Chemture Gamification to Improve Learners' Cognitive Ability on Acid-Base Material

Hanum Pramudyah[1], Achmad Lutfi[2]✉
Universitas Negeri Surabaya, Indonesia[1,2]
e-mail : hanumpramudyah.20009@mhs.unesa.ac.id[1], achmadlutfi@unesa.ac.id[2]

Abstrak

Penelitian ini bertujuan untuk memperoleh media pembelajaran berupa permainan yang memenuhi kategori layak dalam meningkatkan kemampuan kognitif peserta didik pada materi asam basa. Jenis penelitian yang digunakan adalah *Research and Development (R&D)* dengan mengacu pada model pengembangan 4D Thiagarajan dan dibatasi sampai tahap *Development*. Instrumen yang digunakan meliputi lembar validasi, angket respon peserta didik, lembar observasi aktivitas peserta didik, dan lembar pretest-posttest. Hasil penelitian yang diperoleh menunjukkan bahwa validitas media mendapatkan skor ≥ 3 dengan kriteria valid, kepraktisan media diperoleh dari hasil angket respon dan lembar observasi aktivitas peserta didik untuk angket respon diperoleh presentase sebesar 92,50% dengan kriteria sangat praktis, sedangkan hasil observasi aktivitas peserta didik pertemuan 1 sebesar 91,1% sedangkan pertemuan 2 sebesar 94,4% dengan kriteria sangat praktis. Hasil keefektifan diperoleh dari hasil pretest-posttest yang dianalisis mengguakan uji klasikal dan uji-T, hasil analisis menggunakan uji klasikal memperoleh nilai sebesar 97,06% untuk tes hasil belajar kognitif peserta didik dengan kategori efektif. Hasil uji Wilcoxon menunjukkan bahwa hasil belajar memperoleh nilai signifikansi (2-tailed) sebesar 0,000 yang menunjukkan bahwa terdapat perbedaan signifikansi hasil belajar pretest dan posttest. Sehingga, dapat disimpulkan bahwa permainan *Chemture* telah memenuhi kategori layak sebagai media pembelajaran untuk meningkatkan kemampuan kognitif peserta didik.
Kata Kunci: Media Permainan, Kemampuan Kognitif, Asam Basa.

Abstract

This study aims to obtain learning media in the form of games that meet the appropriate category in improving the cognitive abilities of students on acid-base material. The type of research used is Research and Development (R&D) with reference to Thiagarajan's 4D development model and limited to the Development stage. The instruments used include validation sheets, student response questionnaires, student activity observation sheets, and pretest-posttest sheets. The results obtained showed that the validity of the media received a score ≥ 3 with valid criteria, the practicality of the media obtained from the results of the response questionnaire and the observation sheet of students' activities for the response questionnaire obtained a percentage of 92.50% with very practical criteria, while the results of the observation of students' activities at meeting 1 were 91.1% while meeting 2 was 94.4% with very practical criteria. The effectiveness results were obtained from the pretest-posttest results which were analyzed using the classical test and T-test, the analysis results using the classical test obtained a value of 97.06% for the test of students' cognitive learning outcomes with the effective category. The Wilcoxon test results showed that the learning outcomes obtained a significance value (2-tailed) of 0.000 which indicated that there was a significant difference in pretest and posttest learning outcomes. So, it can be concluded that the Chemture game has met the feasible category as a learning media to improve students' cognitive abilities.
Keywords: Game Media, Cognitive Ability, Acid-Base.

INTRODUCTION

Education is one of the benchmarks of a nation's progress because good quality education reflects the quality of a country's human resources (Halean et al., 2021). Education is an important aspect of developing a country. Education involves individual efforts to provide instructions and guidance to the next generation of the nation. The main goal of education is to produce qualified and competent graduates, able to meet the demands of society and contribute to the progress of the nation (Putri et al., 2023). Improving the quality of education is influenced by several main components in education including learning methods, learning media, students, and teachers. Teachers have an important role in learning as facilitators to improve student learning outcomes and motivate students. Interesting learning media is needed to help deliver the material. The function of learning media as a tool to facilitate the learning process so that learning can be achieved effectively and efficiently (Arifin Zainal & Setiyawan Adhi, 2012). Education in the 21st century is challenged to prepare the nation's generation to face technological and information advances (Rawung et al., 2021). One of the needs of 21st-century education is the integration of information and communication technology as a learning medium to develop student's learning skills. The use of technology and information must be good starting from planning, implementation, and assessment (Suyatno & Gio, 2017).

