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Production of a Psyofments Game Oriented Toward High-Level Thinking on the Periodic Table of Elements Material"

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ABSTRACT
This research aims to describe the appearance of the Psyofments game, analyze the results of the validation test, and examine the results of the feasibility test of the Psyofments game oriented toward higher-order thinking skills in the material of the periodic system of elements. The research method used is Design-Based Research (DBR) with the ADDIE approach model, which consists of three stages: analysis, design, and development. The Psyofments game is an Android-based game application that contains questions about the periodic system of elements with varying levels of difficulty at each stage and is oriented toward HOTS questions. The results of the research show that the Psyofments game displays consist of menu selection screens, identity input screens, start game screens, game level screens, material reward screens, and final score screens. The results of the validation test from the validator obtained an average r-count value of 0.863 from all aspects, indicating that the Psyofments game is valid as a learning medium. After the media was revised based on suggestions from the validator, a feasibility test was conducted on 11 students who had studied the periodic system of elements. The results of the feasibility test showed an average percentage of 90% across all aspects, indicating that the Psyofments game is highly suitable to be used as a learning medium.

Introduction

The periodic table of elements (SP) is a core chemistry topic taught in grade 10, semester one. This material is considered abstract because it involves the study of extremely small substances (Hendriayana et al., 2013). The periodic table is a crucial prerequisite that students must master in order to understand other chemistry concepts (Pusparini et al., 2017). However, in practice, students often tend to memorize the periodic table without fully understanding its underlying principles. This approach leads to quick forgetting, boredom, and increasing difficulty as chemical concepts become more complex (Manggabarani et al., 2016).

To overcome these challenges, innovation in learning activities is essential. A suitable and appropriate learning medium can provide a solution (Hidayah et al., 2017). As stated by Putra et al. (2016), learning media serve as aids for teachers in communicating material to students and helping students understand concepts, as they can be used independently anytime and anywhere.

The development of learning media is closely linked to technological advancements (Rozi et al., 2020). Among these, Android-based smartphone learning applications are considered capable of improving students' academic abilities (Sari et al., 2017). Android-based learning media offer several advantages: they are easy to use, attractive, accessible both online and offline, and can be utilized anytime and anywhere (Pratama et al., 2020). One effective way to leverage technology in Android-based learning media is through games. Games can make the embedded material more engaging and significantly increase students' interest in learning (Suci et al., 2019).

Instructional games used on Android devices are widely popular across all age groups, especially among students who are accustomed to integrating technology and smartphones into various aspects of their daily lives, including learning (Sukarjo, 2017). Utilizing games as learning media can shift classroom culture from teacher-centered or traditional learning to student-centered learning. Games not only foster cognitive development but also enhance students' discipline

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and creativity. Furthermore, they can support students' emotional, psychomotor, and cognitive development, teaching them how to communicate, position themselves, respect others, and follow rules (Bintiningtiyas et al., 2016).

The integration of learning games for the periodic table of elements has been explored in previous research. Mariscal et al. (2012) developed a paper-based card game designed by students themselves. However, paper-based periodic table games have limitations in durability; they are not long-lasting, are inflexible, and are easily torn. Additionally, research by Traver et al. (2021) utilized desktop-based technology for an educational card game called Chemmend for the periodic table of elements. A number of users suggested that mobile applications would be far superior due to greater accessibility, allowing usage without spatial or temporal limitations, thereby increasing students' learning opportunities anywhere. The need for variation in questions and levels of difficulty was also highlighted.

Moreover, learning becomes truly meaningful when students are encouraged to engage in higher-level thinking. Mastery of concepts is reflected when students can think at a high level, corresponding to the C4 (analyzing), C5 (evaluating), and C6 (creating) cognitive domains of Bloom's Taxonomy. Students need to be accustomed to activities that train Higher Order Thinking Skills (HOTS), so they do not merely remember or memorize concepts but can also analyze, evaluate, and create effectively, ensuring long-term retention (Ndiung et al., 2020).

Therefore, to create meaningful learning and address the issue of students merely memorizing the periodic table without understanding, a modern and appropriate medium is essential. This can be achieved by creating the "Psyofments" game (Periodic System of Elements), which is specifically oriented towards developing higher-order thinking skills for the periodic table of elements. The Psyofments game is designed to challenge students to solve problems presented through questions effectively. The learning context within this game encourages students to pose questions and actively seek answers. Higher scores in the Psyofments game indicate greater proficiency in problem-solving.

