSSION

The developed games were made to be played in laptop or personal computer with Windows operating system.
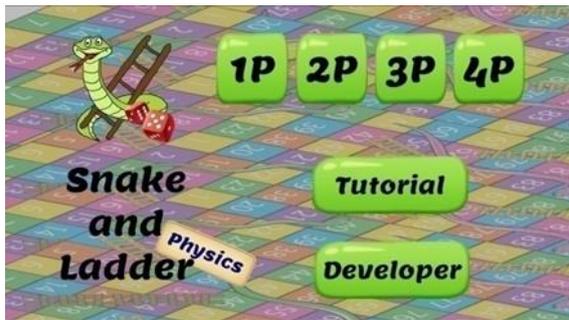

FIGURE 2. Initial Display

FIGURE 3. Tutorial Panel

FIGURE 4. Game Start View

FIGURE 5. Question Example 1

FIGURE 6. Question Example 2

FIGURE 7. Game Over Panel

Feasibility Test

The feasibility test result can be seen in TABLE 7 to TABLE 9

TABLE 7. Evaluation Experts Feasibility Test Results

Statement	Score	Percentage	Information
Question items in accordance with the odd semester high school Physics materials	4	100%	Strongly Feasible
Question items are in accordance with the question indicators that has been made	3	75%	Feasible
Question indicator can describe the odd semester high school Physics subject class XI	4	100%	Strongly Feasible
Language used is communicative and does not have multiple interpretation	4	100%	Strongly Feasible
The sentences used are clear and concise	4	100%	Strongly Feasible
Spelling and punctuation according to Indonesian spelling	4	100%	Strongly Feasible
Text uses appropriate fonts and sizes, easy to read, consistent, and attractive	4	100%	Strongly Feasible
Image placement is appropriate and clearly visible	4	100%	Strongly Feasible
Stimulus qiestions use real situations in everyday life	3	75%	Feasible
The types of questions used vary	4	100%	Strongly Feasible
The answer is not implied in the question	3	75%	Feasible
Average	3.73	93.18%	Strongly Feasible

TABLE 8. Media Experts Feasibility Test Results

Statement	Score	Percentage	Information
Media is effective for independent or group learning	4	100%	Strongly Feasible
Media can be relied upon in the learning process	4	100%	Strongly Feasible
Media can be used repeatedly	4	100%	Strongly Feasible
Media can be used easily	4	100%	Strongly Feasible
Media can be run according the plan (Windows)	4	100%	Strongly Feasible
Media is easy to use	4	100%	Strongly Feasible
The developed media contains content that is in accordance with the curriculum	4	100%	Strongly Feasible
Coverage of content in the media according to learning objectives	4	100%	Strongly Feasible
Media can increase the use's learning appeal	4	100%	Strongly Feasible
The language used is communicative and does not have multiple interpretations	4	100%	Strongly Feasible
The media uses interesting and fun concepts	4	100%	Strongly Feasible
The sound used in the media does not distract concentration	4	100%	Strongly Feasible
The font used is easy to read	4	100%	Strongly Feasible
The combination of the text color with the background on the media is clearly visible	4	100%	Strongly Feasible
The image on the media is clearly visible	4	100%	Strongly Feasible
Average	4	100%	Strongly Feasible

TABLE 9. Software Engineer Feasibility Test Results

Statement	Score	Percentage	Information
Media is effective and efficient	3	75%	Feasible
Media can be managed and used easily	4	100%	Strongly Feasible
Students can use the media independently	4	100%	Strongly Feasible
There are clear instructions for the image	4	100%	Strongly Feasible
No bugs found during program operation	4	100%	Strongly Feasible
Media operate smoothly on Windows, personal computer/laptop	4	100%	Strongly Feasible
Simple animation and easy to the eye	4	100%	Strongly Feasible
Easy to understand and use	4	100%	Strongly Feasible
Board view and questions don't look empty	3	75%	Feasible
Students interactivity according to the plan	3	75%	Feasible
The sound doesn't bother the user	3	75%	Feasible
Text uses appropriate fonts and sizes	3	75%	Feasible
Screen uses appropriate color composition	3	75%	Feasible
Image is appropriate and visible	3	75%	Feasible
Average	3.5	87.5%	Strongly Feasible

Perception Test

Perception test were given to 2 physics teachers and 30 students in state high school 14 Bekasi class XI science.

