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Development of Website based Multiple Representation on Buffer Solution Topic in Chemistry Learning

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Abstract. Buffer solution is one of chemistry difficult topics. It contains theory, calculation, and experimentation, so it requires good analysis and understanding of concepts. The results of interviews with students in Bintan Regency showed that the sub material of determining buffer solution components and analyzing the working principles of buffer solutions was the most difficult part because it was abstract. Multiple representations on the website media will visualize abstract things from the topic of buffer solution so as to increase the understanding of concepts from students. The research aims to produce multiple representation website on buffer solution topics and to determine its feasibility, practicality, and readability. The research method used is research and development (R&D) following the 4D development model by Thiagrajan (define, design, develop, and disseminate). The sample research used 21 students and five chemistry teachers in Bintan Regency to collect user responses related to practicality and readability. The data analysis calculates the average score of the validation and response values and classifies them into the available categories. The results of the validation show that the average score of material experts is 63.5 (learning, materials, multiple representations, and evaluation aspects), while the average score of media experts is 71.5 (graphic design, software engineering, and media selection criteria aspects), which are classified as very good. The results of practicality and readability responses are 119 (learning, materials, multiple representations, evaluation, graphic design, software engineering, and media selection criteria) and 70.5 (learning, graphic design, and software engineering), which are very good categories.

Keywords: 4D; Buffer Solution; Learning Media; Practicality, Readability

Introduction

All sectors in the world are being influenced by technological breakthroughs in today's Society. Indonesia, as a developing country, has the right to follow this breakthrough in order to have better quality, especially in the education sector. One of the strategies that can be done to master literacy skills in the 21st century, namely information literacy, communication, and technology. This is in line with what Sudibjo et al. (2019) said that the current learning process is influenced by huge technological breakthroughs. A survey conducted by the Global Educational Center (2018) shows that Indonesian student

s are ranked highest as technology users in the world. The digital literation skills of Indonesian students will be increasingly trained if these technological developments are juxtaposed with learning, especially chemistry learning.

Chemistry is a component of science which is dominated by experiments answering questions about natural events, this is also related with its nature, transformation and dynamics (Ministry of Education and Culture, 2017). The chemistry teacher as a facilitator will package chemistry learning as interesting as possible perhaps by combining media, teaching materials and learning models so that chemical material can be understood easily.

Buffer solution is one of the important chemistry topics to understanding, it is taught in class XI of Indonesia high school. Rery et al. (2022) explain buffer solution is a difficult topic because it contains theory, calculation, and experimentation, so it requires good analysis and understanding of concepts. Redhana et al. (2017) also felt the same thing that students experienced difficulties in solving buffer solution calculation problems and how the buffer solution works. The results of pra research interviews with students in Bintan Regency showed that the sub material of determining buffer solution components and analyzing the working principles of buffer solutions was the most difficult part because it was abstract.

Buffer solutions are a topic that is abstract, so multiple representations are needed that can describe all parts of the buffer solution topic (Drastisianti et al., 2019). Devi et al. (2018) said that understanding the three levels of chemical representation in the topic of buffer solutions is very important by understanding the events that exist (macroscopic) then connecting them with the concepts (sub microscopic and symbolic). Field facts show that multiple representations are still rarely used as a focus in chemistry learning, even though students' representational abilities play an important role in understanding chemical concepts (Susilaningsih et al., 2019). Things that can be done to facilitate multiple representations on the buffer solution topic are to integrate them into technology based learning media.

Information pra research interviews obtained from high schools in Bintan Regency is that teachers in schools have used technology based learning media such as video from Youtube, but it is not enough to visualize chemical objects in buffer solution material from all multiple representation components and to help students concepts understanding. The videos only represents chemical material into macroscopic and symbolic components, while submicroscopic ones are ignored. A similar case also occurred in Tasker & Dalton on Liu & Elms (2019) where teachers only used the symbolic and macroscopic levels, while submicroscopic levels were ignored. In fact, the submicroscopic component can be facilitated by the teacher's technology-based media operating skills to achieve current learning trends. Cholifah et al. (2020) stated that teacher administration is busy and obstacles in operating technology are the reasons why teachers have not developed technology in learning media.