The use of Android-based learning media is one of the implementations of 21st-century learning styles. Android-based learning has the potential to help students' academic performance, especially learning outcomes in the cognitive domain. Android devices can function as interactive learning media for students. Learning will be more effective if the learning atmosphere is fun. Learning is considered fun when the learning environment can increase enthusiasm, exhilarate, and make students feel comfortable, so that students have full attention to the learning process, meaning that the time of attention (time on ask) is high (Utami et al., 2020).

Chemistry is a branch of science that studies the structure, properties, and changes in matter (Artini & Wijaya, 2020; Dewi et al., 2018). In fact, many students have difficulty understanding chemistry learning. The difficulties experienced by students are because chemistry is an abstract and complex concept that requires more understanding to learn it (Sariati et al., 2020). Chemistry is one of the fields of science that is not liked by students because it is considered a difficult and boring lesson by most students (Muderawan et al., 2019).This is evidenced in the results of pre-research at MA Negeri 7 Jombang as many as 66.7% of students stated that learning chemistry is difficult. One of the learning difficulties of students is that students do not know how to learn, have difficulty connecting between concepts, and require the ability to utilize logic, mathematics, and language skills (Zakiyah et al., 2018).

The age of high school students is classified as adolescence which tends to like to play. With this phenomenon, children spend their time playing and forget the time to learn. Games become their own magnet that makes players feel like continuing to play. This phenomenon can be utilized in creating innovative learning media so that it is used in education to support teaching and learning activities and motivate students to learn. By understanding the characteristics of learners, teachers can easily plan meaningful learning activities for learners. Some aspects needed to improve the quality of learning are increasing activity, creativity, learning motivation, and improving learning outcomes. Increased learner activity and creativity is based on learner activeness, increased learning motivation is based on learners feeling interested in learning materials. Improving student learning outcomes can be seen from the increase in grades obtained by students. This aspect can be achieved by using interesting learning methods for students, one of which uses game media.

The novelty of this research includes the use of game media using the theory of Self-Efficacy and Self-Determination. Self-efficacy has an influence on students to achieve achievements in their learning and self-development through student activities (Zahra & Hernawati, 2015). In learning chemistry, there is material

that is abstract, one of which is the acid-base theory related to Arrhenius, Bronsted-Lowry, and Lewis theories, including the transfer of protons between acids and bases based on the concept of acids and bases, the transfer of pairs of 2 free electrons (PEB) based on the Lewis concept. The occurrence of these three events cannot be observed using the five senses. In order for students to master chemical material well, students need to develop confidence in their abilities or self-efficacy. In developing students' self-efficacy efforts, it is necessary to design media that is made as interesting as possible and can improve students' cognitive abilities. The game media design can provide feedback to students in an effort to increase students' self-efficacy, especially in chemistry learning, for example, the game media contains a microscopic explanation of acid-base theory with an explanation of the material supported by visualization. In addition, in answering questions at each level there is feedback on the discussion of the questions. With the provision of feedback, it can provide reinforcement for the actions and understanding of students, so that students are confident in their cognitive actions and understanding. Meanwhile, self-determination theory can provide a theoretical framework for motivation that has strong implications for classroom practice and technology-based education reform policies. The theory supports learning using game media that makes students' learning motivation will increase. Self-determination includes three criteria to make learners motivated including competence, autonomy, and connectedness fulfilled (Ryan & Deci, 2020). For example, the competence of learners in solving problems in each level of the game that can earn points, the autonomy of learning content is made interesting by the use of animation in-game media that is made different and connectedness through collaboration and interaction of learners in completing the game at each level. So there is a strong correlation between self-determination and the achievement of academic goals in the form of developing cognitive abilities in thinking and expressing scientific ideas systematically and practically.

