Questing through Acid–Base Chemistry: An RPG-Based Educational Game for High School Learning

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Article Info	Abstract
	The background of this study was triggered by the long time period in which students spend playing games and the ineffective use of learning media in teaching chemistry subjects. The purpose of the study is to design a model for learning through an Educational Role Playing Game (RPG) to be feasible and practical in teaching acid-base principles for grade XI students. In addition, the study Using the analysis, design, development, implementation, and evaluation (ADDIE) approach in conjunction with a research and development approach. The participants in this study were media experts, subject matter experts in the area of chemistry, chemistry teachers, and learners in Grade XI from MAN 1 Mataram. The study used interviews and questionnaires as techniques to collect data from the study participants. With validation scores of 92.85% from media professionals, 90.62% from subject experts, and 97.36% from chemistry professors, the study's findings demonstrate the viability of the suggested learning game. Students with an 85.90% practicality level also provided a very positive feedback. This outcome also leads to the conclusion that this RPG-based instructional game is workable and useful for improving students' comprehension of acids and bases.

INTRODUCTION

Digital technology has gradually transformed instructional practices towards learning environments that are more interactive and focused on the needs of the students in the 21st century; moreover, it has increasingly supported active engagement and visualization of concepts in science classrooms through the use of digital tools and applications (Ali et al., 2023; Nugraheni & Srisawasdi, 2025). Specifically, in the context of chemistry education, digital media can represent complex, abstract concepts that are not easily represented by traditional instruction by providing them with multimodal and interactive experiences (Aroch et al., 2024). However, despite the possibilities of digital media for enhancing cognitive engagement and processing, instructional media are still being adopted in a limited manner in chemistry classrooms, and their design often does not fully address the cognitive challenges faced by students, especially regarding conceptually demanding topics such as acid-base chemistry. (Widarti et al., 2024; Wohlfart et al., 2023). Challenges to be addressed include the need for pedagogically integrated tools that go beyond mere visualization in order to support active meaning-making and problem-solving.

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Acid-base principles are central to advanced chemistry issues, but are also cognitively problematic for students in chemistry classes owing to their abstract nature and complex representation structures. In chemistry education, students are tasked with linking microscopic to macroscopic phenomena and symbolic equations, which represent complex cognitive tasks when learners lack adequate supportive instructional design strategies to enable linking and integration of multiple representation structures in chemistry learning and teaching (Ainsworth, 2006; Cooper et al., 2016; Hungwe et al., 2025; Johnstone, 2000). From Cognitive Load Theory principles, learning becomes more difficult when learners are presented with information that lacks proper cognitive structures. Cognitive complexity surpasses cognitive working memory space in learners and instructors alike when learning or teaching chemistry and acid-base principles in particular (Ginns & Leppink, 2019; Kala & Ayas, 2023; Sweller, 2020; Sweller et al., 2011). Moreover, theoretical and empirical research regarding chemistry learning principles illustrates that students memorize chemistry rules and principles regarding pH and titration in acid-base chemistry without necessarily understanding chemistry principles, thus common incorrect knowledge of the concepts of acid-base in chemistry learning and teaching by students in biology and chemistry courses in particular (Mubarak & Yahdi, 2020; Shaafi et al., 2025). Therefore, instructional approaches that effectively integrate multiple chemical representations and scaffold learners' cognitive processes are critical for meaningful understanding of acid–base chemistry.

Several electronic media for learning through simulations, serious games, or mobile chemistry applications have been produced in an attempt to overcome the cognition and engagement difficulties in science learning, particularly in chemistry (Araújo et al., 2025; Putri et al., 2022). While these media have generally improved engagement and visualization of the abstract subject matter for students, often the existing approach tends to be expository or linear in its delivery of subject matter with a focus on surface interaction in terms of cognition as presented in the literature (Byusa et al., 2022). Thus, despite findings within the literature that game-based learning can help in knowledge gain and engagement, the learning capacity of digital games in terms of engaging the cognition creatively through decision-making or problem-solving remains a potential within the existing body of research or practice surrounding chemistry learning today (Putri et al., 2022; Safitri et al., 2025).

