

## DEVELOPMENT OF MOLECOOL GAME IN INSTAGRAM FOR CHEMISTRY MOL CONCEPT FUN LEARNING

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### Abstract

This study aims to develop the Molecool game in the Instagram application for a fun learning of the chemistry mole concept. The objective of the study is to determine the validity and identify the usability of the Molecool game from the constructs of usefulness, satisfaction, and ease. The study design is a developmental study that adapts the instructional design of the ADDIE model. The study population is among chemistry trainee teachers from Universiti Pendidikan Sultan Idris. A total of 107 respondents were selected through a simple sampling technique. A descriptive statistical analysis was employed in this study. The research instrument consists of a content validity form, questionnaire validity as well as a Molecool game usability questionnaire. The findings of the study were analyzed using SPSS software version 27.0.0.0 by observing at the values of frequency, percentage, mean and standard deviation. The results of the study show that the Molecool game has a good level of content validity through the percentage of expert agreement that exceeds 70%. The research findings for the three constructs in the usability questionnaire obtained a good mean value of 3.74 (sd = 0.397) for usefulness, 3.74 (sd = 0.387) for satisfaction and ease of use was 3.74 (sd = 0.397). This shows that the Molecool game has a good level of usability. The implication is that the Molecool game has the potential to be used as a teaching aid as well as a reinforcement activity for students in learning the standard content of the mole concept.

**Keywords:** Interactive Learning, Instagram, Mol concept, ADDIE Model, Game based learning

*Article History:- Received: 24 July 2023; Revised: 09 October 2023; Accepted: 19 October 2023; Published: 31 October 2023  
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### Introduction

The existence of social media has become a platform or medium for finding an easy-to-use and user-friendly source of information regardless of age. According to a survey by the Malaysian Communications and Multimedia Commission (MCMC) in 2020, 88.7% of Malaysians are internet users, and a significant 93.3% of them utilize social media services. Social media encompasses various network categories and applications, including Facebook, Instagram, Twitter, and LinkedIn, which form the online network and ecosystem categories, as noted by Salleh, Basir, Salman & Omar (2018). Among these, Instagram stands out as one of the most widely used social media platforms, particularly popular among teenagers. In May 2017, Instagram introduced facial filters, a feature allowing users to apply specific visual effects to their photos, which expire within 24 hours (Anggraini, Supriatna & Soleh, 2021). This unique feature paved the way for a variety of filters and effects, transforming Instagram into a learning medium by integrating quizzes and digital games that are easy to navigate. Game-based learning, with its capacity to stimulate students' interest and concentration, has the potential to alleviate boredom issues in the classroom, and combining social media platforms with learning sessions provides a contemporary alternative to traditional teaching methods (Abdullah, 2020). Notably, previous studies have demonstrated the positive impact of social media use on student engagement and academic performance, further highlighting the potential of social media in enhancing student learning outcomes (Mohamad et al., 2018; Alshuaibi et al., 2018).

To address issues related to motivation and uninspiring teaching methods that hinder students' comprehension of chemistry subjects, teachers need to diversify their instructional approaches to keep students engaged and motivated during the learning process. According to Kamaruddin and Mohamad (2011), every individual has a unique learning style developed from childhood and subsequently employed in their educational pursuits. One promising solution to this challenge is the application of a game-based learning approach. This approach offers an effective way to help students navigate complex topics. Game-based learning not only enhances problem-solving skills but also fosters the development of 21st-century skills and high-level thinking capabilities. In this context, a game named "Molecool" has been developed on the social media platform Instagram as a part of this study. By leveraging Instagram as a learning tool, students can experience a more engaging and interactive learning process, ultimately improving their understanding of challenging subjects like chemistry. Table 1 shows the objectives and research questions of this study.

Table 1. Objectives and research questions

Research Objective	Research Question
Developing a Molecool game on Instagram for the mol concept content standard for Form 4 Chemistry subjects.	Do Molecool games on Instagram for the mol concept content standards have a good validity?
Identify the usability of Molecool games on Instagram for the mol concept content standard for Form 4 Chemistry subjects.	What is the value of the trainee teacher's perception of Molecool games on Instagram to reach a satisfactory level of use?