Game media is a learning media that has the potential to increase students' understanding and knowledge, making learning more interesting. The use of game media in learning can make students happy, prevent boredom, leave long-term memory impressions, and create a more pleasant atmosphere during the teaching and learning process without ignoring the learning objectives to be achieved (Qomariyah, 2016). Using games as learning media is one way to create a learning experience that is fun, not boring, and easily understood by students (Carrillo et al., 2019). In addition, the use of games can make students active in learning activities because not only by reading and listening to the teacher's explanation but by playing there is a learning process. Based on this description, it is necessary to develop the latest innovations regarding learning media that can improve student learning outcomes so that learning media in the form of game media is developed in chemistry learning, especially on acid-base material. Chemture (Chemistry Adventure) is a game that was developed to contain material and practice questions about acids and bases. Chemture (Chemistry Adventure) is a game developed with an adventure theme that can make students interested in learning.

METHOD

Research Design

This research design uses research and development (Research and Development) using the 4D Thiagarajan development model which has 4 stages including the Define, Design, Development, and Disseminate stages. This research is limited to the development stage, namely at the limited trial stage. The media was developed in the form of Chemture (Chemistry Adventure) game media with an adventure theme on acid-base material.

Location Time and Research Subjects

This research was conducted in March-April 2024, held at the Chemistry Department of Surabaya State University for the validation stage which was carried out by 3 validators, namely 2 chemistry education

lecturers and 1 chemistry teacher. The implementation of limited trials was carried out at MA Negeri 7 Jombang. The target of this study was the Chemture game media which was tested on 34 students in class XI MIPA.

Research Instruments

The instrument used in this study is a review sheet given to media experts to obtain suggestions for the media developed. The media validation sheet is used to determine the validity of the game media filled in by the validator. The response questionnaire sheet is used to find out the responses of students who are filled in by students after using the game media. Learner observation sheet to find out the activities of students filled in by observers including the activities of students during the learning process. Pretest and posttest sheets to determine the effectiveness in the form of cognitive abilities of students on acid-base chemistry material.

Data Analysis Technique

Data analysis techniques in the form of validity data analysis, practicality data analysis, and effectiveness data analysis. Validation data analysis if the score obtained ≥ 3 is declared valid. The validation data is in the form of ordinal data which has properties that are not equivalent and cannot be done in mathematical operations (Lutfi, 2021). Validation scoring is based on a Likert scale as shown in Table 1.

Table 1 Likert Scale Score

Score	Skala Penilaian
1	Totally Invalid
2	Invalid
3	Valid
4	Very Valid

Practicality data analysis is reviewed from the results of the response questionnaire and observation of student activities. The results of the students' response questionnaire are in the form of students' responses to the games used in the learning media. The questionnaire prepared refers to the Guttman scale as shown in Table 2

Table 2 Guttman Scale Score

Statement	Evaluation	
	Yes	No
Positive	1	0
Negative	0	1

The results of students' questionnaire responses to learning using game media can be calculated using the following formula.

$$\text{Percentage of positive answers } (\%) = \frac{Score\ Obtained}{Maximum\ Score} \text{ x } 100\%$$

$$\text{Percentage of negative answers } (\%) = \frac{Score\ Obtained}{Maximum\ Score} \text{ x } 100\%$$

The results of observation of students' activities in the form of activities carried out by students during the process of learning activities using Chemture media, which were observed by the observer. The results of students' observations of learning using game media can be inferred by the following formula.

$$\% \text{ Activity } = \frac{Amount\ of\ student\ activities\ that\ appear}{Maximum\ amount\ of\ activity} \text{ x } 100\%$$

The results of the response questionnaire and the results of the observation of students' activities obtained were interpreted based on the practicality criteria shown in Table 3.

Tabel 3 Kriteria Kepraktisan

Presentase	Skala Penilaian
0-20	Not good
21-40	Less Good
41-60	Good enough
61-80	Good
81-100	Very Good

Chemture game media developed on acid-base material is included in the practical category, if the percentage of the results of the response questionnaire and student activity obtained is $\geq 61\%$ in the very good category so that it can state the media is practical.

Analysis of effectiveness data is reviewed based on the results of pretest and posttest scores of students' cognitive abilities on acid-base material. The effectiveness data analysis was analyzed using the classical completeness test and the T test. For the classical completeness test, the learning outcomes of a class are said to be complete if the percentage of classical completeness obtained is 85% (Afrita, 2021). The classical completeness of a class on learning using game media can be calculated using the following formula.

$$\text{Classical Completeness} = \frac{Number\ of\ students\ completing\ KKM}{Number\ of\ all\ students} \times 100\%$$

After that, it is analyzed using the T-test, before analyzing using the T-test, a normality test is carried out as a prerequisite to determine whether the data is normally distributed or not. Normality test using Shapiro-Wilk assisted by SPSS Version 26. A data is called normally distributed with the provision of a significance value> 0.05 (Suardi, 2019). If the data from the normality test is not normally distributed, a nonparametric test is used in the form of the Wilcoxon test which is used to determine the average difference before and after using the learning media that has been developed.

