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Development of Redox Animation Application to Enhance Students' Critical Thinking Skills on Oxidation Reduction Reaction Topics

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Abstract: Critical thinking skills are one of the four 21st-century skills defined as the ability to reason rationally and logically. In the context of chemistry, critical thinking plays a vital role as it is required to understand chemical concepts, mechanisms, equations, reactions, and elements, as well as the ability to make appropriate judgments. However, based on previous research and field surveys, it was found that students' critical thinking skills are generally low. Three levels of chemical representation in chemistry need to be connected integrally to develop an understanding of chemical concepts and critical thinking. Integrating the three levels of representation can be done through visualisation media in animation. Thus, a visual communication media that includes three representative levels is developed to improve critical thinking skills and facilitate students' understanding of chemical materials, especially in the context of reduction and oxidation reactions, namely the Redox Animation application. In this article, this research aims to develop a Redox Animation application that is feasible in terms of two learning media feasibility criteria, namely validity and practicality. The development research model used in this research is the Sukmadinata model, which has three main stages: preliminary studies, model development, and model testing. This study is limited to the trial step. The research data shows that the Redox Animation application developed meets the feasibility in development research on validity criteria with the acquisition of a content validity mode score of 4 with valid criteria and a construct validity mode score of 4 with valid criteria and practicality criteria with the acquisition of a percentage in a learner response questionnaire of 96.33% with efficient criteria. Thus, the Redox Animation application is declared feasible for enhancing students' critical thinking skills on redox reaction topics based on validity criteria and practicality criteria in development research.

Keywords: Animation; App; Critical Thinking; Redox.

Introduction

The skills required in the modern world have undergone substantial transformation during the late 20th and early 21st centuries, and critical thinking skills are one of the four 21st-century skills [1], [2]. Critical thinking is defined as the ability to reason rationally and logically. It is an active process that involves analysing, learning, and observing problems to reach a definite conclusion. Critical thinking aims to achieve a deep understanding that encourages continuous learning over a long period [3]. Facione & Gittens identified the fundamental skills of critical thinking as encompassing: (1) interpretation, (2) analysis, (3) evaluation, (4) inference, (5) explanation, and (6) self-regulation [4].

In the context of chemistry, critical thinking plays an essential role as it is required to understand chemical concepts, mechanisms, equations, reactions, and elements, as well as the ability to make sound judgments [5]. Chemistry includes abstract concepts, such as phenomena at the submicroscopic level, which cannot be observed or sensed directly by humans and are represented through symbolic means. Chemical representation is divided into macroscopic phenomena, submicroscopic interactions, and symbolic representations. One chemical material containing these three levels of representation is reduction and oxidation (redox) reaction material [6]. The three levels of representation need to be connected integrally to develop an understanding of chemical concepts. Working with multiple representations will engage learners in constructive and critical thinking, help capture learners' engagement in the learning process, and produce more comprehensive long-term learning outcomes [7].

The findings of pre-research conducted at SMAN 20 Surabaya showed that the critical thinking ability of students on five indicators in redox material was still low, with details of interpretation by 40%, analysis by 25%, evaluation by 8%, inference by 17%, and explanation by 1%. This finding can be caused by the limited variety of chemistry learning media at SMAN 20 Surabaya, especially media that can connect the three representative levels in chemistry. One of the teachers of SMAN 20 Surabaya also suggested that this difficulty can occur because chemistry is abstract, and the submicroscopic level in redox material needs more explanation. This is also reflected in research conducted by Dewi et al. at SMA Negeri 8 Semarang, which found quite similar things [8].

The three levels of representation can be connected through visualisation media in the form of animation. Animation offers three main benefits: first, it serves as a tool to engage with the dynamic aspects of chemical reactions. Second, it assists learners in understanding the particulate nature of matter, including substances, mixtures and phase changes. Third, evidence suggests that animations can encourage learners to connect different levels of

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representation for chemical phenomena [9], [10]. One of the teachers of SMAN 20 Surabaya also agreed that animation media can facilitate three levels of representation and develop students' critical thinking skills, especially in redox reaction material. This is supported by research conducted by Wahyuni et al. (2018) and Sari & Utami, which shows that animated media affects critical thinking skills [11]. Thus, students' low critical thinking ability in reduction and oxidation reactions can be overcome using learning media equipped with animations that contain and connect the three representative levels. Therefore, the Redox Animation application was developed to overcome these problems.