## Methods

### Research Design

Development design studies by applying the ADDIE model are used as a reference in the development of Molecool games. This model is used to ensure that the game developed is operating and effective. ADDIE models are selected because this model is easy to practice, especially in the development of teaching materials (Cheung, 2016). The model was also used by Muslims, Nordin, Mansor and Yunus (2017) in the development of mobile teaching applications and also used by widyastuti and Susiana (2019) in the development of learning materials. The ADDIE model consists of five phases namely analysis, design, development, implementation, and evaluation. In analysis phase, the researcher assesses the needs and goals of the study. A need analysis has been conducted to identifies the problem related to mol concept in school and learning objectives for teaching the mol concept in Form 4 Chemistry. This stage involves a detailed analysis of the content to be covered and the learning environment on Instagram. The design stage focuses on planning the overall structure of the Molecool game. A detailed outline of the game's content, including the specific challenges and activities that will teach the mol concept effectively was created. The user interface was designed and experience for the Instagram game, ensuring it is user-friendly and engaging for students. Storyboards was created to visualize the game's flow. In the development stage, the instructional content is translated into the actual Instagram game. This includes creating the game elements, such as questions, quizzes, interactive components, and any required multimedia assets. The Molecool game developed according to the design specifications, ensuring it aligns with the learning objectives and is suitable for the Instagram platform. Once the Molecool game is developed, implementation stage was initiate where the game is launched on Instagram and made accessible to the target audience. The final stage (evaluation) focuses on assessing the usability of the Molecool game in teaching the mol concept. Data is collected to helps determine whether the game met its learning objectives.

### Population and Research Sample

This study was carried out amidst the challenges posed by the pandemic, which made it difficult for researchers to collect data in schools. To address this constraint a population of 107 chemistry trainee teachers from Universiti Pendidikan Sultan Idris (UPSI) were selected as respondents, as they have already received training to become educators and possess a deep understanding of the education landscape in Malaysia. The number of respondents selected was 80 students based on the sample size

determination of Krejcie and Morgan (1970). The sampling technique used is a simple sampling technique.

### Research Instruments

There are 2 instruments used in this study. The first instrument is the game content validity evaluation form and the second instrument is a Molecool game usability questionnaire. Molecool game validity evaluation form will be evaluated by two experts in Chemistry Education from UPSI. Meanwhile, the game usability questionnaire was adapted and modified from the USE usability questionnaire (Lund, 2001). USE approach is a questionnaire used to measure usability dimensions such as usefulness, easy to use and satisfaction. This approach was chosen because of its validity and reliability in the assessment of usability dimensions based on respondents' feedback and the items stated are simple. The questionnaire form is divided into two sections, Part A is the demographic information of the respondents and Part B is the usability of the molecool game. Three usability constructs are measured in this study: useful, easy to use and satisfaction. Table 2 shows a summary of the relationship between research questions, instruments and data analysis methods used in this study. Content validity of the game was analysed by measured the percentage of expert consent and the usability questionnaire of the game was analysed through the value of frequency, percentage, mean and standard deviation.

Table 2. Procedure for data analysis

Research question	Instrument	Data analysis
Do Molecool games on Instagram for the mol concept content standards have a good validity?	Expert Assessment Form (Content Validity)	Percentage of expert consent
What is the value of the UPSI chemistry trainee teacher's perception of Molecool games on Instagram to reach a satisfactory level of use?	Molecool game usability questionnaire	Descriptive statistics (frequency, percentage, mean and standard deviation)

## Result and Discussion

### Development of Molecool Game

The development of Molecool games begins with design draft sketches, media types and questions that fit the mol concepts in the Curriculum Standard Document and Assessment (DSKP) Form 4 Chemistry. Based on the Content Standards in DSKP, the lesson standards 3.2.2; connect Avogadro constant, number of particles and the number of moles and lesson standards 3.2.4; Connect with molar mass, mass and number of moles were selected to apply in this game. This game was prepared in English version which will not only limited to Malaysia student, but also provide opportunities for students around the world.