In the development of this periodic table game, we utilized Smart Apps Creator (SAC) software. According to Suhartati (2021), the use of SAC in a flipped classroom learning model can significantly increase students' enthusiasm for learning and prevent boredom. Furthermore, SAC technology simplifies media creation and design without requiring programming knowledge, and its output can be converted into various formats, including Android, iOS, desktop, and web-based HTML, allowing both offline and online use (Khasanah et al., 2020). Thus, the application of SAC software in developing the Psyofments game for the periodic table of elements represents a novel approach compared to previous research.

Previous research by Mariscal et al. (2012) created a paper-based periodic table game that lacked durability, flexibility, and was easily damaged. The HTML5 version of the game developed by Traver et al. (2021) had usage limitations and lacked variation in question difficulty. To address these shortcomings, the Android-based Psyofments game has been developed to be flexible, easily accessible, equipped with clear rules, and filled with a variety of questions further developed using high-level thinking indicators, thereby enhancing students' capabilities.

This study addresses the problem that students currently tend to memorize the periodic table of elements without deep understanding, leading to quick forgetting and a lack of engagement with higher-order thinking skills (HOTS). There is a clear need for an innovative learning medium that can shift students from rote memorization to analytical and problem-solving approaches, thereby cultivating HOTS in the context of the periodic table. Based on this problem, the research aims to describe the appearance of the Psyofments game as a tool to facilitate the development of HOTS and improve conceptual understanding of the periodic table of elements, analyze the validation test results of the Psyofments game to ensure its pedagogical soundness and effectiveness in addressing the identified learning challenges, and analyze the feasibility test results of the Psyofments game to confirm its practicality and utility as an Android-based learning medium for fostering higher-order thinking skills in periodic table material.

Methods

This study employed a Design-Based Research (DBR) method, integrating both qualitative and quantitative approaches to develop and assess the Psyofments game, which aims to foster high-level thinking skills in the context of the periodic system of elements. DBR was chosen because it focuses on creating and evaluating the effectiveness of a product within a learning environment. The research adopted the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) as its framework. However, this study focused only on the analysis, design, and development stages, as the educational game had not yet been fully implemented in teaching and learning activities.

In the analysis stage, relevant journals were reviewed, students' media needs were identified, and teaching materials for the periodic system of elements (referring to Basic Competencies 3.3 and 3.4) were analyzed. This stage also involved creating concept maps, defining indicators for high-level thinking questions, constructing question grids, and conducting question trials with students who had already studied the material. The design stage focused on structuring the game framework by gathering references for content, questions, images, audio, and text, which informed the creation of flowcharts and storyboards for the Psyofments game to illustrate the media flow. The development stage involved creating the initial Psyofments game product based on the analysis, flowchart, and storyboard. This prototype was then validated by three experts using a validation questionnaire. Following validation and refinement, the improved product underwent a feasibility test with 11 high school students who had completed the periodic system of elements material.

Data collected were both qualitative and quantitative. Qualitative data, derived from the flowchart and storyboard, were analyzed descriptively to detail each stage of media creation. Quantitative data came from the scoring of the validation

and feasibility test questionnaires. These scores served as references for determining the game's validity and feasibility. Data sources included three validators for the validation test and 11 high school students for the feasibility test. Qualitative data analysis described the game's appearance based on the flowchart and storyboard. Quantitative analysis of the validation questionnaire compared the calculated feasibility value (r) against a critical r-value of 0.3 (at a 5% error level), using a specific formula for calculation:

R = Feasibility value

x = Respondent's answer weight n = Number of respondents

N = Number of items

Media is said to be valid if the feasibility value (r)

> rcritical (0.3). According to the interpretation of the feasibility value rcountas below:

Table 1. Interpretation of Feasibility (r) (Sugiyono, 2015)

No	Eligibility value (r)	Interpretation
1	$0.80 \geq r \leq 1.00$	Very High
2	$0.60 \geq r \leq 0.80$	High
3	$0.40 \geq r \leq 0.60$	Medium
4	$0.20 \geq r \leq 0.40$	Low
5	$0.00 \geq r \leq 0.20$	Very low

The analysis of the feasibility test questionnaire was obtained by calculating the percentage of each aspect using the following formula (Sugiyono, 2015):

Response percentage (%) = $\frac{\sum n}{N}$ x 100% Information:

∑n = Frequency of answers

N = Total number of respondents

To find out the eligibility ofgamesthat has been created, the calculation result data is compared with the following eligibility criteria:

Table 2 Class Test Criteria (Sugiyono, 2015)

Percentage (%)	Qualification
90 – 100	Very Worth It
80 – 89	Worthy
70 – 79	Quite Decent
60 – 69	Less Worthy
< 60	Totally Unworthy

Results and Discussions

The The development of the "Psyofments" game, focusing on the periodic system of elements, was guided by the Design-Based Research (DBR) method, specifically utilizing the ADDIE development model (Yuliandini et al., 2019). In this study, the ADDIE model was applied only up to its development stage.