The presence of multiple representation based website media will be a solution to overcome understanding concepts and train students' digital literacy skills. In this case, the role of website media is very important to help represent the three components in multiple representations on the topic of buffer solutions, such as macroscopic related to the stable pH of the buffer, submicroscopic discusses buffer particles, and symbolic is the calculation and reaction. Multiple representations on the website media will visualize abstract things from the topic of buffer solution so as to increase the understanding of concepts from students. According to Camel et al. (2020) using website media can increase student understanding on chemsitry learning, students feel more easy to understand analytical chemistry cause there are many learning features that can be used. The other reasearcher also said using website media, each learning material will be well structured and each chemistry topic will be presented according to each level of understanding (Hamid et al.,

2021). The using media is also considered easy because it can be accessed using any type of device without an installation process.

This research is novel in the form of website media that integrates multiple representation approaches in buffer solution material, different from research by Nanggara & Laksono (2023) regarding chemistry in life websites and Yulianti et al. (2020) regarding ion solution websites without a multiple representation approach. This website media is also designed with Google Sites which is considered easy without requiring large costs and coding programming (Utoyo & Sofiana, 2023; Antika & Setiawan, 2023; Khoiriyah & Hermawan, 2023).

The purpose of this research is to produce multiple representation website media on buffer solution topic and to determine its feasibility, practicality, and readability. The research used R&D method with 4D model by Thiagarajan.

Methods

This research is followed by the research and development (R&D) method with 4D development model by Thiagarajan (Fahmi et al., 2022). The research participants are material and media expert to validate feasibily of media, five high school chemistry teachers to assess the practicality of media, and 21 students of class XII MIPA to conduct media readability tests. Material and media experts are chemistry education masters lecturers who have experience in the field of solution chemistry and technology based media. Teachers and students came from high schools in Bintan Regency with details, namely three chemistry teachers from SMAN 1 East Bintan, two chemistry teachers from SMAN 1 Toapaya, and 21 students of class XII MIPA SMAN 1 Toapaya. The procedure steps followed only reach the develop stage, considering that the purpose of the study is only to determine feasibility, practicality, and readability of media. Here are the steps of the 4D procedure carried out in the study: Define includes front end analysis, learner analysis, task analysis, concept analysis, and specifying instructional objectives. Design includes criterion referenced test, media selection, format selection, and initial design. Develop includes expert appraisal and development testing.

The research instruments used were validation sheets, practicality assessment sheets, and media readability questionnaires. The results of the data obtained through validation sheets, practicality assessment sheets, and media readability questionnaires were analyzed by calculating the average score. The average score obtained was then classified based on the category calculation in Table 1 by Azwar (2015).

Table 1. Score Category

No	Score	Category
1	$\bar{X} > M_i + 1.8\ SB_i$	Very good
2	$M_i + 0.6\ SB_i < \bar{X} \leq M_i + 1.8\ SB_i$	Good
3	$M_i - 0.6\ SB_i < \bar{X} \leq M_i + 0.6\ SB_i$	Enough
4	$M_i - 1.8\ SB_i < \bar{X} \leq M_i - 0.6\ SB_i$	Low
5	$\bar{X} \leq M_i - 1.8\ SB_i$	Very low

Information:
$\bar{X}$: Actual score
M_i : Mean
SB_i : Standard deviation

Results and Discussion

Define

The first step is front end analysis to indentificate and determine basic problem from chemistry learning. The use of smartphones for learning needs has been allowed by the school, which cannot be separated from the supervision of teachers, not only that the school has facilitated wifi in every classroom. The condition of digital literacy of students in schools can be said to be quite good, but there are still some things that need to be leveled, such as critical information, where there are still students who learn through website references that are less valid authenticity. Critical information is needed in digital literacy to reduce the spread of hoax information (De Paor & Heravi, 2020). The way that can be done to improve digital literacy in the learning process is to use technology based learning media. Research conducted by Silamut & Petsangsri (2020) also said that literacy skills could be improved by using digital based media. Chemistry teachers in schools have also tried to use technology based learning media in learning, but the learning media used are still simple such as ppt, excel, and video, so it is not enough to explore students' digital literacy skills well.