The Molecool game development process on Instagram is divided into graphics, software applications and manual video setup. The production of Molecool graphics is produced by themed black teaching boards using Canva software. Figure 1 shows the draft interface for the start of a Molecool game, examples of questions and examples of answers to be included in the Instagram application. Upon completion of the graphic image design from Canva software, the images were then uploaded to the Meta Spark Studio v153 (Figure 2) software. The encoding process using patch editors at Meta Spark Studio is done to add more interactions, animations and logic in Molecool games. Then the game will be exported to the Meta Spark Hub to publish into the Instagram. A guide video that includes a detailed Molecool game description is also built as a reference to users (Figure 3). The QR code is also provided to make it easier for users to access the game anytime.

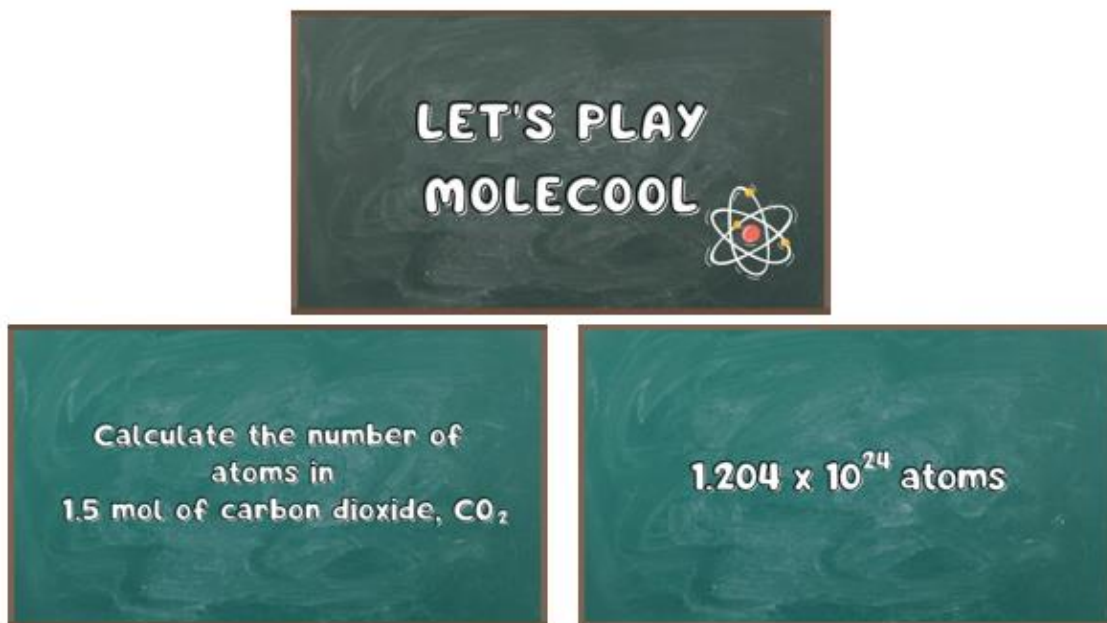


Figure 1. Molecool game interface

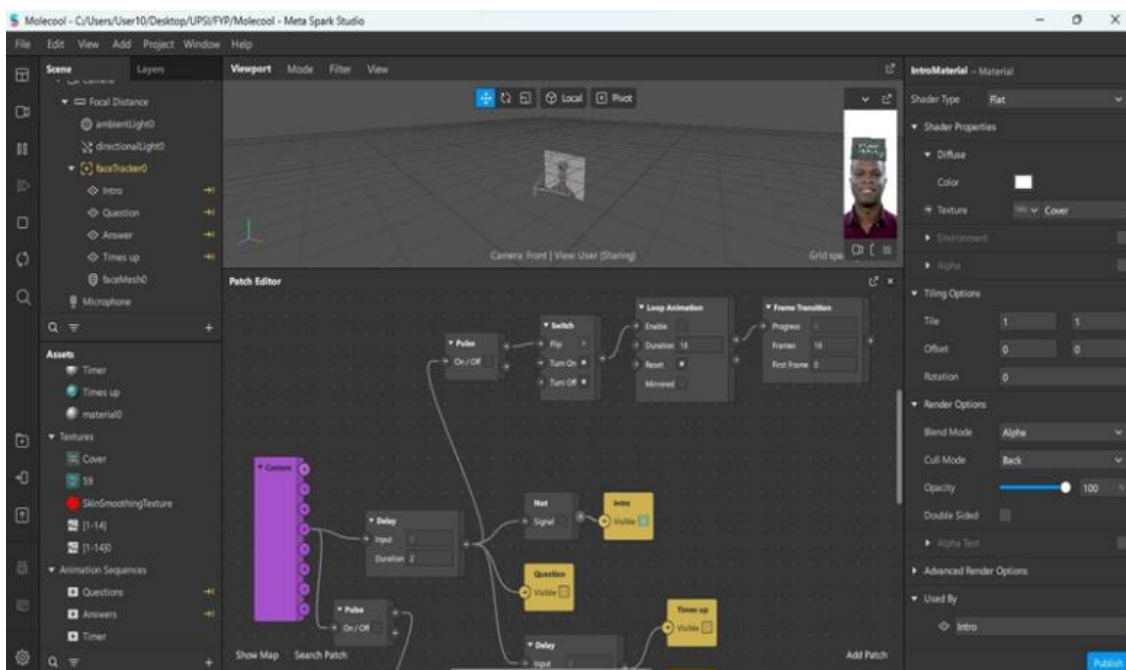


Figure 2. Development of Molecool games using Meta Spark Studio v153 software



Figure 3. (a) user manual for Molecool game and (b) screenshot of Molecool game.

### Content Validity of Molecool Game

Table 3 shows the average percentage of agreement on the validity of the game content and the validity of the molecool game usability questionnaire. The findings of the content validity form for molecool games found that the average percentage of two experts was 76.14 % while the validity of the content for the questionnaire instrument was 80.77 %. According to Harun and Ghani (2016), the validity value of more than 70% shows the validity of both instruments is very good. The validity of molecool game content contains 11 items that report a high percentage of consent from a high expert. 9 of the 11 items contained in the validity form obtained a scale of agreement and strongly agree from both experts. While there are two items that have a scale of disagree and strongly disagree because there are spelling errors in terms of chemical formula writing and the items specified in relation to students' interest and are not suitable for content validity items. Amendment was made for both items.

Table 3. Percent agreement of content validity and usability questionnaire

Percentage %	Validity of the game content	Validity of usability questionnaire
Expert 1	75.0	90.0
Expert 2	77.27	71.15
<b>Average %</b>	<b>76.14</b>	<b>80.77</b>