Based on this description, it can be concluded that a visual communication media covering three representative levels is needed to improve critical thinking skills and facilitate students' understanding of chemistry material, mainly regarding reduction and oxidation reactions. The purpose of this study is to develop a Redox Animation application that is feasible to use to enhance student's critical thinking skills on redox reaction topics based on validity criteria and practicality criteria in development research. This article will discuss two learning media feasibility criteria: validity and practicality [12], [13].

Research Methods

The development research model used in this study is the Sukmadinata model with three main stages, namely the first preliminary study, which includes (1) a literature study, (2) a field survey, and (3) preparation of the initial draft. The preparation of the initial draft of the media that has been completed is categorised as draft one media. Draft 1 media is incorporated in the second stage of model development, which includes (1) media review of draft one media, which resulted in draft two media, and (2) validation of draft two media, which resulted in validation data and draft three media. Furthermore, draft three media is incorporated in the third stage, namely model testing, which includes (1) test of draft three media and (2) final media. In this research, it is limited to the testing stage. [14]. The preliminary study consists of three steps, namely, the literature study, which aims to find concepts or theoretical foundations; field surveys, which aim to complement the concrete data of the literature study; and the preparation of initial drafts that rely on preliminary study data and field surveys in the form of product designs in the form of storyboards. The preparation of the initial draft that has been completed is then reviewed and validated before entering the trial step.

Review and validation are included in the model development stage. Validation produces validity data used to measure validity, a criterion for the feasibility of learning media. Validity data was obtained through a validity questionnaire sheet by three validators: two chemistry lecturers and one chemistry teacher. The validity data in this study is in the form of a score of 1-5, guided by the Likert scale [15]. The validity data were analysed descriptively and quantitatively, namely analysed on each indicator using the mode, which was declared valid if the mode score was at least 4 [16].

After passing the validity test, the next stage is the model test in the trial step. The trial was conducted on a limited basis to 20 students of SMAN 20 Surabaya. In this stage, practicality data was obtained through a learner response questionnaire after the trial. The learner response questionnaire contains positive and negative statements guided by the Guttman scale, where it scores one if it gives a "No" answer to a negative statement and a score of 1 if it gives a "Yes" answer to a positive statement. The Redox Animation application is considered practical if the percentage of practicality is obtained ≥61% [15]. The learner response questionnaire in this study was also supported by the learner activity observation sheet filled in by observers during the trial. Five observers carried out the observation process, each observing four students. The learner activity observation sheet also contains positive and negative statements that are guided by the Guttman scale, where it gets a score of 1 if it gives a "No" answer to a negative statement and gets a score of 1 if it provides a "Yes" answer to a positive statement. The learner observation sheet is declared to support the learner response questionnaire if the percentage of support is ≤61% [15].

Results and Discussion

Sukmadinata's research and development model begins with a preliminary study stage [14]. The initial study produced findings that are mapped in Table 1 below.

Table 1. Findings at the preliminary study stage.

No.	Findings
1.	Based on the research of Wahyuni et al., Mashami & Gunawan, Ritonga et al., and Sari & Utami, the effect of using animation media on critical thinking skills was found [17], [18], [19].
2.	Based on pre-research at SMAN 20 Surabaya, 84.8% of respondents thought that chemistry was one of the subjects that was difficult to learn due to the abstract nature of the material as conveyed by one of the teachers of SMAN 20 Surabaya, this difficulty occurs because chemistry is abstract and the lack of explanation of the submicroscopic level in redox reaction material.
3.	Based on pre-research at SMAN 20 Surabaya, students' critical thinking ability on five indicators namely interpretation, analysis, evaluation, inference, and explanation in redox material is still low.
4.	The curriculum used at SMAN 20 Surabaya is the Merdeka Curriculum.
5.	Students of SMAN 20 Surabaya are entering their late adolescence.
6.	Redox reaction material has five learning objectives incorporated in Phase F of the Merdeka Curriculum.
7.	The learning media developed is an electronic learning media that uses the android operating system. This learning media contains redox reaction material which includes three levels of representation, namely macroscopic, submicroscopic, and symbolic which are packaged in the form of animation.
8.	The learning media contains a usage guide menu, learning objectives, reduction and

No.	Findings
	oxidation reaction material, practice questions, and evaluation.