RESULTS AND DISCUSSIONS

Define stage

The purpose of the defining stage is to determine the requirements as a reference in developing learning media according to the needs/problems at school, based on pre-research questionnaires, and interviews. There are five steps in the defining stage including beginning-end analysis, learner analysis, task analysis, concept/material analysis, and analysis of learning objectives. The initial analysis aims to find out problems related to chemistry learning. Chemistry learning still applies conventional learning models or lectures that are teacher-centered besides the lack of use of interactive media. Learning tends to use a blackboard which makes students less interested in learning. Analysis of students based on the results of questionnaires and interviews, students have difficulty understanding chemical concepts due to the lack of varied learning media, which causes students' interest in learning to decrease. Analysis of learner tasks that must be mastered by students to achieve the minimum competencies determined by the school. Task analysis is adjusted to learning objectives, as a reference in developing game media, namely related to acid-base chemistry material. The concept of material as a reference in determining the content used in-game media. Analysis of learning objectives is reviewed based on the curriculum. Learning objectives as a basis for determining product design along with learning instruments.

Design Stage

The purpose of the design stage is to design game media formats and test instruments that are tailored to the learning objectives to be achieved. The design stage consists of test preparation, media selection, format selection, and design selection or initial design. The preparation of the test is based on learning objectives, the test prepared in the game media has 20 items, divided into 4 levels that are adjusted to the learning objectives that must be achieved. The pretest and posttest tests of students' cognitive abilities have 18 items in accordance with the learning objectives. Selection of media that is relevant to the characteristics of students. High school students are the millennial generation, where there is a very rapid development of technology and communication. At the design stage, researchers designed game media that would be used to support the learning process. Game media is a learning media that is expected to increase understanding and knowledge, making learning more interesting. Educational games are an effective and efficient learning strategy in the learning process. Educational games are an alternative learning media so that lessons are more interesting with students can interact directly (Widyastuti & Puspita, 2020). Format selection aims to determine the content of the game media developed. The media design is adjusted to the selected learning materials and learning objectives. Format selection is related to determining the cover design, adjusting the theme, and background, determining the color, font type, backsound, and material summary, and determining the audio effect that is interesting and does not interfere with the concentration of students when operating the media contained in the storyboard. Not only the material contained in the game but the questions at each level, in one level there are 5 questions to improve the cognitive abilities of students. In addition, there are features that help learners in operating the game media. The initial design or design aims to design the developed media. The design that has been determined based on the preparation of tests, media selection, and format selection obtained game results. Game media can be used as learning media or media for training (Aprilia & Iswendi, 2021).

The results of the design and initial design of game media to improve students' cognitive abilities on acid-base material are contained in Table 4.

Table 4 Learning Media Design Results

Media Design

Initial display before starting the game

Game view on level 1
(each level with a different background)

| Level map view in the game | Material display |

Development Stage

The development stage aims to determine whether the game media's results have met the eligibility criteria, namely valid, practical, and effective. At this stage, media validity tests and limited trials conducted by students are carried out.

Validity of Chemture Game Media

Draft 1 media design obtained at the design stage, then validated by three validators, namely two chemistry education lecturers and one chemistry teacher, which aims to obtain comments and suggestions from validators and revisions until the media is declared suitable for use in learning. Media validation assessment is reviewed from the content aspect and construction aspects. In the content aspect, there are two assessment indicators including the correctness of the concept and the suitability of the material in the game with learning objectives. While the constructed aspect there are 12 assessment indicators including (1) the characteristics of science (2) compatibility with the characteristics (3) having rules (4) there are aspects of guiding (5) there is competition, requirements, and strategies (6) challenging and actively involving students (7) there are standards for the success of students (8) provide feedback (9) there are aspects of decision making (10) color display, graphic size and animation (11) software engineering and (12) audiovisual communication. The results of the validation assessment can be reviewed in Table 5.