This research addresses the question: How are the display, validation test results, and feasibility test results of the "Psyofments" game, which is oriented toward high-level thinking skills in the periodic system of elements, assessed? The following findings answer this question. Display Description of the "Psyofments" Game Oriented Toward High-Level Thinking Skills on the Periodic System of Elements Material.

The "Psyofments" game was developed based on the DBR method, incorporating the five stages of the ADDIE model (Harjanta et al., 2018). However, this study was limited to the development stage. Below, we'll outline the outcomes of each step taken during the development of the "Psyofments" game, designed to enhance high-level thinking skills related to the periodic system of elements.

The analysis stage involved reviewing academic journals to identify relevant prior research and assess novelty. A needs analysis was also conducted to determine the most suitable learning media for students, leading to the selection of a game-based medium as an innovative and engaging teaching alternative.

Subsequently, teaching materials were analyzed by gathering content on the periodic system of elements from diverse sources, including textbooks, Grade X chemistry textbooks, and journals. A concept analysis was then performed to simplify student understanding by identifying the nature and characteristics of each concept. The results of this analysis are shown in Figure 1, and were then mapped into a concept map, illustrating the connections between interrelated subconcepts, as presented in Figure 2.

Achievement indicators were determined through syllabus analysis to identify appropriate basic competencies. These competencies refer to Basic Competencies (Kompetensi Dasar/KD) 3.3 and 3.4 of the Grade X curriculum on the periodic system of elements. These competencies were further broken down into several Achievement Indicators (Indikator Pencapaian Kompetensi/IPK), as illustrated in Figure 3. Furthermore, question indicators were developed based on high-level thinking skills, specifically critical and creative thinking, to foster problem-solving abilities in students (Saraswati et al., 2020). The concept of Higher Order Thinking Skills (HOTS), derived from Bloom's taxonomy, encompasses the cognitive levels of analyzing (C4), evaluating (C5), and creating (C6) (National et al., 2019). These indicators served as both references and constraints for the questions integrated into the "Psyofments" game.

The questions were designed to cover cognitive levels C3, C4, and C5, each representing varying degrees of difficulty. Although the C3 level (applying) isn't categorized as high-level thinking, it was included as a stimulus to prepare students for more complex questions. Conversely, the cognitive level of creating (C6) was deemed less feasible for a game format, as it necessitates students to organize or combine various skills into a new structure or pattern. This type of ability is not easily assessed through objective tests but rather through descriptive tasks or performance-based assessments that require product creation (Sudjiono, 2011). An example of a question grid for the "Psyofments" game can be seen in Figure 4.

Concept label	Definition of Concepts	Atribute		HIERARKI KONSEP			Typeof concept	Example	No-example
		Critis	Variable	Superordinat	Ordinat	Subordinat			
1. Periodic Table of Elements	The properties of elements related to their position in the periodic table (Chang, Raymond. 2008).	• Element properties • Element position • Periodic table	• Type of element	-	-	• Atomic properties • Physical properties • Chemical properties	Abstract concept	Atom numbre	Appearance, color, smell, boiling point.
2. Element	An element is a single substance that cannot be broken down into other substances through ordinary chemical reactions (Sugiyarto, Teguh. 2008).	• Element • Single substance • Other substances • Chemical reaction	• Type of element	-	-	-	Concept stating symbols	Na, K, Rb, Ca	NaCl, CuSO4, NaOH
3. Period	A period refers to the number of electron shells or the principal quantum number in an electron configuration. It represents the horizontal arrangement of elements in the periodic table (Tro, Nivaldo. 2011).	• Period • Number of shells • Principal quantum number • Electron configuration • Element • Periodic table of elements	• Type of element	Modern periodic table	• Group	-	Abstract concept	Period 1, 2, 3, 4, 5, 6, 7	Group of alkali Alkali metals Alkaline earth metals Halogens Noble gases