Based on these findings, the validators prepared and validated the initial draft. The preparation of the initial draft produced media, as shown in Figure 1 below.

Figure 1. Media After Initial Draft Design.

The validity measured in this study is content validity and construct validity. Content validity is defined as measuring how the Redox Animation application can answer the need to improve critical thinking skills based on the latest knowledge [12]. The content validity mode score on each objective is shown in the graph below, as Figure 2.

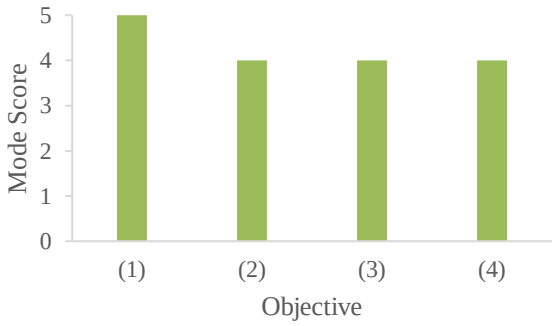

Figure 2. Content Validity Mode Score.

Content validity in this study has four objectives, namely: (1) knowing the suitability of the media with criteria related to the material; (2) knowing the suitability of the media with criteria related to the presentation of the material; (3) knowing the suitability of the media with criteria related to illustrations; and (4) knowing the suitability of the media to improve critical thinking skills. Based on Figure 2, the overall mode score of content validity in the first objective is 5 with a very valid statement, the second objective is 4 with a valid statement, the third objective is 4 with a valid statement, and the fourth objective is 4 with a valid statement.

The first objective has three aspects of assessment, namely: (1) the suitability of learning objectives with the Learning Phases/Achievements; (2) the suitability of the material in the developed media with the learning objectives to be achieved; and (3) the suitability of media material with the development of science and technology. Each aspect received a mode score of 4, 5, and 5 with valid, very valid, and very valid statements, respectively. Thus, the mode score of content validity on the purpose of knowing the suitability of the media with criteria related to the material is 5, with a very valid statement. This shows that the Redox Animation application is based on the curriculum used, namely the Merdeka Curriculum, both in terms of learning objectives and formulated material [20]. Science and technology also developed The Redox Animation application because it is an electronic learning media accessible on a smartphone or tablet with high flexibility. And based on the various animation features offered [21].

The second objective has three aspects of assessment, namely: (1) learning objectives have been formulated clearly and by the learning outcomes; (2) the material on the media presented in the form of animation is displayed communicatively, proportionally, and consistently; and (3) the animation presented clarifies the concept. Each aspect gets a mode score of 4, 5, and 4 with valid, very valid, and valid statements, respectively. Thus, the mode score of content validity on the purpose of knowing the suitability of the media with criteria related to the presentation of material is 4 with a valid statement. This can be interpreted as animation in the Redox Animation application, which uses clear and easy-to-understand Indonesian language. The visual display, audio, and text are presented in a balanced and well-organized manner, and each animated video maintains a communicative and proportional presentation uniformly [22], [23], [24]. In addition, animation in the Redox Animation application has three levels of representation that can explain concepts and phenomena beyond direct observation and cannot be perceived by human senses in chemistry [10], [25].

The third objective has two assessment aspects, namely: (1) The animation used in the media is clear, relevant, and accurate to support the concept, and (2) There are three levels of chemical multi-representation (macroscopic, sub-microscopic, and symbolic). Each aspect gets a mode score of 4 and 5 with valid and very valid statements, respectively. When two modes have the same distance from the standard, the smaller value is chosen to emphasise the imbalance and unbalanced proportion in the data distribution [16]. Thus, the content validity mode score on the purpose of knowing the suitability of the media with criteria related to the presentation of the material is 4 with a valid statement. Animation in the Redox Animation application can support the concept because the visualisation of chemical processes can help students with accurate concept understanding [26]. Visualisation of chemical processes is presented accurately through animations containing three levels of representation: macroscopic, submicroscopic, and symbolic [10].

The fourth objective has two assessment aspects: (1) the media is equipped with animations that can improve students' critical thinking skills, and (2) the media is equipped with activities related to critical thinking skills. Each aspect gets a mode score of 4 with a valid statement. Thus, the mode score of content validity on the purpose of knowing the suitability of media to improve critical thinking skills is 4 with a valid statement. Animation is said to support critical thinking skills when animation can support active learning so that it involves students actively in the learning process [10], [27]. In addition, the early stages of critical thinking skills can be developed through practice, fostering awareness of the most effective ways of thinking to solve problems [28].