Table 5 Media Validation Results

Aspects	Score
Content Validation	3 and 4
Construct Validation	3 and 4

Based on the results of media validation in Table 5, the validation of content and construct aspects obtained a validation score with a score of 3 and 4 respectively showing the valid category. The validation result data is ordinal data which has unequal properties and cannot be performed mathematical operations. Based on the validation results obtained from media experts, it has met the requirements so that the game media meets the valid category to be used as a learning media that can improve the cognitive abilities of students in acid-base chemistry material.

Chemture game media that has met the aspects of valid criteria requirements then conducted a limited trial. The limited trial aims to determine the practicality and effectiveness of the Chemture game media that has been developed. The results of media practicality data are reviewed from research instruments in the form of response questionnaires and student learning activity observation sheets. The effectiveness of the media is

reviewed from the instrument of pretest and posttest results. The instrument used has gone through the validation stage which has been declared valid by the validator. The limited trial design uses the One Group Pretest Posttest, by giving a test before using the game media and after using the game media and giving a response questionnaire.

Media Practicality

The practicality of the media is reviewed based on the results of the student response questionnaire and observation of student activities. The results of the students' response questionnaire have 3 objectives that must be achieved including interest in the media used, ease of operating the media and students' interest in learning. The results of the response questionnaire can be reviewed in Table 6.

Tabel 6 Results of the Learner Response Questionnaire

Purpose	Percentage	Category
Interest	95,88%	Very Good
Ease of Use	90,44%	Very Good
Learning Interest	91,18%	Very Good
Average	**92,50%**	**Very Good**

Based on Table 6 on the purpose of students' interest in Chemture game media obtained the highest percentage of 95.88% with a very practical category. Based on research conducted by Carrillo states that the use of game media that can be used in the delivery of learning material is an effort to create learning that is fun, not boring and students easily understand the material (Carrillo et al., 2019). This shows that students feel happy and excited when learning by using Chemture game media so that students' cognitive abilities can increase. The use of various learning media, makes the delivery of messages and materials received by students will be more optimal and able to improve student learning outcomes.

The purpose of ease of use of Chemture game media obtained a percentage of 90.44% in the very good category. The ease of use of the media can help students in operating the media, thus making learning more optimal. In addition, the ease of use of game media is explained in the guidebook, starting from how to install the media, operate the media, and the function of using the navigation buttons in the game so that it makes it easier to operate the media. Instructions in using learning media make students not experience difficulties when using the media, instructions need to be studied and understood before using learning media (Siahaan S, 2019).

The purpose of learning interest after the use of Chemture game media obtained a percentage of 91.18% in the very good category. It shows that the use of innovative and varied learning media can attract students' interest in learning. The use of game learning media makes students participate more actively and feel challenged to complete the game, so as to increase student learning motivation, if student learning interest is high, student learning outcomes will increase. Based on Table 6, the average percentage of practicality is 92.50% with a very good category. In addition, practicality is reviewed from the results of student activity observations. The results of student activity observations can be reviewed in Table 7.

Table 7 Results of Observation of Student Activity

Learner Activity	Activity Percentage	
	Meeting 1	Meeting 2
Relevant Activity	91,1%	94,4%
Irrelevant Activities	8,9%	5,6%
Total Percentage	100%	100%

Based on Table 7, the relevant activities carried out by students at meeting 1 and meeting 2 obtained a percentage of 91.1% and 94.4% which were included in the very good category. Learning activities that are well implemented can be reviewed based on the activities of students, which are expected to be carried out in learning so that they can achieve learning objectives. In addition, based on previous research, students who have good activeness in learning activities can achieve learning outcomes by learning objectives (Achmad et al., 2020). Based on research by Iksaniya and Jaryanto, learning activities in the classroom focus on the application of knowledge gained by students such as exercises and discussions to expand higher-order thinking skills, such as skills in solving problems in game media and applying theory in practice (Iksaniya & Jaryanto, 2024). Based on the response questionnaire and student activities included in the good category, it has fulfilled the practicality aspect which states that the Chemture game media is practical for improving students' cognitive abilities on acid-base chemistry material.