Figure 1. Concepts analysis

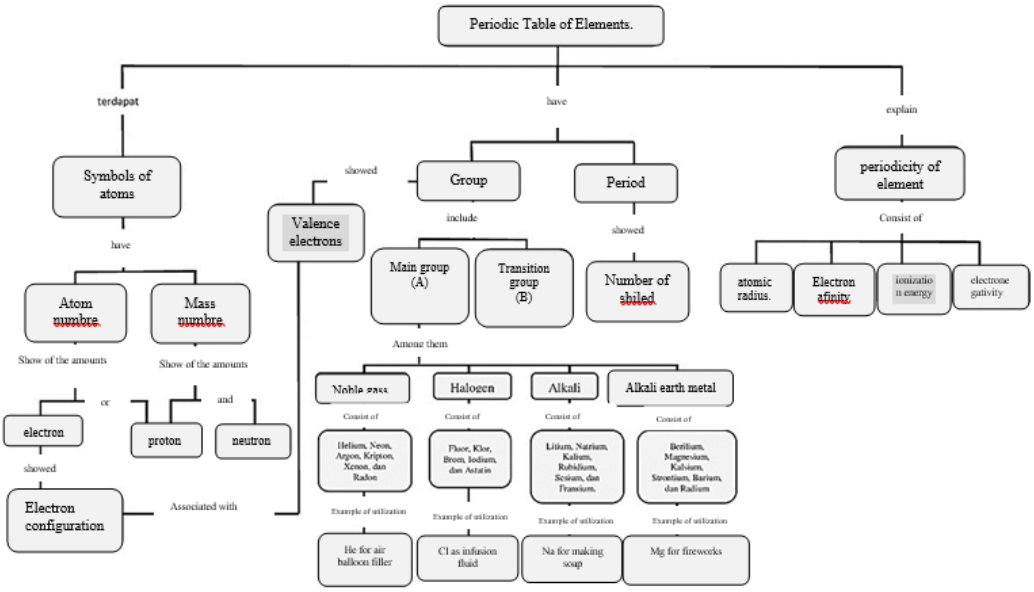


Figure 2. Map concept

Indicators of Learning Achievement

3.3.1. Determine and analyze the electron configuration of an ion or element.
3.3.2. Analyze the characteristics of an element based on its electron configuration.
3.3.3. Determine and analyze the periodic properties of an element.
3.3.4. Evaluate the utilization of main group elements in daily life based on their characteristics.
3.3.5. Determine the number of paired and unpaired electrons.
3.3.6. Determine the group and period of an element.
3.3.7. Determine the four quantum numbers of an element.
3.4.1. Determine the graph showing the relationship between atomic

Figure 3. Indicaror of Learning Achiefment / Indikator Pencapaian Kompetensi (IPK)

Basic Competencies	Question Indicators	Cognitive Levels	Type of questio	Question numbre	Question Description	Answer Key	Scoring Rubric
Level 1 (*drag and drop*)							
3.3 Explaining electron configuration and the pattern of outermost electron configuration for each group in the periodic table.	Students are able to accurately determine the electron configuration of cations based on an element's atomic number.	C3	Multiple choice	1	Given the atomic number of Mn = 25, the electron configuration of the Mn^{2+} ion is... Answer: **$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5$**	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5$	0: if not answered / incorrect answer 10: if answered correctly
	Students are able to accurately determine the electron configuration of anions based on an element's atomic number	C3	Multiple choice	2	Given the atomic number of S = 16, the electron configuration of the sulfide ion, S^{2-}, is... Answer: **$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$**	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$	0: if not answered / incorrect answer 10: if answered correctly
	Here's the translation: Students are able to accurately determine the electron configuration of anions based on the number of electrons and protons.	C3	Multiple choice	3	Given the number of electrons and protons for element F = 9, the electron configuration of the F^- ion is... Answer: **$1s^2\ 2s^2\ 2p^6$**	$1s^2\ 2s^2\ 2p^6$	0: if not answered / incorrect answer 10: if answered correctly
	Peserta didik dapat menentukan konfigurasi elektron kation	C3	Pilihan Ganda	4	Suatu unsur X memiliki elektron 26 dan proton 26. Konfigurasi elektron ion X^{3+} adalah... Jawaban: **$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5$**	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5$	0: jika tidak menjawab/jawaban salah

Figure 4. Grid of Questions in the Game

After developing the question grid, a trial of the questions was conducted with students who had previously studied the periodic system of elements. This was done to evaluate the quality of the questions. One of the outcomes of this trial was the analysis of question validity, the results of which are presented in Figure 5.