Game-based learning is a promising approach towards turning the recreational activities of students with games into learning experiences, as evidence has found that the use of stories and interactivities is effective in enhancing the engagement of the learners in the classroom (Ali et al., 2023; Byusa et al., 2022; Putri et al., 2022; Wildana et al., 2020). Moreover, RPGs have characteristics that make them distinct from other game-based learning activities as they incorporate story-based progression concepts in order to engage the character-based decisions and quests-based problem-solving approaches that offer opportunities to interact with the student (Dorożyński & Dorożyńska, 2022; Surendeleg et al., 2014). These types of narrative frameworks can serve as a type of narrative scaffolding that supports learners in addressing progressively complex tasks, and this can be related to the learning theories of constructivism, with the learners themselves constructing their understanding through exploration and reflection in a gameplaying process that includes embedded learning feedback (Sholichah et al., 2022). The RPG system has the ability to engage learners cognitively in a learning process that is embedded in a story instead of information.

Although the attractiveness of educational games continues to grow, research on role-playing games (RPGs) in science learning is still restricted in terms of exploring the concepts within the gamified subject itself. Recent reviews indicate that most digital learning media in chemistry, such as simulations, serious games, and mobile applications, primarily emphasize engagement, visualization, or motivational outcomes, rather than embedding conceptual reasoning and decision-making processes aligned with curricular goals (Cheng & Kinoshita, 2024; Gao et al., 2020; Hwang et al., 2008; Ilić et al., 2024; Wang et al., 2022; Wu et al., 2021). In chemistry education, interactive technologies often fail to meaningfully connect symbolic, macroscopic, and submicroscopic representations within authentic problem-solving contexts, which constrains deeper conceptual understanding (Ali et al., 2023; Araújo et al., 2025; Byusa et al., 2022). Moreover, studies on game-based learning rarely examine the practicality of RPG-based educational games for classroom implementation at the senior high school level using systematic instructional design frameworks,

limiting their transferability to real instructional settings (Hu et al., 2022; Plass et al., 2015; Wouters et al., 2009). These gaps highlight the need for curriculum-aligned, RPG-based educational games in chemistry that are developed through structured design models and empirically evaluated for classroom feasibility.

Thus, the purpose of this study is to design and assess the feasibility and practicality of a PC-based RPG learning game for acid and base learning for grade XI students. The learning game was designed with a set of quests and tasks related to the subject matter of acids and bases, in accordance with the curriculum learning objectives. This research gives a theoretical and verified reference in chemistry learning regarding the use of a learning RPG game media in understanding chemistry concepts.

METHODS

This study was an R & D approach towards developing and evaluating a desktop-based RPG educational game feasibility and practicality to learn acid–base concepts in Grade XI chemistry. The development process followed the ADDIE framework analysis, design, development, implementation, and evaluation of instructional design, applied iteratively to ensure product quality and alignment with learning objectives.

Product Description

This is a Windows-based desktop RPG Maker that was used to create an instructional game. In the game, the concepts of acid-base are integrated into narrative-driven quests, problem-solving tasks, and decision-making activities so that students can learn chemistry concepts through structured gameplay. The final output is an executable (.exe) file intended for classroom use and independent learning.

Participants and Validators

There were three types of participants involved in the study. Expert Validators (Feasibility Assessment) involve three experts in the media field, having skills in educational technology, as well as digital media design. Three experts in the materials area have academic backgrounds in teaching chemistry, as well as knowledge about teaching concepts related to acid-base. Expert validators were selected based on educational background, as well as a minimum of five years of professional experience. Moreover, Practitioner Reviewers (Practicality Assessment) involve two senior high school teachers teaching chemistry in grade XI, familiar with the theory as prescribed under the national curriculum. Even though the role of the chemistry teachers in this project was not as expert validators, they were involved as practitioners in the review of the game developed and its practicality. The final stage involves thirty-five grade XI students, who took part in practical testing at MAN 1 Mataram.

Development Procedure

The process involved the ADDIE model, described in detail: Analysis involved curriculum analysis, characteristics analysis, and analysis of difficulties in learning concepts related to acids and bases to design the objectives of the game; Design involved designing the conceptual framework of the game, incorporating storyline, design, rules, and interface; Development involved designing the prototype, validation, and modifications based on feedback from the users, incorporating use of RPG; Implementation involved testing the design with the teachers and students; Evaluation was done integrally, with emphasis on feedback from the experts.