Media Effectiveness

The effectiveness of game media is reviewed from pretest and posttest learning outcomes to improve students' cognitive abilities. Tests of students' cognitive abilities were given before (Pretest) and after (Posttest) using game media during a limited trial. The test of students' cognitive abilities amounted to 18 items which were divided according to the learning objectives to be achieved. The results of the pretest and posttest can be reviewed in Figure 1.
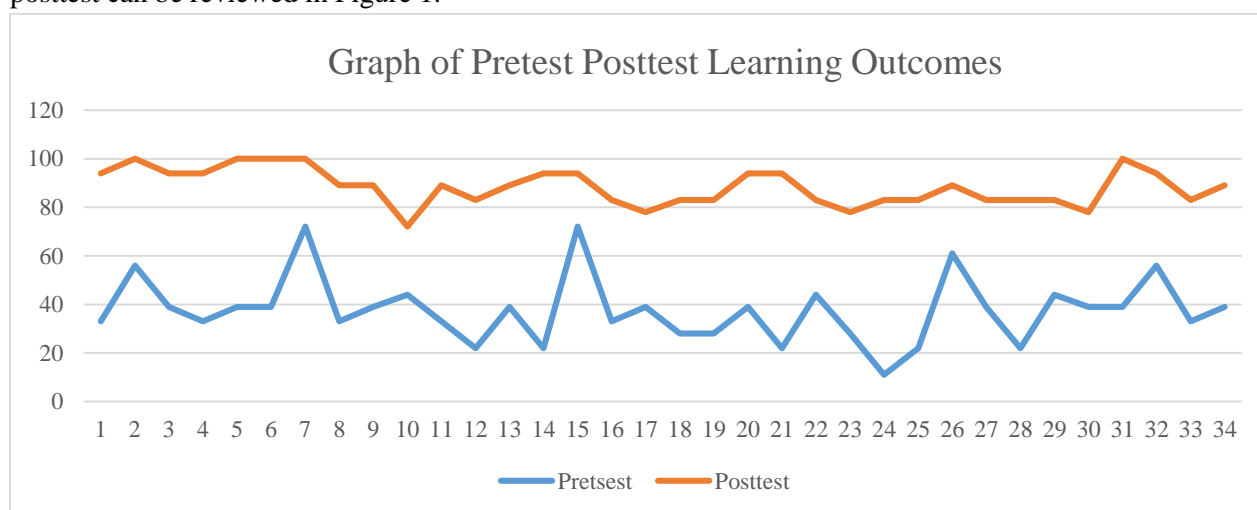

Figure 1 Graph of Pretest Posttest Results

Based on Figure 1, the results of the pretest and posttest were obtained, from the pretest results it can be seen that no students obtained individual completeness. Individual completeness is obtained if the acquisition of minimum learning completeness ≥ 76 which has been determined by the school. In the pretest results, classical completeness was obtained at 0%, it was because there were no students who met the KKM score. This shows that the class is not complete, because it does not meet the percentage of classical completeness which is $\geq 85\%$. The classical test of a class is said to be complete learning if the percentage of learning outcomes is 85% (Afrita, 2021). The acquisition of pretest results does not meet the criteria for completeness due to the lack of use of learning media which causes monotonous learning and makes students not maximize the learning outcomes obtained. The use of learning media makes the delivery of material clearer in meaning so that it is easier to master and achieve predetermined learning objectives (Iskandar, 2019). While the posttest results were only one learner who was not individually complete, with the acquisition of classical completeness of 97.06%, it showed that the class met classical completeness after the use of Chemture game media. It can be reviewed based on the graph that the pretest score is below 80 while the post-test results have

increased significantly after using the Chemture game media. In addition, the results of the pretest and post-test scores were analyzed using the T-test. There are prerequisites that must be met before the T-test is carried out, namely the normality test. The normality test aims to determine whether the data is normally distributed or not. The criteria in testing if α> 0.05 then the data is normally distributed. The results of the normality test can be reviewed based on Table 8.

Table 8 Normality Test Results

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	Df	Sig.
Pretest	.226	34	.000	.910	34	.009
Posttest	.226	34	.000	.914	34	.011
a. Lilliefors Significance Correction						

Based on the results of the normality test of students' cognitive abilities, the significance of the shapiro-wilk test was obtained with a significance on the pretest of 0.009 while on the posttest 0.011. From these data that the pretest and posttest scores are not normally distributed. This is because it does not meet the significance if α> 0.05 (Suardi, 2019). Because the data was not normally distributed, a nonparametric test was performed using the Wilcoxon test. The Wilcoxon test is used to determine the average difference between two paired samples that have two data. Wilcoxon test results can be reviewed based on Table 9.