### Usability of Molecool Game

Overall, the mean score obtained for the three constructs was 3.74 as shown in Table 4. According to Nooraini dan Jamaludin (2017), the mean score value can be categorized into four stages, which strongly disagree with the mean score of 1.00 to 1.75, disagree with a mean score of 1.76 and 2.50, agree with a mean score of 2.51 and 3.25, and strongly agree with the mean score integration 3.26 to 4.00. Therefore, based on the mean value of the score obtained, it shows high levels of interpretation. The number of items contained in the Molecool game usability questionnaire is 13 items. This questionnaire using a 4-point Likert scale that started with strongly disagree (scale 1), disagree (scale 2), agree (scale 3) and strongly agree (scale 4).

Table 4. Overall mean in the usability of Molecool games

Construct	No. of Item	Overall Mean	Standard Deviation	Interpretation
Useful	4	3.74	0.3974	High
Satisfaction	4	3.74	0.3871	High
Easy to use	5	3.74	0.3966	High
<b>Overall</b>	13	3.74	0.3937	High

According to Choong (2013), the concept of usefulness is related to consumer enjoyment while using a product. Usability means how well a product can help consumers complete their tasks or work effectively in no time. The operational definition of the usability in this study refers to the level of assessment that users can use to achieve the established learning standards. Molecool games are being developed as a teaching aids for teachers. Therefore, aspects of usefulness are taken into account from the perception of the trainee teacher. Table 5 shows the frequency, percentage, mean distribution and standard deviation by respondents to the use of molecool games. This construct contains four items. The entire item recorded the majority of consent strongly agreed with the average mean score of 3.74 (high) and a standard deviation value of 0.397 (low). The majority of respondents agreed that molecool games could encourage active involvement of students in learning the content standards of mol concepts and to engage students when learning the lesson standards. This is because, game-based learning encourages students to participate during the learning and teaching process and make it more fun (Rula, Fatima & Mazin, 2016). Players will focus more on enhancing their understanding and achievement in the assessment, especially when there is a period of time during the game. Hushaini (2019) also supported that he found that the level of interest of the students was at a high level when learning to use game -based learning aids. This situation is in line with Chen, Shih, and Law (2020) view, the importance of competition -based learning allows for helping to enhance student motivation. In addition, learning of games and gamifications are used in the learning process in the 21st century.