Research Instruments

Data collection was through questionnaires and interviews. Questionnaires to test for feasibility and practicality, 5-point Likert-scale questionnaires were developed. Indicators associated with feasibility were content accuracy, instructional design, interface quality, and technical functionality. Indicators of practicality included ease of use, clarity of instructions, interactivity, and suitability for classroom implementation. Cronbach's alpha was used to assess the reliability of each instrument, and was acceptable in terms of internal consistency. Interviews:

Semi-structured interviews were conducted during both the Development and Implementation stages with expert validators and chemistry teachers. The interviews were held for the purpose of garnering detailed feedback for revision of the product. The sequential process of developing the instructional media, guided by these stages, is illustrated in Figure 1.
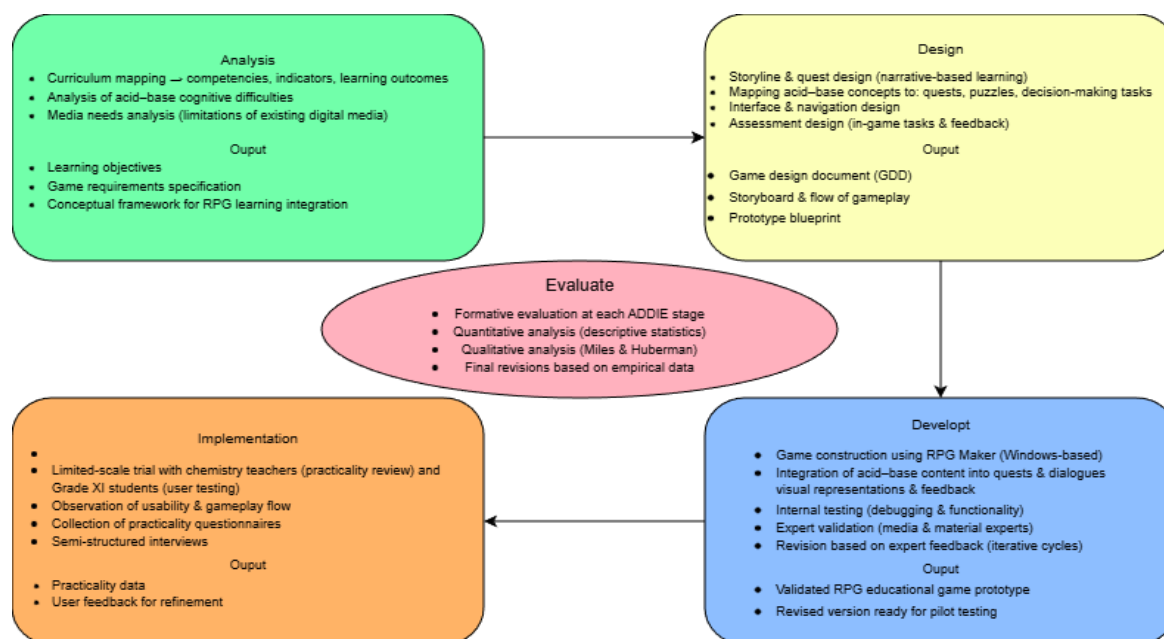

Figure 1. ADDIE-based Development Flow of a Windows-based RPG Educational Game using RPG Maker for Acid–base Learning.

Data Analysis

Quantitative information from questionnaires was analysed using descriptive statistics, calculating feasibility and practicality percentages using the following formula:

$$\text{Percentage} = \frac{\text{Obtained score}}{\text{Maximum score}} \times 100\%$$

The interpretation of the results of the validity and practicality of the instruments and learning media was carried out based on the percentage of the average score with a ranking system as follows: 61-80% (valid/practical), 41-60% (moderately valid/practical), 21-40% (less valid/less practical), 81-100% (very valid/very practical) and 0-20% (invalid/Impractical).

Open-ended questionnaire answers and qualitative data from interviews were examined using the Miles and Huberman interactive model (Miles et al., 2013), involving data reduction, data presentation, and forming conclusions. Professional recommendations were systematically used to revise and improve the game during the Development phase.