Content validation of the four objectives has shown that the Redox Animation application is valid with a mode score of 5, 4, 4, and 4, respectively. Based on the Likert scale

score adapted from Riduwan, 4 is the minimum requirement for the data to be declared valid [15].

Construct validity measures how consistent and interrelated all the components of the Redox Animation application are [1]. The mode score of construct validity on each objective is shown in the graph, Figure 3 below.

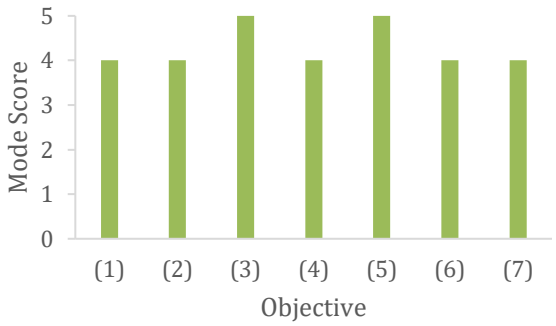

Figure 3. Construct Validity Mode Score.

Construct validity in this study has seven objectives, namely: (1) Knowing the characteristics of chemistry; (2) Knowing the suitability with the characteristics of students; (3) Knowing the existence of rules; (4) Knowing the existence of standards of success of students; (5) Knowing the existence of decision-making elements; (6) Knowing the appearance of applications as learning media; and (7) Knowing audio-visual communication. Based on Figure 3, the overall mode score of construct validity in the first objective is 4 with a valid statement. The second objective is 4 with a valid statement, the third objective is 5 with a very valid statement, the fourth is 4 with a valid statement, the fifth is 5 with a very valid statement, and the sixth is 4 with a valid statement. The seventh objective is 4 with a valid statement.

The first objective has one assessment: media presented with clear and relevant facts, concepts, and theories. This aspect received a mode score of 4 with a valid statement. Thus, the mode score of construct validity on the objective of knowing the chemistry characteristics is 4 with a valid statement. The Redox Animation application is characterised by chemistry, namely the presence of distinctive, sequential and dynamic abstract concepts and their diversity, with each topic exhibiting unique attributes [29].

The second objective has four aspects, namely: (1) Suitability with the age of students; (2) Writing sentences using language that is easy to understand; (3) Writing sentences according to the rules of good and correct Indonesian, and (4) Accuracy of writing scientific/foreign terms. Each aspect received a mode score of 4 with a valid statement. Thus, the mode score of construct validity on the purpose of knowing the suitability with the characteristics of students is 4 with a valid statement. This shows that the Redox Animation application is based on the character of the learners. In terms of the age of students, SMA/MA students are generally late adolescents aged between 15-19 years, which has entered the formal operation stage according to Piaget's theory of cognition development [30], [31], [32].

The third objective is to know the existence of rules, with the aspect that there are specific rules to use the Redox Animation application successfully. This aspect received a mode score of 5 with a very valid statement. The regulations in the Redox Animation application aim to make students successful in using it. The successful use of learning media is an essential factor in achieving learning goals, which directly affects the success of achieving these goals [33].

The fourth objective is to know the standard of success of students by inviting them to learn systematically with the standard of success in the form of achieving minimum competencies. This aspect received a mode score of 4 with a valid statement. Learner success standards are found on the Evaluation page in the Redox Animation app. Evaluation is an essential fundamental activity in every learning session, designed to assess the success of the learning process and support reflective analysis of learning outcomes [34].

Knowing that there is an element of decision-making is the fifth goal in construct validity. This objective has the aspect that there are several answer choices in the exercise questions. This aspect received a mode score of 5 with a very valid statement. Decision-making in multiple-choice tests involves making choices under the learner's control [35].