A culture of learning to understand a concept of material has been created in schools, but some students still find it difficult to understand the concept of chemical matter, one of which is a buffer solution. The daily test results of class XI buffer solution material last year showed that some students had incomplete grades. The same thing was felt by Salame et al. (2022) that students consider buffer solutions to be materials that are difficult to understand because they involve complicated calculations. The teacher said students had difficulty determining the buffer solution components because students did not remember the acid-base compounds. To understand buffer solutions, learners must understand chemical equilibrium (Kurniawan et al., 2020) and acid base (Boothe et al., 2023) . On the topic of the working principle of buffer solution, students tend to memorize the material in the package book so that when given a mixture of other buffers, students find it difficult to answer.

In the learning process, teachers have used learning media in the form of videos from the YouTube website but have not received maximum results. The learning video used only displays material explanations similar to textbooks in schools and is only facilitated at the symbolic level and macroscopic levels, so it is not enough to improve students' understanding. Ideally, to understand the concept of buffer solution, learners should understand it from macroscopic, submicroscopic, and symbolic dimensions. Based on the nature of chemistry, chemistry will be easier to understand if it is presented in the form of three levels of representation (Mousemi et al., 2023). The working principle of the buffer solution can be explained by the phenomenon of ion effects together with the help of three levels of representation (Dewi, 2022), as well as its components.

The second step is learner analysis to know the student’s characteristics. Class XII students are in the age range of 16-17 years; according to Piaget's theory of cognitive development, adolescents are mentally able to think logically about various abstract things and ideas. Based on the information obtained from students, the topic of the working principle of the buffer solution becomes difficult to understand the buffer solution material, because students are accustomed to memorizing the theory in the package book, so when given the same type of buffer solution with different components, they cannot explain how the principle works. They also find it difficult to imagine abstract things about how the working principle occurs so that the buffer solution undergoes insignificant pH changes. This is in line with research by Susilaningsih et al. (2022) that the analysis indicator of the working principle of buffer solutions is in the bottom 4, with the lowest score of the ten existing indicators. One of the efforts that can be made to overcome abstract things in chemistry is to use learning media. Learning media will facilitate three levels of

representation in chemistry learning, especially at the symbolic and submicroscopic levels (Eliyawati et al., 2018), so as to help visualize abstract things.

All students in the school already own and use smartphones as learning facilities. This, of course, will facilitate the learning process because, with a touch, that does not mean students are able to access the desired information. Smartphones can make it easier for someone to find information and communicate anywhere and anytime; besides that, they can also prepare for work and access entertainment (Siregar & Oktavia, 2022). Another condition shows that students have never had experience using more complex learning technology, such as virtual labs, so their skills in using digital media are limited to simple technology. Learners also said that they were very happy with learning juxtaposed with games, they thought game based learning could overcome its saturation in studying chemistry. This is in accordance with what da Silva Júnior et al. (2021) said game based learning can not only increase students' understanding but also increase learning motivation.

The third step is concept analysis to design chemistry topics that students must understand. The chemistry topic is buffer solutions which consist of properties, pH calculations, how to make them, and their role in life.

The final step is specifying instructional objectives, the learning objectives obtained through the basic competencies of the 2013 curriculum syllabus revised by the Ministry of Education and Culture. The learning objectives are students can explain the working principle, pH calculation, and the role of buffer solutions in the body of living things and make buffer solutions with a certain pH.

Design

The first step is criterion referenced test to make research instruments. The research instruments are validation sheets, practicality assessment sheets, and media readability questionnaires. Validation sheets are used to validate media by material and media experts can seen in Table 2 and Table 3, practicality assessment sheets are used to asses media practicality by chemistry teachers can seen in Table 4, and media readability questionnaires are used to get readability responses from students can seen in Table 5. Validation sheet instruments and practicality assessment sheets are arranged based on needs consisting of several aspects such as learning aspects, materials, evaluation, multiple components of representation, graphic design, software engineering, and media selection criteria. As for the readability questionnaire, it consists of aspects of learning, graphic design, and software engineering.