RESULT AND DISCUSSION

This particular study aims at the creation of an instructional role-playing game (RPG) related to acid & base subjects for the support of chemistry learning at MAN 1 Mataram. There have been several results achieved through the process of research & development, such as: (1) RPG educational game related to acid & base subjects, (2) content validation through subject specialists utilising a Material Validation Questionnaire, (3) design validation through media experts using a media specialists utilising a Media Validation Questionnaire, (4) evaluation by chemistry instructors, & (5) feasibility study through students' responses utilising a questionnaire for student responses. The RPG educational game was designed using the Addison-Eyndt Development & Instructional Design (ADDIE) model. The stages of the ADDIE development process used in this study are as follows.

Analysis Stage

This phase will help in identifying some of the difficulties encountered in learning chemistry, especially in relation to subjects involving acids and bases. This analysis will be done by focusing on some of the salient factors, such as the curriculum, the medium of learning, the characteristics of the students, and preparations for developing the educational game. This summary of the analysis is presented in Table 2.

Table 2. Pedagogical Needs Analysis for RPG-based Acid–base Learning

Aspect	Empirical Findings	Pedagogical Implications	Design Decisions in RPG
Curriculum Analysis	The teaching of acid-base principles is conducted in grade XI based on the 2013 Curriculum, which employs technology and a scientific methodology. But instructional resources are still restricted to textbooks	Learning should emphasize conceptual reasoning rather than memorization	Quests require players to apply acid–base concepts to solve problems
Learning Media Analysis	Existing media are linear and passive	Limited engagement and decision-making	Non-linear RPG quests with branching choices
Student cognition	Students struggle to distinguish Arrhenius, Brønsted–Lowry, and Lewis definitions (teacher interviews)	Indicates cognitive overload and representational confusion	Concepts introduced gradually through leveled quests
Representational level	Teaching focuses on symbolic equations, limited macroscopic or submicroscopic links	Violates chemistry triplet integration	NPC dialogue links equations with real-world phenomena
Learning motivation	Students show high interest in digital games (survey & teacher observation)	Recreational behavior can be redirected to learning	RPG mechanics used to embed learning tasks

Analysis results indicate that students' difficulties in acid–base learning are primarily rooted in the abstract nature of the concepts and the dominance of symbolic representations, which increase extraneous cognitive load (Sweller et al., 2011). Furthermore, the lack of explicit connections between levels that are macroscopic, submicroscopic, and symbolic reflects insufficient integration of the chemistry triplet (Johnstone, 2000). These findings suggest the need for a learning medium that supports gradual conceptual scaffolding and representational integration, which can be facilitated through narrative-driven RPG mechanics.

The analysis explained that students still struggle when learning acid–base concepts due to the abstract nature of and necessity to learn deeply about them. Other research has found that chemistry subjects with Reactions and substances' characteristics tend to lead to Students' misconceptions, especially when learning is focused on symbolic expressions that are not sufficiently contextualized (Mubarak & Yahdi, 2020; Petterson et al., 2020; Wiyarsi et al., 2021). Additionally, PowerPoint-based instruction and textbooks continue to dominate modern teaching methods, which limits Students' capacity to participate in active and meaningful learning processes (Karin et al., 2025; Rahayu et al., 2025).

To meet all these challenges, an RPG educational game was developed, incorporating teaching aspects that are compatible with the learning objectives of acid-base teaching. The interactive nature of the educational game allows the student to interact with the concepts via exploration activities, thus assisting in constructing concepts from a constructivist theory. The story-based scenario assists in contextualizing concepts related to acid-base within various problem contexts, which are compatible with situated theory. The addition of NPCs assists in providing explanations, whereas quizzes within the educational game assist in correcting misconceptions.

Moreover, analysis of the curriculum indicates a fit between the design principles used in the gaming system and those in the 2013 Curriculum, which focuses on key learning skills such as scientific inquiry, context-based learning, and technology integration. Moreover, analysis of student interests indicates a significant desire to be involved in digital games, especially RPGs, which indicates that such an intervention can easily boost learning motivation and engagement. Different studies have already proved the ability of learning games to promote experimental learning and improve student understanding of abstract chemical principles (Kaban et al., 2021; Liana, 2021; Rasyid et al., 2020).

Design Phase

In this phase, the focus is on designing an instructional role-playing game (RPG) and demonstrating how such an RPG can be developed using RPG Maker MV software. Many important parameters are taken into consideration in the design of the RPG and are given in Table 3.