TABLE 10. Teachers Perception Tests Results

Statement	Score	Percentage	Information
The content used relevant to odd semester High School class XI Physics	3.5	87.5%	Strongly Feasible
The media developed according to learning objectives	3	75%	Feasible
Contains learning elements	3	75%	Feasible
The Physics concepts used appropriate to learning objectives	3.5	87.5%	Strongly Feasible
The Physics concepts used easy for student to understand	3	75%	Feasible
The Physics concepts used are contextual and actual	2.5	62.5%	Feasible
The Physics concepts used appropriate with students ability	2.5	62.5%	Feasible
Questions given are relevant with learning objectives	3	75%	Feasible
This game is interesting to play	3.5	87.5%	Strongly Feasible
The language used is easy to understand and appropriate with students development	3	75%	Feasible
The language used does not cause misinterpretation	3.5	87.5%	Strongly Feasible
The sentences used are straightforward and clear	2.5	62.5%	Feasible
Total	36.5		Strongly Feasible
Average	3.04	76.04%	

TABLE 11. Students Perception Tests Results

Statement	Score	Percentage	Information
I am interested to play the developed game	3.5	87.5%	Strongly Feasible
The developed game is easy to play	3.23	80.75%	Strongly Feasible
Icon appearance, picture and animation in game is interesting	3.27	81.75%	Strongly Feasible
Sounds inside the game does not interfere with concentration	3.33	83.25%	Strongly Feasible
Buttons placement in game are interesting	3.33	83.25%	Strongly Feasible
The game instructions are very clear	3.47	86.75%	Strongly Feasible
This game is easy to install on various platforms	3.17	79.25%	Strongly Feasible
I can play objects in game individually	3.1	77.5%	Strongly Feasible
This game is not boring	3.3	82.5%	Strongly Feasible
I am interested if learning is done using games and applied in other material	3.5	87.5%	Strongly Feasible
Total	33.2		Strongly Feasible
Average	3.32	83%	

Overall, the developed educative games found feasible for use based on the feasibility test result from evaluation experts, media experts, and software engineering experts. The developed games also attract attentions and found feasible from the perspective of students and teachers.

CONCLUSION

From the result and discussion we can conclude the developed Snake and Ladder game as a medium for practicing high school Physics questions on the topic of mechannics and fluids is categorized as strongly feasible for use in learning or training activities.

REFERENSI

[1] T. Anastasiadis, G. Lampropoulos, K. Siakas, "Digital game-based learning and serious games in education," *International Journal of Advances in Scientific Research and Engineering*, vol. 4, no. 12, pp. 139-144, 2018.

[2] S. B. Chiruguru, "The Essential Skills of 21st century classroom (4Cs)," 2020.

[3] V. Erdoğan, "Integrating 4C skills of 21st century into 4 language skills in EFL classes," *International Journal of Education and Research*, vol. 7, no. 11, pp. 113-124, 2019.

[4] E. Fokides, "Digital educational games and mathematics, Results of a case study in primary school settings," *Education and Information Technologies*, vol. 23, no. 2, pp. 852-867, 2018.

[5] M. Hendri, M. Jarnawi, "Development of nano physics learning media (physics monopoly game) based on software," *Journal of Physics: Conference Series,* IOP Publishing, vol. 2126, no. 1, p. 012019, 2021.

[6]   U. Jaenudin, D. Sahroni, "Psikologi Pendidikan," 2021.

[7]   G. Jeet, S. Pant, "Creating joyful experiences for enhancing meaningful learning and integrating 21st century skills," *International Journal of Current Science Research and Review*, vol. 6, no. 2, pp. 900-903, 2023.

[8]   J. Panjaitan, "Peningkatan Motivasi Dan Hasil Belajar Fisika Dengan Menerapkan Model Pembelajaran PAKEM," *Jurnal Penelitian Fisikawan*, vol. 3, no. 1, pp. 8-17, 2020.

[9]   B. S. Samosir, N. Nursahara, A. F. Pohan, "Upaya meningkatkan minat belajar matematika menggunakan model pembelajaran (pakem) di SMA Negeri 2 Siabu," *Jurnal Karya Pendidikan Matematika,* vol. 7, no. 1, pp. 14-21, 2020.

[10]   W. Wijayanti, M. Efendi, "Efektivitas model PAKEM dalam meningkatkan konsentrasi belajar anak usia dini," *Jurnal Pendidikan Anak usia Dini*, vol. 2, no. 1, pp. 92-109, 2021.

PF-114