Therefore, both have a similar approach to incorporating a culture of innovation in teaching that can make the teaching and learning process more interactive and enhance the quality of education of the country. Therefore, the first construct in the questionnaire has a high level of use in terms of molecool games and proves that molecool games on Instagram can attract students and train them in mol concept content standards.

The construct of satisfaction assessed in the Molecool game usability questionnaire refers to the satisfaction or feelings of the user when using the product. Table 6 shows the frequency, percentage, mean distribution and standard deviation by respondents for satisfaction constructs. Table 7 shows that 25.2% of respondents selected agree and 74.8% voted strongly agree to the first item S1. The mean score for item S1 was 3.75, indicating that respondents strongly agreed that they were happy to play molecool games. While the value of the standard deviation for the item is at a low level of 0.436.

Next, for the second item S2 and the third item S3, 24.3% agree and 75.7% strongly agree. The second item and the third item have a high mean score value of 3.76 with a lower standard deviation of 0.431. This is because respondents strongly agree that they will suggest Molecool games to other friends and not get bored when using molecool games. Whereas for item S4, 27.1% of respondents chose to agree and 72.9% strongly agree on the statement that the molecool game meets the requirements of educational -based games. The mean score for this item was 3.73 and the standard deviation value showed a value of 0.447. Finally, for the last item, S5, 26.2% selected Agree and 73.8% Voted strongly. The mean score for S5 was 3.74, indicating that respondents strongly agreed that molecool games could be used smoothly without interruption. The standard deviation value of this item is 0.442.

Table 5. Analysis of useful construct in Molecool game

Item	Statement	Score frequency (%)				Mean	Standard deviation
		1	2	3	4		
U1	Molecool games encourage student actively involve in learning a Lesson Standards 3.2.2: Avogadro constant, $N_A$ , number of particles and number of moles.			30 (28.0)	77 (72.0)	3.72	0.451
U2	Molecool games encourage student actively involve in learning a Lesson Standards 3.2.4: Relate a molar mass, mass and the number of moles.			27 (25.2)	80 (74.8)	3.75	0.432
U3	Molecool games able to attract students while studying a Lesson Standard 3.2.2: Avogadro constant, $N_A$ , number of particles and number of moles.			27 (25.2)	80 (74.8)	3.75	0.436
U4	Molecool games able to attract students while studying a Lesson Standards 3.2.4: Relate a molar mass, mass and the number of moles.			28 (26.2)	79 (73.8)	3.74	0.442
<b>Overall</b>						<b>3.74</b>	<b>0.397</b>

The average mean score is high when the mean score obtained is 3.74 and the standard deviation for easy -to -use constructs for molecool games is 0.387, indicating a small difference in the mean distribution. This illustrates that the molecool game is satisfactory based on the value of the respondents' high consent. This study found that the respondents (trainee teachers) were very pleased with the development. The players are satisfied and will suggest molecool games to other friends. This has shown that there is a very positive potential among teachers and students to use molecool games in learning the standards of mol concept content. In line with the study of Sreerambhatla (2010) that shows that the level of consumer satisfaction increases when the product produced is in line with the requirements of the target group. Similarly, the findings in the study of Nawi, Hamzah and Surina Akmal Sattai (2014), who say consumers are happy and happy when an application or product has good usability features.

On the other hand, a study by Pham and Ahammad (2017). states that the level of consumer satisfaction is greatly influenced by the features provided in the product itself. Respondents also gave the view that they did not get bored when using molecool games on Instagram. This has shown that the pleasure of play has caused students not to feel that they are learning because this situation can generate the skills and motivation of students, where it will attract students and make learning more meaningful and effective, in line with the Hartt, Hosseini, and Mostafapour (2020). Indirectly, there is a healthy competition among students to do something better in the learning session as students can know the level of achievement of their peers through game-based learning (Chen and Law , 2016).