The sixth objective has four aspects, namely: (1) The use of colours according to the theme; (2) The use of animation in the media is developed accordingly and clearly; (3) The presentation of animation and text in the application is interesting and can be read well; and (4) The suitability of feature placement. Each aspect received a mode score of 5, 5, 4, and 4 with very valid, very valid, and valid statements, respectively. Thus, the mode score of construct validity on the purpose of knowing the application's appearance as a learning media is 4 with a valid statement. As can be seen, the main colour themes in the Redox Animation app are blue and purple. In the learning process, blue and purple colours can be used to create an environment that encourages concentration, relaxation, and reflection, increases cognitive engagement by fostering a sense of calm and stability and evokes feelings of elegance, creativity, visual appreciation and imaginative exploration during long learning sessions [36], [37]. In addition, the animation in the Redox Animation application is based on the learning objectives formulated based on the phases and learning outcomes of the Merdeka Curriculum. It is well-presented and attractive in terms of colour selection, readability of writing, and audio clarity [38], [39]. The Redox Animation application has a layout that allows the design to achieve an attractive aesthetic [40].

The seventh objective discusses audio-visual communication. This objective has two aspects: (1) There is continuity between animation, instructions, and sound in the animated video, and (2) There is continuity of colour and text placement with the background provided in the application. Each aspect received a mode score of 5 and 4 with valid statements, respectively. Thus, the mode score of construct validity on the purpose of knowing audio-visual communication is 4 with valid statements. This shows that the animation, the instructions provided, and the accompanying sound are interconnected. Animations are often enhanced with music and sound that match the accompanying narrative text, facilitating the integration of nonverbal and linguistic information, thus aiding its retention in memory [41]. Paivio's dual code theory, closely related to information processing theory, states that information presented in visual and verbal formats is more memorable than information presented in only one format

[30]. In addition, the text in the Redox Animation app already has colour continuity and text placement. Image text is usually positioned in a homogeneous area to increase contrast and visibility to attract one's attention [42].

In the validation process, there were several suggestions, inputs, and improvements obtained from the validators, namely: (1) several captions have colours that are less contrasting with the background; and (2) The sentence "today" in the Definition sub-matter is less relevant to be used in the future. Based on these suggestions, appropriate improvements were made, and the validity score was as described.

Construct validation of the seven objectives has shown that the Redox Animation application is valid with the mode score of each objective successively amounting to 4, 4, 5, 4, 5, 4 and 4. Thus, the Redox Animation application is declared constructively valid based on the Likert scale score adapted from Riduwan [15]. The Redox Animation application, which has been declared valid both in content and construction, enters the third stage in development research by Sukmadinata, namely model testing in limited trials [14].

Practicality refers to the condition in which users can use the media quickly, as intended by the developer. This includes aspects such as smooth and straightforward operation, easy access, relatively low cost, high mobility, and simple management [12], [43,44]. The Redox Animation application is declared practical if the percentage of practicality criteria is ≥61% with practical criteria [15]. Practicality data analysis was obtained through a student response questionnaire sheet given to students after the trial. The practicality of the Redox Animation application is reviewed through three objectives, namely knowing the ease of using the Redox Animation application, knowing the usefulness of the Redox Animation application on learning outcomes, and knowing the usefulness of the Redox Animation application on critical thinking skills. To support this, this study also used a student activity observation sheet filled in by observers during the trial. This observation sheet is used to obtain data on how students respond to the Redox Animation application through the observer's point of view. The learner activity observation sheet is declared to support the learner response questionnaire if the percentage of support criteria ≥61% is obtained [15].

The first objective in the learner response questionnaire is related to convenience, which is reviewed from six statements, namely: (1) Opening/installing quickly; (2) Display and features are simple and not confusing; (3) It doesn't take long to open the Redox Animation application; (4) The Redox Animation application is too heavy so it uses a lot of device memory and makes the device slow; (5) The writing is too small so it is difficult to read; and (6) The animation is too small so it is not visible. The percentage of the first objective practicality criteria for each statement is mapped in Figure 4 below.

Based on Figure 4, it can be seen that all statements in the first objective received efficient criteria with details of the percentage of practicality criteria, namely: statement (1) by 85%, statement (2) by 100%, statement (3) by 95%, statement (4) by 90%, statement (5) by 100% and statement (6) by 100%. This shows that the Redox animation application can be installed and opened quickly. Ease of installation is important because application installations are generally made manually, especially installing and removing applications [45]. In addition, the appearance of the Redox Animation application is easy to understand, the writing is easy to read, and the animation can be played and viewed easily [23], [39-40].