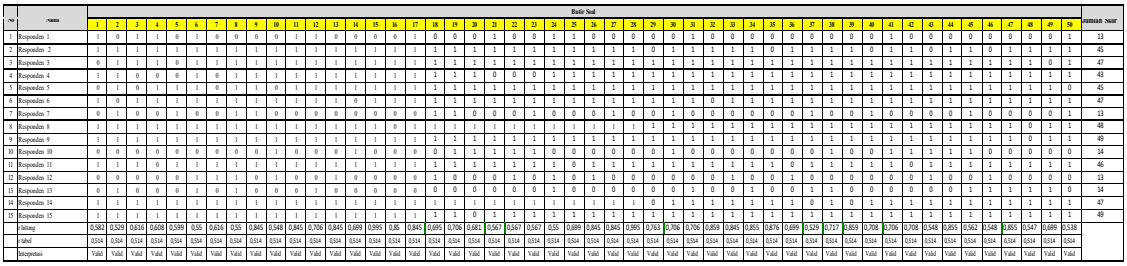


Figure 5. Validity Test Results

The design or planning stage was carried out by developing a framework for the game structure through the collection of references related to the material, questions, images, audio, and other components that support the creation of the flowchart and storyboard, in accordance with the results of the analysis stage.

The purpose of creating the flowchart is to facilitate understanding of the media flow being developed and to show the relationships between one display and another in a visual chart format. The flowchart display of the *Psyofments* game is shown in Figure 6.

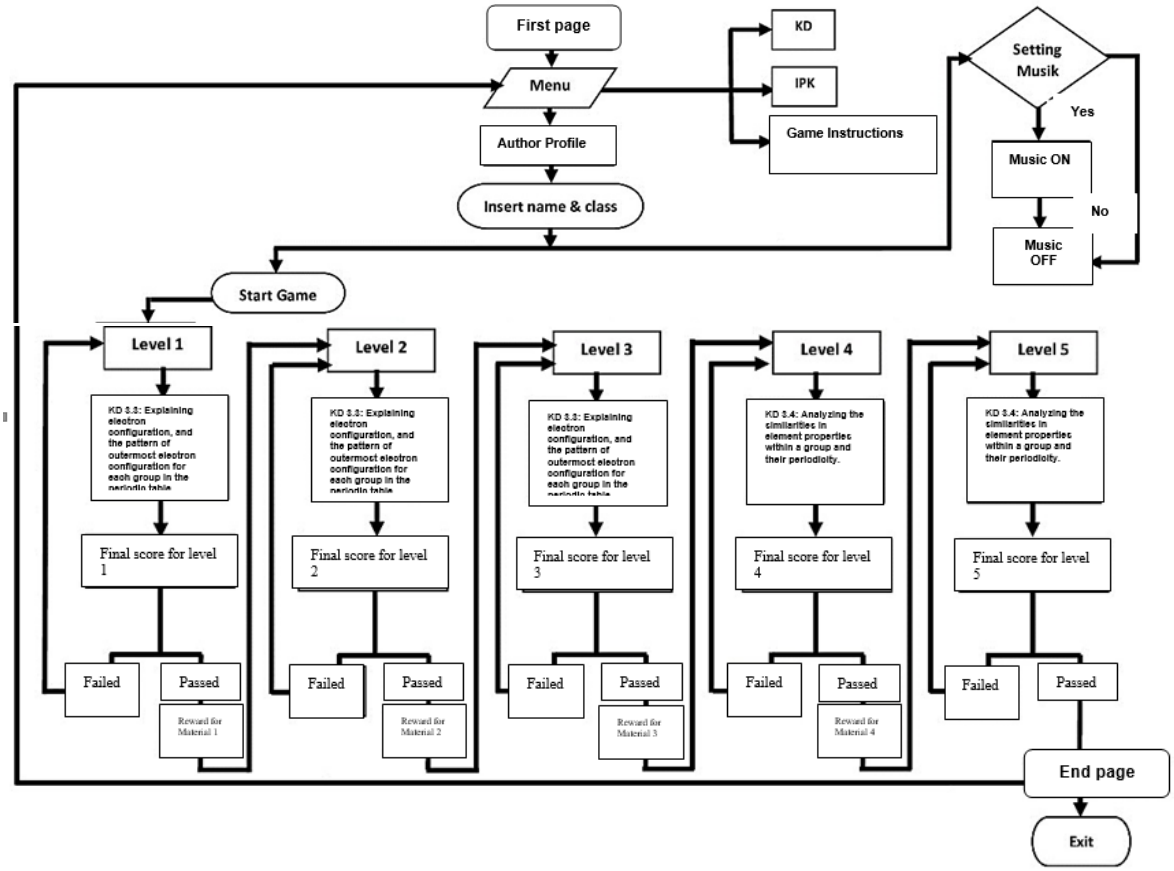


Figure 6. Flowchart display of the *Psyofments*

After being developed into a storyboard, it serves to facilitate the visualization of story ideas or media plots, helping others to understand and imagine the storyline through the images presented, which are accompanied by descriptions. The appearance of the storyboard is shown in Figure 7.