Table 3. Results at the Design Stage

Design Aspects	Description
Storyline	The players get to be the protagonist in an adventure game where they are expected to solve different tasks that relate to concepts such as acids and bases. Every task is correlated to an interactive learning activity.
Game Structure	There are multiple stages in the game, different levels that contain learning materials in addition to activities like quiz elements and interactions between player (PC) and non-player (NPC) characters.
User Interface (UI)	The design of the interface is simple and user-friendly. This allows learners to easily access the interface. The navigation menu is useful for accessing different in-game elements.
Interactive Features	The game includes quiz sections, simulations and virtual experiments of concepts of acid and bases to increase engagement of students. Students can also interact with NPCs to know more.
Scoring and Feedback System	Every time the player completes a challenge or a quiz, they will receive a score and feedback on the challenge/quiz completed by the students to assess the knowledge gained of the material.
Supporting Media	The games have animations, pictures, and sound effects to make them more attractive and useful as learning aids.
Platform and Accessibility	On a desktop, the game can be played offline. Computer with an Intel HD Graphics processor and at least 2GB of RAM.

The outcome of the design process reveals that the Educational Role-Playing Game has been carefully designed in terms of storyline, structure, interface, and play-and-interaction abilities to facilitate learning about the concepts of acids and bases. This is in line with a learning method by using technology, which has been encouraged by the 2013 Curriculum.

The game was designed with the idea of an instructional adventure game, in which players are tasked with problem-solving related to acid and base concepts via NPCs and quizzes, virtual lab simulations, and experiments. Studies conducted previously have demonstrated that studying through games can improve mental understanding, critical thinking, and motivation skills for learners (Liana, 2021).

On the technical side, the game aims to incorporate a simple and intuitive interface. The game is offline and available on desktop computers with specifications common in educational settings. The game incorporates scoring, and students self-assess their understanding of the topics. With this in mind, this RPG-style educational game is supposed to allow students to interactively comprehend topics on acids and bases with fewer misconceptions and with learning as a fun experience. We feel strongly that learning chemistry should have aspects of fun in the

productive play model (Lima et al., 2019; Wilson & Samide, 2014). An educational game product was created based on the outcomes of the educational game design mentioned above, as seen in Figure 2.

(a)

(b)

(c)

(d)

(e)

(f)

(g)

Figure 2. Display of Role Playing Game (RPG) based Educational Game; (a) Main Menu; (b) Prolog; (c) Character Selection Menu; (d) Character Name Input; (e) Character Task Running View; (f) Game Data Save View; (g) Material Content Display.

When entering the game, the player will be shown (a) the main menu for running the game. The main menu display design is as simple as possible for better UX. Then, when the player decides to start the game, (b) the prologue appears to tell the player about the game's storyline. All games have some amount of narrative (Holcomb, 2023). This will provide the primary reason players engage with the game. Then the player decides on (c) character selection and (d) naming their character while interacting with the game storyline. A person must comprehend the persona they are portraying to take meaningful action. Every character needs an attitude and a point of view. These are what spur individuals to action (Lankoski, 2002). In this game, the character is limited to only two options that show the preferred gender. (e) In the RPG-based educational game, the storyline is implemented through a sequence of character-driven quests that require players to apply acid–base concepts to complete each mission. For example, at an early level, players take the role of a student-apprentice chemist tasked by a non-player character (NPC) to identify acidic and basic substances in a virtual laboratory environment. Players must classify substances based on their properties and pH values to unlock the next area.

At higher levels, the quests become more complex, such as determining the strength of acids and bases or solving contextual problems involving pH calculations to neutralize environmental hazards within the game. The material on acid–base is not given as separate knowledge but is instead embedded in conceptual explanations after each mission; this provides the players with feedback as to how the choices made in the missions relate to the chemical concepts. (f) The save-progress feature in the game allows resumption of gameplay at any moment. (g) As players progress to higher levels, deeper explanations and more complex acid–base concepts are introduced, ensuring that learning content is scaffolded according to players' in-game performance. A cohesive storyline, supported by recurring characters and mission-based challenges, fosters exploration, emotional engagement, and contextual learning, thereby enhancing Students' comprehension of acid-base principles (Crucho et al., 2025; Holcomb, 2023).