Table 9 Wilcoxon Test Results

	Posttest – Pretest
Z	-5.099[b]
Asymp. Sig. (2-tailed)	.000
a. Wilcoxon Signed Ranks Test	
b. Based on negative ranks.	

Based on Table 8, the results of the Wilcoxon test on the learning outcomes of students' cognitive abilities obtained a significance value of 0.000 which states that there is a difference in the average pretest and posttest results, which means that there is an effect of using game learning media in improving students' cognitive abilities. The results obtained from the use of Chemture game media in chemistry learning, show a fun learning process, make students participate actively, and create independent learning so as to achieve learning objectives. Therefore, the design in using learning media is needed and adjusted to the characteristics of students who can improve student learning outcomes. Android-based game media is increasingly considered a promising learning media for learner motivation and the provision of learning environments can be designed so that learners gain knowledge and learning skills through play (Lutfi et al., 2023). Based on Figure 1, it shows that there is an increase in student learning outcomes so that game media can be declared effective.

CONCLUSIONS

Based on the results of the research that has been conducted, it can be concluded that the Chemture game on acid-base chemistry material has met the eligibility criteria (valid, practical and effective) so that the Chemture game developed can be used as a learning media to improve the learning outcomes of students' cognitive abilities in acid-base chemistry material. That is because the Chemture game has obtained a validity score of 4 which is included in the valid category. In addition, in terms of the response questionnaire obtained

a percentage of practicality of 92.90% while the observation questionnaire of the relevant activities of students at meetings 1 and 2 obtained a practicality of 91.1% so that the media can be said to be very practical. The effectiveness of the media in terms of learning outcomes of students' cognitive abilities obtained classical completeness of 97.06%, the results of the Wilcoxon test showed that there was an average difference before and after using the Chemture game media, and was able to improve students' learning outcomes. So that the Chemture game media can be declared feasible as a chemical learning media on acid-base material.

REFERENCE

Achmad, A. H., Dinar, M., & Bernard, B. (2020). Pengaruh Keaktifan Belajar, Kemandirian Dan Kreativitas Terhadap Prestasi Belajar Matematika Siswa Kelas IX SMP. *Issues in Mathematics Education (IMED)*, *4*(1), 11. https://doi.org/10.35580/imed15287

Afrita, N. (2021). Melalui Model Pembelajaran Student Teams Achievement Division (STAD) untuk Meningkatkan Hasil Belajar Kimia Materi Sifat Garam yang Terhidrolisis. *KATALIS Jurnal Penelitian Kimia Dan Pendidikan Kimia*, *4*(1), 23–32.

Aprilia, Y., & Iswendi, I. (2021). Pengembangan Permainan Ular Tangga Kimia Berbasis Android Sebagai Media Pembelajaran Pada Materi Senyawa Hidrokarbon di Sekolah Menengah Atas. *EDUKATIF : JURNAL ILMU PENDIDIKAN*, *3*(4), 1220–1230. https://doi.org/10.31004/edukatif.v3i4.548

Arifin Zainal, & Setiyawan Adhi. (2012). *Pengembangan Pembelajaran Aktif dengan ICT*. Skripta Media Kreatif.

Artini, N. P. J., & Wijaya, I. K. W. B. (2020). STRATEGI PENGEMBANGAN LITERASI KIMIA BAGI SISWA SMP. *Jurnal Ilmiah Pendidikan Citra Bakti*, *7*(2), 100–108. https://doi.org/10.38048/jipcb.v7i2.97

Carrillo, D. L., García, A. C., Laguna, T. R., Magán, G. R., & Moreno, J. A. L. (2019). Using Gamification in a Teaching Innovation Project at the University of Alcalá: A New Approach to Experimental Science Practices. *Electronic Journal of E-Learning*, *17*(2). https://doi.org/10.34190/JEL.17.2.03

Dewi, F., Efrianto, B., & Afrida, A. (2018). Analisis Keterlaksanaan Pendekatan Experiential Learning dan Pengaruhnya terhadap Keterampilan Proses Sains Siswa pada Materi Ikatan Kimia. *Journal of The Indonesian Society of Integrated Chemistry*, *10*(1), 1–8. https://doi.org/10.22437/jisic.v10i1.5307

Halean, S., Kandowangko, N., & Goni, S. Y. (2021). Peranan Pendidikan dalam Meningkatkan Sumber Daya Manusia di SMA Negeri 1 Tampan Amma di Talaud . *Jurnal Holistik*, *14*(2).