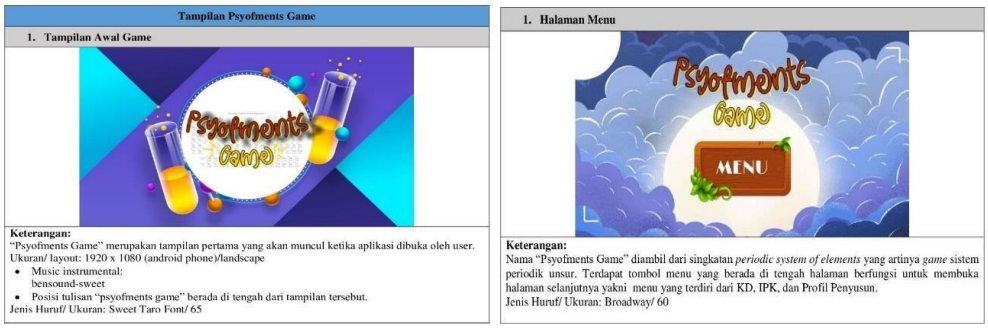


Figure 7. Storyboard of the *Psyofments*

At the development stage, the Psyofments game—designed to promote high-level thinking skills on the periodic system of elements—was produced based on the results of the analysis, flowchart, and storyboard stages. The game was developed using Smart Apps Creator (SAC) software version 3.0. The display of the Psyofments game development results is described as follows:

Initial View

The initial view is the loading screen that appears when the Psyofments game application is first launched. This display is presented in Figure 8.

Figure 8. Initial view of the *Psyofments*

Main Menu Display

The main menu display, shown in Figure 9, contains a menu button that can be clicked to navigate to the menu selection page. When this page appears, background music in the application plays automatically.

Figure 9. Main menu view of the *Psyofments*

Menu Options Display

The menu selection page, as shown in Figure 10, contains several interactive buttons.

Figure 10. Menu selection display of the *Psyofments*

These include the KD button (Basic Competency), IPK button (Learning Indicators), Game Instructions button, Background Music Settings button, Home/Main Menu button, and a Next button.

Compiler Profile View

The compiler profile display, as shown in Figure 11, is a page that contains information about the developers of the Psyofments game, including the students, the first supervisor, and the second supervisor. This display is intended to provide users with information regarding the identities of the game's developers.

Figure 11. Compiler profile view of the *Psyofments*

Self-Identity Display

The self-identity display, as shown in Figure 12, contains identity fields that can be filled in by students before starting the game. After the student fills in the name and class fields, they can click the Next button located at the bottom right to proceed to the game start page.

Figure 12. Self-Identity Display view of the *Psyofments*

Appearance Start Game

Appearancestart game can be seen in Figure 13.

Figure 13. Start Game Display

Initial View of All Game

After clicking the button start game then the initial display of all game levels will appear as in Figure 12.

Figure 14. Initial View for Level 1

After clicking the 'Start Game' button, the initial display showing all game levels will appear, as shown in Figure 14. (Figure 14: Initial View for Level 1) This image presents a selection of five game levels, which must be completed sequentially. To begin, students are required to click on Level 1 to start the game at that level. Students must successfully complete all questions at Level 1 and achieve a minimum final score of 70 to proceed to the next level (Level 2). This requirement applies to all levels

Game View Level 1

The Level 1 game, displayed as shown in Figure 15, is designed as a drag-and-drop game. This level features 10 questions covering cognitive levels C3, C4, and C5. The questions in Level 1 relate to KD 3.3, with the expected learning outcome for students being the ability to determine and analyze the electron configuration of an ion or element, and to analyze the characteristics of an element based on its electron configuration.

Figure 15. Example of Level 1 Display

Then, in the display of this level 1 game, there is a score number on the top right. In addition, there is a time limit for completing each page on the top left. Each question is given 3 minutes or the equivalent of 180 seconds. If the time runs out, it will automatically move to the next page. This applies to all levels of the game.

Level 1 Final Score Display

The final score for Level 1 is displayed at the top right of the screen. Players must enter this score into the designated column to advance to the next level. To proceed to Level 2, players need to achieve a final score of 70 or higher. If they do, a "Next" button will appear, allowing them to claim reward material and continue the game. Conversely, if a player's final score is below 70, a "Repeat" button will appear, requiring them to replay Level 1. This system applies to all levels of the game. An example of the final score display is shown in Figure 16.