Meanwhile, easy to use constructs in molecool games are the level of user evaluation of satisfaction in using the products developed as shown in Table 7. According to Table 7, all items show high mean value and low standard deviation. The overall mean of the easy to use construct was 3.74 which showed a high level of interpretation. While the standard deviation value of 0.397 showed a high consensus among the respondents. Overall, the findings show that respondents have a positive perception towards Molecool games in terms of easy to use. The first item in this construct, E1, 24.3% agreed and 73.8% strongly agreed. However, there were also 1.9% of respondents chose disagreed. Item E1 is an item with the lowest mean value of 3.72 with the highest standard of 0.491 compared to the other three items.

However, the findings of the study have shown that respondents strongly agree that molecool games can be used without referring to the game manual.

Table 6. Analysis of satisfaction in Molecool game

Item	Statement	Score frequency (%)				Mean	Standard deviation
		1	2	3	4		
S1	I feel happy to play Molecool games			27 (25.2)	80 (74.8)	3.75	0.436
S2	I would suggest Molecool game to my friend.			26 (24.3)	81 (75.5)	3.76	0.431
S3	I don't feel bored using the game Molecool.			26 (24.3)	81 (75.5)	3.76	0.431
S4	Molecool game is capable fulfilled my wishes in educational-based games.			29 (27.1)	78 (72.9)	3.73	0.447
S5	Molecool games can be used smoothly without any interruption			28 (26.2)	79 (73.8)	3.74	0.442
<b>Overall</b>						<b>3.74</b>	<b>0.387</b>

Next, items E2 and item E4 had the highest mean value of 3.75 and 3.75 with a lower standard deviation of 0.436. This indicates that respondents agree that molecool games are user-friendly and accessible anywhere in the event of internet access. The majority of respondents respond strongly to all the items in the construct easy to use. The mean value of the entire construct was 3.74 and with the average standard deviation was 0.397. These results indicate that respondents strongly agree that Molecool games are simple and easy for users. Molecool games are easy to use because they come with a simple and easy-to-understand manual. In addition, molecool games can be used at any time and anywhere by using devices such as smartphones with internet access.

Table 7. Analysis of easy to use construct in Molecool game

Item	Statement	Score frequency (%)				Mean	Standard deviation
		1	2	3	4		
E1	Molecool games can be played by users without relying on game manual.		2 (1.9)	26 (24.3)	79 (73.8)	3.72	0.491
E2	Molecool games is user friendly			27 (25.2)	80 (74.8)	3.75	0.436
E3	Molecool games can be access at any time.			28 (26.2)	79 (73.8)	3.74	0.442
E4	Molecool games are accessible anywhere if there are access to internet.			27 (25.2)	80 (74.8)	3.75	0.436
<b>Overall</b>						<b>3.74</b>	<b>0.397</b>

### Conclusion

This study is to develop and identify the usability of a Molecool game on Instagram as a fun teaching aid for students. The findings of the study show that the instruments developed have a good level of validity when the average percentage of expert agreements reaches more than 70 percent of 76.14% for content validity and 80.77% for questionnaire validity. Furthermore, the perception of molecool games



among trainee teachers is well received by the findings of the study. The mean value of the construct of use is 3.74 (sd = 0.397) For use, 3.74 (sd = 0.387) for satisfaction and easy to use was 3.74 (sd = 0.397). This indicates that the Molecool game has the potential to be used as a teaching aid as well as a reinforcement activity for students in learning the chemistry mole concept.

#### Acknowledgement/Funding

The authors would like to extend their sincere gratitude to Universiti Pendidikan Sultan Idris and everyone who provided valuable suggestions and encouragement for this research to be published. The authors received no financial support for the research

#### Author Contribution

MIS and FHMF designed the research question and applied the data generation instrument to undergraduate chemistry students. FHMF designed the electronic data collection instrument. MIS and FHMF carried out the data analysis and contributed to the writing of this article.

#### Conflict of Interest

Authors declare no conflict of interest

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