Iksaniya, N. F., & Jaryanto, J. (2024). Pengaruh Model Flipped Classroom Berbantu Gamifikasi terhadap Motivasi Belajar Materi Laporan Keuangan Siswa Akuntansi dan Keuangan Lembaga. *EDUKATIF : JURNAL ILMU PENDIDIKAN*, *6*(2), 1096–1110. https://doi.org/10.31004/edukatif.v6i2.6417

Lutfi, A. (2021). Research and Development (R&D) Implikasi dalam Pendidikan Kimia. *Unesa University Press*.

Lutfi, A., Aftinia, F., & Permani, B. E. (2023). Gamification: Game as a medium for learning chemistry to motivate and increase retention of student learning outcomes. *Journal of Technology and Science Education, JOTSE*, *13*(1), 193–207.

Muderawan, W., Wiratma, I. G., & Labila, M. Z. (2019). Analisis Faktor-Faktor Penyebab Kesulitan Belajar Kelarutan. *Jurnal Pendidikan Kimia*, *3*(1), 17–23.

Putri, N. I., Sabrina, S. I., Budiman, N., & Utami, W. T. P. (2023). HAMBATAN GURU DALAM PENERAPAN KURIKULUM MERDEKA TERHADAP PROSES PEMBELAJARAN DI SD NEGERI 3 BROSOT. *Indonesian Journal of Elementary Education*, *5*(1), 51–60.

Qomariyah, S. S. (2016). Quality of learning media, learning interests, and student learning outcomes: study of economic subjects in class X IIS 12 Public High School Jakarta. *Jurnal Pendidikan Ekonomi Dan Bisnis*, *4*(1).

Rawung, W. H., Katuuk, D. A., Rotty, V. N., & Lengko, J. S. (2021). Kurikulum dan Tantangannya pada Abad 21. *Jurnal Bahana Manajemen Pendidikan*, *10*(1).

Ryan, R. M., & Deci, E. L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. *Contemporary Educational Psychology, 61, 101860.*

Sariati, N. K., Suardana, I. N., & Wiratini, N. M. (2020). Analisis Kesulitan Belajar Kimia Peserta didik Kelas XI pada Materi Larutan Penyangga. *Jurnal Ilmiah Pendidikan Dan Pembelajaran*, *4*(1).

Siahaan S. (2019). Pemanfaatan Teknologi dalam Penyelenggaraan Pendidikan Terbuka/Jarak Jauh. *Jurnal Teknodik*, *9*(16).

Suardi. (2019). Pengaruh Kepuasan Kerja terhadap Kinerja Pegawai pada PT Bank Mandiri, Tbk Kantor Cabang Pontianak. *JBEE : Journal Business Economics and Entrepreneurship*, *1*(2), 9–18.

Suyatno, & Gio, P. U. (2017). *Statistika Nonparametrik dengan SPSS Minitab dan R.* USU Press.

Utami, F. V, Saputro, S., & Susanti, E. (2020). Analisis Jenis dan Tingkat Kesulitan Belajar Peserta didik Kelas XI MIPA SMAN 2 Surakarta Tahun Pelajaran 2018/2019 dalam Memahami Materi Asam Basa Menggunakan Two Tier Multiple Choice. *Jurnal Pendidikan Kimia*, *9*(1).

Widyastuti, R., & Puspita, L. S. (2020). Pengembangan Media Pembelajaran Berbasis Game Edukasi Pada MatPel IPA Tematik Kebersihan Lingkungan. *Paradigma - Jurnal Komputer Dan Informatika*, *22*(1).

Zahra, Y., & Hernawati, N. (2015). Prokrastinasi Akademik Menghambat Peningkatan Prestasi Akademik Remaja di Wilayah Perdesaan. *Jur. Ilm. Kel. & Kons*, *8*(2), 163–172.

Zakiyah, Z., Ibnu, S., & Subandi, S. (2018). Analisis Dampak Kesulitan Siswa pada Materi Stoikiometri terhadap Hasil Belajar Termokimia dan Upaya Menguranginya dengan Metode Pemecahan Masalah. *EduChemia (Jurnal Kimia Dan Pendidikan)*, *3*(1), 119. https://doi.org/10.30870/educhemia.v3i1.1784