Figure 16. Example of Final Score Display Level 1

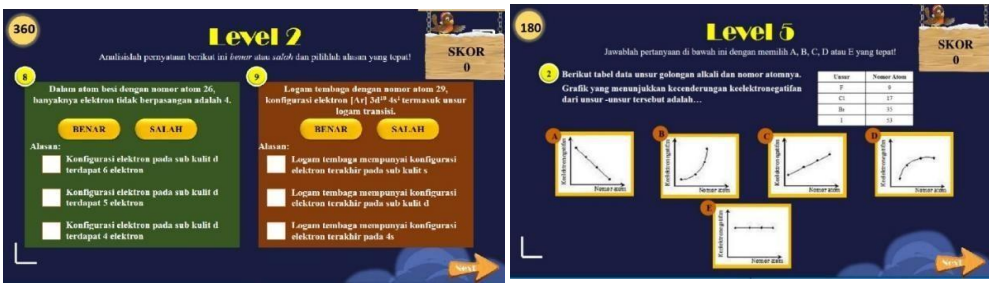
Display of Material Rewards

This display contains periodic table of elements material that can help players in working on questions in the next ***game*** rewards. The materials are at the end of each game level. Here is an example of the displaymaterial *reward 1* as in Figure 17.

Figure 17. Example of Material Reward 1

Game View Level 2

The display of level 2 game in Figure 18 is packaged in the form of a true or false game. multiple choice.



Gambar 18. Display game level 2

Game View Level 3

The display of level 3 games as in Figure 19 is packaged in the form of a game drag and drop Andmultiple choice.

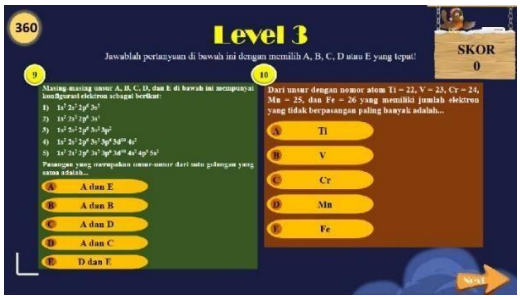


Figure 19. Example of Level 3 Game Display

Level 4 Game View

The display of the level 4 game as in Figure 20 is packaged in the form of a true or false game. multiple choice.

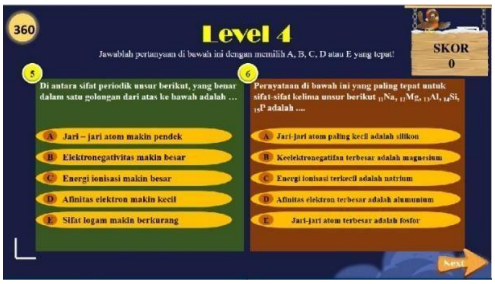


Figure 20. Example of Level 4 Game Display

Final View

The display in Figure 21 is the final display in the application psyofments game.

Figure 21. End Game View

Validation Test Results Psyofments Game Oriented towards High-Level Thinking Skills on the Periodic Table of Elements Material

The validation test aimed to determine whether the created media was valid (Syamsuryadin et al., 2017). This test was conducted from May 29 to June 9, 2023. It involved distributing validation questionnaire files to three validators, covering the assessment of programming aspects, content aspects of the created game, and the display aspect. The purpose of distributing these questionnaires was to obtain suggestions and assessments regarding the game. Based on calculations, the average r-value obtained from each aspect of the validation test for the game can be seen in Table 3.

Table 3. Validation Test Results Psyofments Game

Aspects that Observed	rcount	rcritical	Results
Programming aspect	0.87	0.3	Valid
Content aspect	0.84	0.3	Valid
Display aspect	0.88	0.3	Valid
Rata-rata	**0.863**	**0.3**	**Valid**

Based on Table 3, the average r-value obtained from the three assessed aspects is 0.863. According to Sugiyono (2015), media can be declared valid if the calculated r-value is greater than the critical r-value of 0.3. Based on this, the validation test results generally show that the game can be declared valid, with some suggestions for improvement from the validators. After making improvements according to these suggestions, the game oriented towards high-level thinking skills on the periodic table of elements material yielded even better results.

For the programming aspect, statement items such as ease of media use, ease of selecting program menus, and functionality of navigation buttons all received the same value of 0.87. This emphasizes that learning media must be easily accessible to students, stimulate their interest in learning, and facilitate concept comprehension (Bayir, 2014). In the content aspect, the most prominent statement items were the clarity of language and images used, the suitability of questions to the periodic system of elements material, the alignment of questions with basic competencies and question indicators, and the diversity of question difficulty levels. This highlights the importance of considering question and material quality, as well as readability, when selecting learning media (Sudjiono, 2011). Furthermore, in the appearance aspect, the most prominent statement item was the appropriateness of background music or sound in the "Psyofments" game. This aligns with Lubis (2018), who stated that musical accompaniment is necessary in educational games to stimulate players' cognitive engagement and acceptance of the game.