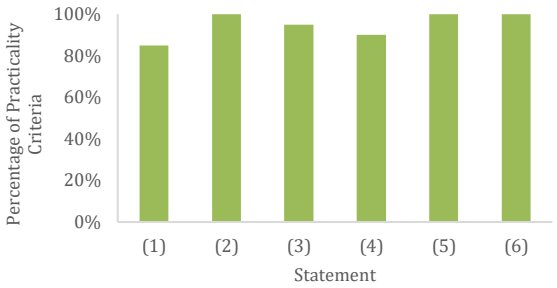

Figure 4. Percentage of First Objective Practicality Criteria

The response questionnaire data related to the ease of use of the Redox Animation application is also supported by the data from observing students' activities. In this case, there are five statements, namely: (1) Learners find it easy to operate the Redox Animation application; (2) Learners use the Redox Animation application by the instructions for use; (3) Learners can play animated videos; (4) Learners can understand the language in the Redox Animation application easily; and (5) Learners complain about the clarity of text and animation. The percentage of criteria supporting the first objective in each statement is mapped in Figure 5 below.

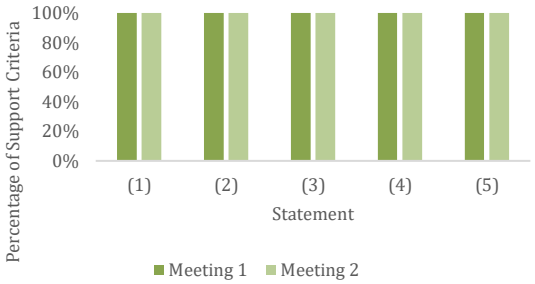

Figure 5. Percentage of Support Criteria for the First Objective

Based on Figure 5, it can be seen that all statements in both meetings 1 and 2 received very supportive criteria with a percentage of supportive criteria of 100%. Thus, the learner activity observation sheet data strongly supports the learner response questionnaire data on the first objective.

The second objective is related to usability which is reviewed from four statements, namely: (1) Increase knowledge of reduction and oxidation reaction materials; (2) Increase the attitude of curiosity in learning reduction and oxidation reaction materials; (3) Increase basic knowledge of chemistry; and (4) Does not improve student learning outcomes in the assessment of their skills. The percentage of practicality criteria in the four statements is mapped in Figure 6 below. This shows that the Redox Animation application can increase students' knowledge and curiosity about redox reaction material and improve their fundamental chemistry and learning outcomes. This means that the Redox Animation application can help make it easier for students to understand abstract learning materials to increase their curiosity about the material [46], [47]. In addition, research

conducted by Ngozi Okeke, Sari and Utami supports increased student learning outcomes. Ngozi and Okeke stated that there is a relationship between critical thinking skills and learning outcomes, namely, good critical thinking skills can improve student achievement [27]. As for Sari and Utami's research, it is concluded that interactive multimedia animation can improve students' learning outcomes [11].

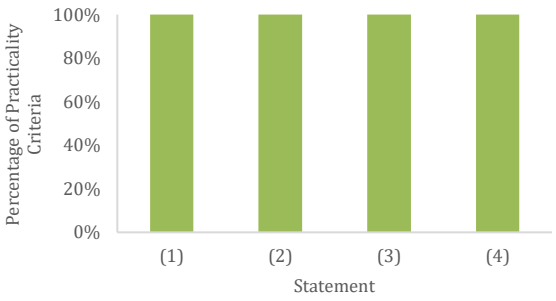

Figure 6. Percentage of Second Objective Practicality Criteria

Based on Figure 6, it can be seen that all statements (1), (2), (3), and (4) in the second objective received efficient criteria, with each getting a percentage of practicality criteria of 100%.

The response questionnaire data related to the usability of the Redox Animation application on learning outcomes is also supported by data from student activity observations. In this case, there are three statements, namely: (1) Learners are not focused on the Redox Animation application (less interested); (2) Learners can do the evaluation directly in the Redox Animation application, and (3) Learners are easy to answer the evaluation available in the Redox Animation application. The percentage of criteria supporting the second objective in each statement is mapped in Figure 7 below.