Development Stage

The instructional game that uses role-playing games (RPGs), during the development phase, passed through an evaluation procedure by content and media specialists, content experts, and subject teachers. Various suggestions and inputs were given by the validators to improve the product for learning purposes. For details, see Table 4.

Table 4. Revision Results based on Validator Suggestions and Input

Rated aspect	Suggestions and Feedback Before Revision	Improvements After Revision
User Interface (UI)	Colors and arrangement of items on the menu are less appealing, as are some of the icons	Colors are made more appealing as contrast is enhanced, layout arrangements are optimized for better usability, and icons are made clearer.

Rated aspect	Suggestions and Feedback Before Revision	Improvements After Revision
Storyline and Narrative	Some of the narratives in the game are too long, which can be boring for students.	The narrative is made more succinct and captivating without omitting crucial details.
Compatibility of Acid and Base Materials	Some ideas are still insufficiently explained, requiring additional explanation in certain parts.	Added additional information via NPCs and pop-up features explaining chemical concepts.
Interactivity in Games	The challenges in the game are still not varied enough; there needs to be more variety in questions and activities.	Added more quizzes, virtual experiments, and challenges based on the concepts of acids and bases.
Interactivity in Games	The challenges in the game are still not varied enough; The questions and exercises should be more varied.	Added more quizzes, virtual experiments, and challenges based on the concepts of acids and bases.
Scoring and Feedback System	Scores do not appear in real-time after quizzes, feedback is not as clear, and concise.	The scoring system is now optimized to be viewed immediately after the quiz, and the results are presented both in words and animations.
Game Accessibility and Performance	On low-spec devices, several functionality lag.	Various optimizations have been done to enable the game to perform well on all gadgets.

The findings of the development stage revealed that the instructional game based on role-playing games (RPGs) experienced some changes regarding recommendations from validators before it was considered suitable to be used. Among those aspects receiving many comments was the User Interface (UI), which was considered less aesthetic and less clear to users in terms of color contrast, layout design, and icon design. Changes occurred when adjustments to color contrast, layout design, and icon design improvements took place to radiate greater usability. In addition, changes to the storyline and narrative of games occurred to ensure that they are more straightforward and less dull to students. This corresponds to findings in former research indicating that aesthetic and less dull design in educational games radiates influences of enhanced user engagement and motivation towards learning (Coutinho et al., 2024; Gupta, 2019; Rasyid et al., 2020; Wildana et al., 2020).

After the revision procedure with the help of the validators' input, the Role-Playing Game (RPG) based educational game was again validated for suitability. The media validators rated it 92.85%, mentioning that it had an attractive gaming interface, simplicity in navigation, and that the altered icons and colors enhanced the game. The content validity was rated 90.62% by the content validators, emphasizing that the educational game content corresponds with the curriculum. Along with that, more thorough conceptual information had been added for students' clear understanding of the acid and base concepts.

Moreover, a rating of 97.36% was given by the teachers of chemistry regarding the appropriateness of the game as a learning aid. The rating indicates that the game is appropriate for use as a learning aid. Additionally, the teachers found the quizzes and experiments available on the game to have the ability to raise the levels of student engagement in understanding the concepts of acids and bases. This information is found in Table 5.

Table 5. Findings from the Validation of Media Experts, Material Experts, and Chemistry Teachers

Validator	Rated aspect	Percentage (%)	Category
Media Expert	The appearance, interface design, and ease of navigation.	92,85%	Very feasible
Subject Matter Expert	Relevancy of content to the curriculum, Concept clarity, Content informativeness	90,62%	Very feasible
Chemistry Teacher	Feasibility of use in learning, effectiveness of games as a learning medium	97,36%	Very feasible
Overall Average		93,61%	Very feasible

Table 5 shows media experts', subject matter experts', and chemistry teachers' validation results. It summarizes the assessed aspects, the scores in percentage, and the feasibility categories of each validator group. The trend of the results obtained indicates that this developed game passed the feasibility testing in media design, quality content, and instructional use, as reflected in the overall average score.