Feasibility Test ResultsPsyofments Game Oriented towards High-Level Thinking Skills on the Periodic Table of Elements Material

The feasibility test aims to determine whether the game is viable. This test is conducted by distributing a feasibility questionnaire to high school/vocational high school students who have studied the periodic system of elements. The questionnaire's assessment aspects include the content of the created game, programming, and display. For this study, the feasibility test was conducted offline on June 11, 2023, at the RT 05 Hall, Laksanamekar Asri Housing Complex, Block F 35 Padalarang, with 11 high school/MA (Madrasah Aliyah) eleventh-grade students. The feasibility test results are presented in Table 4.

Table 4. Results of the Psyofments Game Feasibility Test

Aspects that Observed	Percentage	Information
Programming aspect	93.93%	Very Feasible
Content aspect	86.35%	Feasible
Display aspect	89.69%	Very Feasible
Avarage	**90%**	**Very Feasible**

Based on Table 4, the feasibility test results, obtained from the assessment of 11 SMA/MA students across the three assessed aspects, show an average percentage of 90%. This indicates that the "Psyofments" game is categorized as very suitable for use as an engaging learning medium that can increase student interest. This aligns with Sugiyono's (2015) eligibility criteria, where a percentage of 90-100% falls under the "very eligible" qualification and 80-89% falls under the "eligible" qualification.

Regarding the feasibility test results for the content aspect, the most prominent statement item was the accuracy of term usage according to the scientific field, with a percentage of 93.93%. This supports Hidayatullah's (2017) research, which found that discrepancies in terminology can lead to misinterpretations, misunderstandings, and even a failure to convey intended information.

In the programming aspect, the highest percentage was for the statement items concerning the ease of choosing the program menu and the "Psyofments" game's ability to motivate and attract user interest. This aligns with Suryana et al.'s (2018) research, which suggests that games can facilitate material delivery and present content more clearly and attractively. Furthermore, in terms of appearance, the highest percentage was for the statement item regarding the attractive design used in the application. This is consistent with Rahmatullah et al.'s (2020) research, which indicates that an appropriate learning media design significantly influences learning success, as students feel comfortable and can easily understand the material.

Students also provided comments and input, stating that the "Psyofments" game, aimed at high-level thinking skills for the periodic system of elements, is fun, can train brain capacity, makes learning less boring, and enhances chemical knowledge and skills. Input specifically highlighted occasional bugs in the drag-and-drop game feature. However, overall, students provided a positive response.

Therefore, based on the results of both the validation test and the overall feasibility test, the "Psyofments" game, oriented towards high-level thinking skills on the periodic system of elements, can be considered valid for use in the learning process and worthy of being used as an aid in teaching and learning activities. Nonetheless, some improvements are still needed in programming aspects, such as the accuracy of button reactions in the drag-and-drop game, to further enhance the media

Conclusion

The Based on the research results and discussion, the following conclusions can be drawn:

The "PsyOfMents" game, oriented towards high-level thinking skills on the periodic system of elements, displays several features: menu options (including KD, GPA, and game instructions), self-identity columns, a "start game" display, and various game levels. These levels consist of: Level One (drag-and-drop), Level Two (true/false and multiple choice), Level Three (drag-and-drop and multiple choice), Level Four (true/false and multiple choice), and Level Five (multiple choice). Additionally, the game includes displays for material rewards one to four and a final score display.

Validation test results for the "PsyOfMents" game, oriented towards high-level thinking skills on the periodic system of elements, yielded an average r-count value of 0.863 across all aspects. Specifically, the programming aspect had an average r-count of 0.87, the content aspect had an average r-count of 0.84, and the display aspect had an average r-count of 0.88. This indicates that all aspects of the game are considered valid and can be used in learning, with several suggestions for improvement. These suggestions include: the key to advance to the next level, button layout (back), font size in images, color differences on the game level page, improvements to question indicators, and inconsistencies in word choice in questions.

The feasibility test results for the "PsyOfMents" game, oriented towards high-level thinking skills on the periodic system of elements, showed an average overall percentage of 90%. The programming aspect scored 86.35%, the content aspect 93.93%, and the display aspect 89.69%. This demonstrates that the game is highly suitable for use as a learning medium.

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