Table 2. Material Expert Validation Sheet

No	Aspect	Indicator
1	Learning	Conformity of indicators with basic competencies
		Conformity of learning objectives with indicators
		Compliance of material with indicators
		Helps understand material concepts
		Media attracts user interest and motivation in learning
2	Material	The material follows the principles of 2013 curriculum material development
		The order of material is in accordance with the 2013 curriculum syllabus
3	Multiple Representation	Correspondence of the macroscopic level to the material
		Correspondence of the symbolic level to the material
		Compatibility of the submicroscopic level with the material
4	Evaluation	Suitability of writing question formulations

	Correct grammar
	Sample questions are available
	Match the questions with the answer key

Table 3. Media Expert Validation Sheet

No	Aspect	Indicator
1	Graphic Design	layout
		Color background selection
		Proportional font size
		Letter color matching
		Font type suitability
		Quality of animation used
		The quality of the video used
2	Software Engineering	Clarity of instructions for media use
		Buttons/navigation used
		The media domain/web address represents the product
3	Media Selection Criteria	Ease of access to media in learning
		Technology integrated media
		Media gives rise to two-way communication
		Media has novelty value
		Media has affordable costs

Table 4. Practicality Assessment Sheets

No	Aspect	Indicator
1	Learning	Conformity of indicators with basic competencies
		Conformity of learning objectives with indicators
		Compliance of material with indicators
		Helps understand material concepts
2	Material	The material follows the principles of 2013 curriculum material development
		The order of material is in accordance with the 2013 curriculum syllabus
3	Multipel Representation	Correspondence of the macroscopic level to the material
		Correspondence of the symbolic level to the material
		Compatibility of the submicroscopic level with the material
4	Evaluation	Suitability of writing question formulations
		Correct grammar
		Sample questions are available
		Match the questions with the answer key
5	Graphic Design	layout
		Color background selection
		Proportional font size
		Letter color matching
		Font type suitability
		Quality of videos and animation used
6	Software Engineering	Clarity of instructions for media use
		Buttons/navigation used
7	Media Selection Criteria	Ease of access to media in learning
		Technology integrated media
		Media gives rise to two-way communication
		Media has novelty value
		Media has affordable costs
		Media get support from schools

Table 5. Readablity Questionnaire

No	Aspect	Indicator
1	Learning	Material presented
		Interest in learning
		Practice questions are presented
2	Graphic Design	Video and animation quality
		Appropriateness of color, type and size of letters
		Matching background color
3	Software Engineering	Instructions for using media
		Buttons/ navigation
		Ease of operation
		Interactivity

The second step is media selection to identificate chemistry learning media that suit the characteristics of students based on the define step. The chemistry learning media chosen is website media that can be accessed by any device. This media was created using the Googlesites platform which does not require any costs.

The third step is format selection to determine content from chemistry learning website media. The media parts consist of a menu, instructions of use, competency, developer profile, material, evaluation, and virtual lab. Here are the characteristics of multiple representations inserted into the buffer solution website media: Macroscopic distinguishes the pH of the buffer and non buffer solutions and creates buffer rules with a specific pH. Symbolic is reaction and pH calculation of the buffer solution. Submicroscopic includes components of the buffer solution that work to maintain the pH of the buffer solution.

The last step is initial design to create flowchart, story board and real media. The media that has been created has an output in the form of a link, so users only need to access the media via the shared link can be seen in Figure 1. The content is presented in a learning video that contains an opening; the core is the subject matter, examples of illustrations based on multiple representations, and a discussion of questions. The content can seen in Figure 2. Exercises are presented in the form of game-based evaluations using Wordwall. The order of the material is sorted by indicators and divided into three learning video meetings. Meeting 1 discussed the properties of buffer solutions, meeting 2 discussed the pH of buffer solutions, and Meeting 3 discussed the role of buffer solutions.