Figure 7. Percentage of Support Criteria for the Second Objective

Based on Figure 7, it can be seen that all statements at both meetings 1 and 2 received very supportive criteria with details of the percentage of supportive criteria, namely, statement (1) of 85% at meeting 1 and 95% at meeting 2, statement (2) of 100% at meeting 2, and statement (3) of 100% at meeting 2. Thus, the data from the students' activity observation sheet strongly supports the students' response questionnaire data on the second objective. Please note meeting 1 has several points that do not have a percentage. This happened because students using the Redox Animation application were not evaluated at that meeting.

The third objective is related to helpfulness which is reviewed from five statements, namely: (1) Presentation of macroscopic, sub-microscopic, and symbolic material illustrations is clear; (2) Practice test questions on the application include critical thinking skills questions; (3) Explanation of material is less connected to previous material; (4) Features are less supportive of developing critical thinking skills; and (5) Presentation of animation is clear and complete. The percentage of practicality criteria on the five statements is mapped in Figure 8 below.

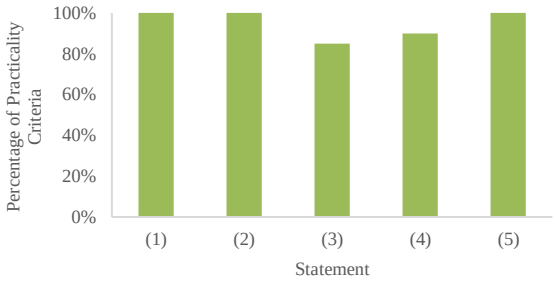

Figure 8. Percentage of Third Objective Practicality Criteria

Based on Figure 8, it can be seen that all statements in the third objective received efficient criteria with details of the percentage of practicality criteria, namely statement (1) of 100%, statement (2) of 100%, statement (3) of 85%, statement (4) of 90% and statement (5) of 100%. This shows that learners can clearly distinguish the level of representation presented. This difference must be presented clearly because three representative levels aim to explain concepts and phenomena beyond direct observation and cannot be perceived by human senses [10], [25]. In addition, the available features can support critical thinking skills, especially questions on the Material and Exercise pages that contain animation [10], [28]. The explanation of the material in the Redox Animation application has also been linked to the previous material. This makes the learning process effective based on meaning and perception factors [48].

The response questionnaire data related to the help of the Redox Animation application to critical thinking is also supported by the data from the observation of students' activities. In this case, there are two statements: (1) Learners can do exercises directly in the Redox Animation application, and (2) Learners can quickly answer the exercises available in the Redox Animation application. The percentage of criteria supporting the third objective in each statement is mapped in Figure 9 below.

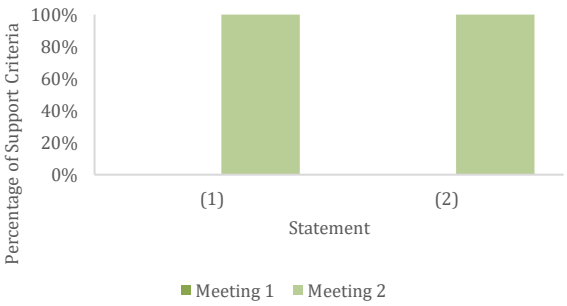

Figure 9. Percentage of Support Criteria for the Third Objective

Based on Figure 9, it can be seen that all statements in 2 received very supportive criteria with a percentage of supportive criteria of 100%. Thus, the learner activity observation sheet data strongly supports the learner response questionnaire data on the second objective. The absence of data at meeting 1 is due to students not doing the exercises in the Redox Animation application at that meeting. Thus, the Redox Animation application is considered very practical based on three aspects, with an overall percentage of practicality criteria of 96.33%.

Based on the discussion above, the Redox Animation application is declared very practical based on three aspects: its ease of use, its usability for learning outcomes, and its usability for critical thinking skills, which get a percentage of overall practicality criteria of 96.33% with efficient criteria. This statement is supported by observation data based on three aspects strongly supporting the students' response questionnaire results.

Conclusion

Based on the results and discussion, it can be concluded that the Redox Animation application developed meets the feasibility to use to enhance students' critical thinking skills on oxidation-reduction reaction topics based on validity criteria by obtaining a content validity mode score of 4 with valid criteria and a construct validity mode score of 4 with valid criteria and practicality criteria by receiving a percentage in the learner response questionnaire of 96.33% with efficient criteria. Thus, the Redox Animation application is declared feasible for enhancing students' critical thinking skills on redox reaction topics based on validity criteria and practicality criteria in development research.

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