Implementation Stage
The application of the educational role-playing game (RPG) for bases and acids is the subject of the subsequent implementation stage. After the validation of the game and making corrections as per the inputs and suggestions provided by the experts in the form of comments, the game became an independent learning process. The participants of the study were 35 students.

The stage of implementation is the stage where the first introduction to learning media-based RPGs was given. It then continues with the testing of the developed product by providing the students with it for a week to be used. After using the product, students completed a feedback form to assess its usefulness. From the viewpoint of the student, the response to the RPG-based educational game was very positive, as can be seen from Table 6.

Table 6. Results of Student Responses to Games

Rated aspect	Percentage (%)	Category
Feasibility aspects of the presentation	85,85	Very Practical
Linguistic aspects	82,32	Very Practical
Characteristic aspects	86	Very Practical
Aspect of Display	87,58	Very Practical
Amount	**85,90**	**Very Practical**

Students found it easy to play, enjoyable, and useful for a better understanding of the matters. Most students declared that it made them more enthusiastic about learning. As confirmed by existing studies, increased learning motivations and conceptual understandings have been made by the application of gamification in learning media (Daubenfeld & Zenker, 2015; Liana, 2021). The self-efficacy of students in this aspect also shows a higher score compared with those in a traditional lecture class. In alignment with other studies, the use of a game-based learning approach can effectively enhance the students' self-efficacy in relation to achieving knowledge compared with a traditional teaching process (Hung et al., 2014; Wang & Zheng, 2021; Yükseltürk et al., 2018). The usefulness of the game, as assessed by the students, was set at a high level of 85.90%. In contrary, a few students felt a need for more varied challenges in certain aspects for a better understanding (Winter et al., 2016).

With all the discussions above, it is hoped that this study can add some value to the educational area of chemistry through this study, which presents a technically feasible approach regarding the integration of Role Playing Game (RPG) elements in learning materials designed to align with chemistry topics, specifically acid-base, at the senior high school level. Through incorporating chemical concepts into story elements, activities, or decision-making processes, the

designed educational game assists students in constructing significant understandings aligned with constructivist or experiential theories regarding learning (Chen et al., 2014; Gupta, 2019). This study also presents concrete data related to the practicality potential regarding the use of RPG-based educational gaming materials as educational instruments, contrary to previous studies, which mostly rely on student motivation aspects, yet lack significant alignment related to subject-specific objectives (Liana, 2021). Furthermore, this study offers a scalable instructional design reference for educators and developers seeking to utilize digital game-based learning to reduce abstraction-related difficulties and misconceptions in chemistry learning (Adu-Gyamfi & Asaki, 2023; Mubarak & Yahdi, 2020).

LIMITATIONS

Although this study effectively illustrates the potential of the RPG-based educational game in learning chemistry acid-based topics, its scope is limited to a pilot phase with a specific sample. Conducting this study among a bigger sample of people and testing its long-term effectiveness in different fields could yield even more valuable results. However, there are some limitations in this current study, particularly since it is constrained in its context, being either in a particular institution or particular students. The tools used might not be totally exhaustive in measuring social, cognitive, instructional, and technological presence. Moreover, this current study does not include the effect of other extrinsic elements in learning, including economic situations or motivation.

CONCLUSION

From the result of the study, the validation assessment result for The educational role-playing game (RPG) created had an average percentage value of 93.61%, and it belonged to the very feasible category, while the practicality test had an average percentage value of 85.90%, and it belonged to the convenient category, and it can therefore be utilised by pupils in class XI as a teaching tool for acid and basic content. The larger-scale implementation can further be done to determine the additional effect that can be gained by the development of the game. The study proved that RPG educational game media can, in fact, be used as a supporting tool for the teacher and students during the learning process and as a facility for self-study. The implementation of educational role playing game (RPGs) learning will therefore help to produce a more pleasurable setting for learning and increased interest in students to learn. The effect on the students' learning outcome can further be investigated for the development game using an experimental design, and its development for other topics within the field of chemistry can further be explored.

AUTHOR CONTRIBUTIONS

SM designed the study, conducted the research, developed the program, executed data collection, conducted the statistical analysis, and drafted the first version of the manuscript. MTNK worked on developing the visual tools and game environment, contributed to the data collection process, and had a major role in the study design. R interpreted the qualitative data analysis and made structural and intellectual content revisions to the manuscript.

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