Figure 2. Website Media Display

Figure 1. Learning Video based Multiple Representation

Develop

The first step is expert appraisal to validate the feasibility of website media. Validators assess based on the aspects of the validation sheet, namely parts of learning, material, learning, components of multiple representations, evaluation, graphic design, software engineering, and media selection criteria. Validators say the multiple representation based buffer solution website media is feasible by making some improvements according to the suggestions. The value of the validation results by validator one and validator two against material eligibility is 65 and 62, respectively, with the very good category, while the value of the validation results by validator one and validator two against media eligibility is 70 and 73 with the very good category. The graph of the validation results can be seen in Figure 3, and the assessment of each aspects can be seen in Table 6.

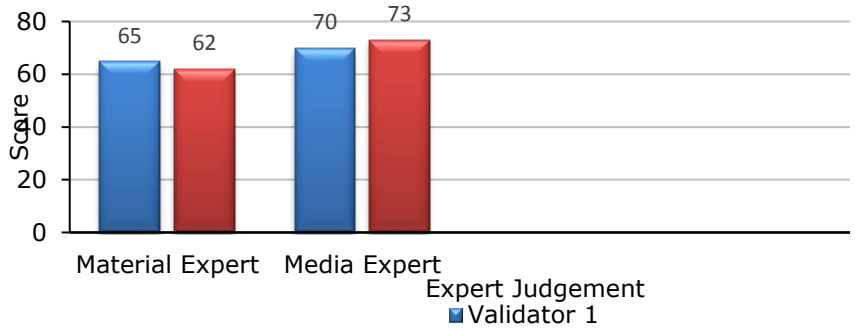

Figure 3. The Validation Results

Table 6. Assessment of each Aspects

No	Aspects	Score		Category
		V-1	V-2	
Material Expert				
1	Learning	20	20	Very good
2	Material	10	10	Very good
3	Multiple representations	15	14	Very good
4	Evaluation	20	18	Very good
Media Expert				
1	Graphic design	32	34	Very good
2	Software engineering	15	14	Very good
3	Media selection criteria	23	25	Very good

In the learning aspect, it shows a very good category. The formulation of indicators in the website media has followed existing rules such as reviewing basic competencies, using operational verbs, and being a reference in compiling assessment tools. Learning objectives in website media have fulfilled the components of formulating learning objectives. Robert F. Mager in Hamzah stated that the formulation of learning objectives must follow the ABCD format, namely audience, behavior, condition, and degree (Pitasari & Febriyanti, 2023). Validators also assess that website media attracts user interest and motivation in learning. Widarti et al. (2022) said that a learning medium must be able to attract interest and motivation from students so that they are not bored following the lesson. The material aspect gets the very good category. There are three principles of developing a learning material, namely suitability, consistency, and adequacy. In this case, the material on the media website has followed the principles of developing 2013 curriculum material and has been sequentially according to the 2013 curriculum syllabus revised. Validators provide

additional comments in the form of presenting material, not only in the form of videos, but also need to be attached to the website. Validators say "The structure of the buffer solution material is good and in accordance with the 2013 curriculum syllabus, but you have to add text material on the website, not just in video form".

In the multiple aspects, representation obtains the very good category. This indicates that the integration of multiple representations of the buffer solution material is in accordance with the nature of each component of multiple representations. The components are macroscopic related to the stable pH of the buffer, submicroscopic discusses buffer particles, and symbolic is the calculation and reaction. Each component of multiple representations has a relationship with each other such as molecular formulas using symbolic, pure substances using macroscopic, and molecules using submicroscopic (Gkitzia et al., 2020). Validators say "Multiple representation components are a characteristic of this website so it is very important to pay attention to each existing component, if there is any inconsistency it will result in misconceptions".

The evaluation aspect has been categorized very well in each assessment indicator. The writing of the question formulation must follow the applicable provisions from the aspects of construction, substance, and language. This indicates that the formulation of the questions listed on the website media has followed the existing rules. Grammar in writing questions must also be considered using EYD instruments and not cause double interpretation. It is also added Pratiwi et al. (2021) that writing question formulations must use Indonesian rules and communicative language. Validators also consider that the discussion of sample questions can be easily learned by students, and the question answer key already has the correct answer.

The graphic design aspect gets a very good category, but there are some comments that are described as material for media improvement. First, by moving the menu on the left alignment, Ahn et al. (2021) in their research explained that the layout of the menu on the website will affect the effectiveness of the website. Second, editing excessive header animations is done so as not to slow down the navigation contained in website media. The content of a website is the most important thing for users to revisit the website; therefore, avoid distracting website elements such as banners, marquees, and excessive use of animation. Third, reduce the width of the website size, but this comment is not used as an improvement by researchers because the website design has adjusted to the size of the accessing device.

The choice of background color on the website media is considered appropriate and quite interesting by using a combination of red and brown. Riadi et al. (2023) convey that color is one of the visual elements that become the identity of the website, so it must be chosen appropriately to attract website visitors. Animations on the website have clear movements and precise timings so that students can clearly see them. The use of animation will help increase the creativity and imagination of learners as they are encouraged to develop visual thinking and bring out creative ideas. The use of type and font size on the website media has used a standard typeface and font size that can be read clearly. Batubara (2020) explains that typefaces should use plain and not much decoration, such as sans serif, Arial, and times new roman, then the font size must be adjusted to how it is used so that it can be read well, for example, in poster media the font size is larger than textbooks. Validator say " choosing the color of content must take into account the target user, this causes users to frequently visit the content that we have designed. The type and size of letters also need to be adjusted to the size of the website".

The software engineering aspect also received a very good category, and there were some comments, so it needs to be improved. The first comment related to not running the evaluation password meeting one so that it could not access the game-based evaluation has been fixed by double-checking the correct password. The second comment is about the lack of instructions for using virtual labs, so it is feared that students feel confused

about using them. Instructions for use must be made as clear as possible so that users know the function of each button/tool in the media; this is in line with what is said by Torous et al. (2021) that computer based media must have general instructions special instructions that can guide users to explore every facility in the media. Validator say "The domain address of the website media represents the type of product, material, and context so that users can easily recognize the website media used because it has distinctive characteristics". There are several things that need to be considered in setting up a website domain, namely not using numbers and hyphens, the domain name arranged briefly, and creating a domain with ekstensi.com (Yanuar & Senubekti, 2022). All navigation buttons on the media website have also functioned properly and go to the appropriate page.

The last aspect is the criteria for selecting media that are categorized very well. Media selection criteria indicators follow what Aulia & Riefani (2021) conveyed regarding access, cost, technology, interactivity, and novelty. Access is the ease of media access; in this case, website media access only uses the website's domain address with their device without having to do the installation process. Cost is the cost incurred to use the media; in this case, users only use the daily internet Kouta they have and do not require a download process, so the Kouta spent is not much. Technology discusses whether the media used is technology-based; in this case, website media is one of the technology-based media that has audio and visual facilities. Interactivity discusses the existence of two-way communication in the media; in this case, the website media already has two-way communication contained in game based evaluations, wherein the evaluation there are scores, rankings, and correct answers. Novelty discusses whether the media has novelty value. In this case, website media already has novelty value from media commonly used by schools. The novelty value of this website media is the virtual lab and interactive game-based evaluation; besides that, there are also navigation buttons that use hypertextual techniques.

The second step is development testing to do practicality tests by chemistry teachers and readability tests by students. Media that has been declared feasible by validators continued to be assessed by five high school chemistry teachers regarding the practicality of media. A graph of the practicality assessment results by five chemistry teachers can be seen in Figure 4

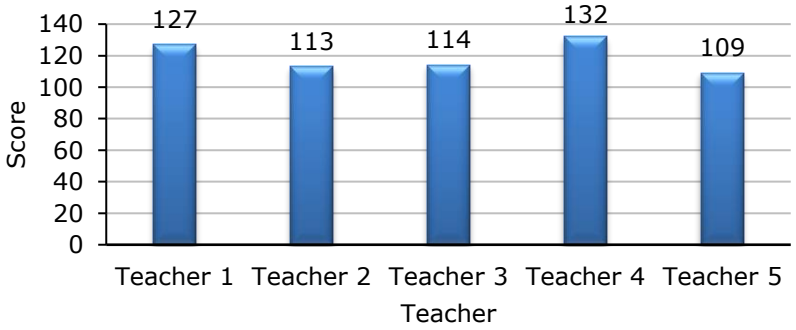

Figure 4. Practicality Assessment Result

The results of the practicality test obtained descriptive data in the form of comments and quantitative data in the form of questionnaire values. The average score of the overall teachers is 119 in the very good category. The implementation mechanism is that researchers send website media links via WhatsApp, and teachers access and assess website media through their smartphones.

The teacher considered that the website media developed was engaging, could help understand the buffer solution material, and access to its use was easy. Still, there were some comments on the website media. The first comment is that the writing on the evaluation question should be enlarged to be visible. Batubara (2020) states that the font

size must be adjusted to how it is used so that the writing can be read; in this case, the website media has used standard font size, but the template of the game has a remote screen size so that the writing is not visible. Therefore, researchers fix it by replacing the game template with a close screen size.

The second comment is the need for more time allocation in working on the evaluation. The teacher said that the time needed to answer the five questions with good concentration. The time provided was 2 minutes for each question, so the time needed to answer five questions was 10 minutes. Therefore, the researcher added 3 minutes for each question so that the time spent answering five questions was 15 minutes. This aligns with what Prastowo & Suyanto (2022) did, using 2-3 minutes to do multiple-choice questions. The third comment is that molecular animation on the working principle of the buffer solution does not represent the number of molecules in the compound, for example, in the CH_3COOH compound, which is composed of three elements, namely C, H, and O. This is related to the multiple components of representation, namely submicroscopic, therefore researchers improve by adjusting the compound and its constituents. In multiples, the submicroscopic level representations are interconnected with other levels, which helps explain why a phenomenon occurs. Baptista et al. (2019) research results say multiple representations help visualize molecular structure and rearrangement of saponification (symbolic) reactions and explain why they occur at the submicroscopic level.

The Readability tests were conducted on 21 grade XII MIPA 3 SMAN 1 Toapaya students to see the readability response of the developed media. The implementation of students using the media through the website link provided, after that, students are asked to fill out a form related to media readability responses. The readability test results received a positive response from students; they said the website media developed was very interesting to use and helped them understand the concept of buffer solution. The average score of the readability test questionnaire was 70.52, which was included in the very good category.

At the time of the readability test, students were enthusiastic about using the developed website media. Students say the media is exciting to use in learning because it differs from the previously used learning media. The same thing was also felt by Syakur et al. (2020) that students felt very interested in using a website learning media called "Absyak" to learn English. The diversity of content provided, such as animated videos, PPT, PDF, and Word, makes students free to choose. The media website developed by researchers also offers several facilities such as animated videos, game-based evaluations, and virtual labs so that students will feel comfortable using it. The use of visual tools will help students to understand chemical concepts from the perspective of multiple representations (Newman et al., 2018).

Website media with interactive content can make the material easier to understand and encourage student motivation (Astuti et al., 2020). Students also feel happy with the game-based evaluation because they can learn and play. Interactive, competitive, and engaging educational games make learners learn through their activities and direct their minds to actively learn (Partovi & Razavi, 2019). Hostovecky et al. (2015) report that game-based evaluation is also beneficial for collecting data and is an effective tool for cultivating digital literacy skills. The presence of the virtual lab is a new impression for students because, when they cannot do practicum directly, they only see practicum videos through YouTube. Using guided inquiry models with the help of virtual labs can improve science process skills; students' skills are formed through direct interaction with virtual labs to find problem answers (Gunawan et al., 2019).

Conclusion

The website media developed has obtained very good feasibility in every aspect of assessment by validators. Website media has the characteristics of multiple representations, which are integrated into buffer solution topics divided into three meeting topics. The results showed that media practicality and media readability were classified as very good. The developed media can help students understand the concept of abstract buffer solutions and practice digital literacy skills. Multiple representation based buffer solution website media can be used for chemistry learning to measure its effectiveness in desired variables such as concept understanding and digital literacy.

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