International Journal of STEM Education for Sustainability, Vol.5, No.1, 2025, pp. 132-149
e-ISSN 2798-5091. DOI. 10.52889/ijses.v5i1.584

# Validity and Practicality Test of e-Student Worksheets Using the ARCS (Attention, Relevance, Confidence, and Satisfaction) Model on Acid-Base Concepts

Submitted 2 January 2025 Revised 27 January 2025 Accepted 31 January 2025

Nindya Cika Ferdian[1], Lenny Anwar[2], Herdini Herdini[3*]

[1,2,3]Department of Chemistry Education, Faculty of Teacher Training and Education, Universitas Riau, Pekanbaru, Indonesia

Corresponding Email: *herdini@lecturer.unri.ac.id

Electronic Student Worksheets (e-Student Worksheets) include teaching materials that are intensively developed to facilitate their learning process. One website with many features that can be utilized to create E-Worksheet is Liveworksheets. This study aims to develop an E-Worksheet based on the Attention, Relevance, Confidence, and Satisfaction (ARCS) model on the subject of acid-base that is valid and knows the user response. The research method used is Research and Development (R&D) with the 4-D development model. Research instruments in the form of validation sheets were given to 3 validators, and user response sheets were given to 2 chemistry teachers, 10 students from a Senior High School A in Pekanbaru, and 10 students from a Senior High School B in Pekanbaru, Indonesia. Material expert E-Worksheet validation obtained a total average score of 97.3% with valid criteria and media expert validation obtained a total average score of 100% with valid criteria. User response obtained results with an average score of 95.3% from teachers and students of 89% with very good criteria. From the research results, it can be concluded that the ARCS-based E-Worksheet using Liveworksheets on acid-base material can be used as teaching materials in the learning process.

Keywords: ARCS, e-Student Worksheet, Validity

## INTRODUCTION

The era of technological advancement has revolutionized education by breaking geographical boundaries, enabling students to access knowledge anytime and anywhere, increasing their interest, and broadening teaching resources (Owoseje, 2023; Maiti *et al*., 2023; Kiong, 2022). Technology reshapes traditional education by facilitating knowledge transfer and transforming passive learning into an engaging, interactive, and more efficient process (Raja & Nagasubramani, 2018; Murad *et al*., 2019; Shishakly *et al*., 2024; Alhanif *et al*., 2024). By using ICT, students can access diverse information from various media sources, enriching their understanding (Dharmayanti *et al*., 2021). Badeleh & Sheela (2020) highlight that the use of ICT approaches in learning can transform the teaching and learning processes from being highly teacher-dominated to being more student-centered.

The presence of devices such as telephones, computers, and the internet facilitates teacher-student interaction, making the learning process more flexible. This flexibility is essential in modern education, where technology plays a crucial role in providing access to knowledge and fostering interaction between teachers and students. Sutiani *et al*. (2022) stated that this flexibility in learning also supports the development of students' 21st-century skills (critical thinking, creativity, collaboration, and communication). When used effectively, ICT can empower students to think critically, collaborate effectively, and innovate, preparing them for the challenges of a constantly evolving global society. Furthermore, as noted by

Budhwar (2017), the appropriate use of ICT strengthens, expands, and enhances the quality of education. Similarly, Carstens *et al*. (2021) argue that integrating technology into education enhances student engagement, motivation, and comfort in the learning process.

Student worksheets serve as an assessment tool to determine students' previous knowledge, learning outcomes, and the learning process, while also allowing students to monitor their own learning progress (Lee, 2014). Student worksheets are teaching materials commonly used in schools and have now developed into electronic student worksheets (E-Worksheet). This transformation is the result of innovation that has turned traditional printed student worksheets into digital versions, making learning more effective (Khastini *et al*., 2023; Alhanif *et al*., 2024). Teachers can create student worksheets based on the material and competencies to be achieved, using models and approaches that address students' specific challenges (Hikmah *et al*., 2023).

The results of the pre-research show that the use of student worksheets in schools has not yet to utilized technology as demanded by 21st-century learning. In addition, the student worksheets used are still informative, containing only exercises, material summaries, practicum guides, and have yet to implement a learning model that allows students to discover concepts independently. The use of printed student worksheets can be easily lost, requires costs, and has no connection to other learning resources. According to Gita (2024), print-out teaching materials can be modified using technology because conventional teaching materials are no longer flexible for use in the classroom. The solution to overcome the problems found in the pre-research is to innovate learning by developing teaching materials that utilize technology to maximize the achievement of learning objectives.

One of the learning models that can be implemented in the development of teaching materials is the ARCS learning model. e-Worksheet based on the ARCS model, developed using the Liveworksheets website, enables the creation of self-instructional materials, allowing students to learn independently when they struggle to understand in the classroom. In addition to increasing productivity, e-Worksheet is not easily damaged, can narrow space and time, and has cheaper usage costs, making it more flexible and efficient (Kosasih, 2021; Norris & Lefrere, 2011). Liveworksheets can boost students' attention and motivation by integrating images, videos, and audio into e-Worksheet, which is accessible anytime and anywhere (Marpaung *et al*., 2023). This platform also enables teachers to design interactive worksheets, enhancing student engagement and making the learning process more efficient (Khoirunnisa *et al*., 2024). Furthermore, electronic worksheets support the development of students' digital literacy skills (Achmad, 2024), allow learners to submit answers and receive

feedback from the teacher (Cristy & Pamenang, 2023), allow searching for worksheets shared by teachers around the world (Huynh *et al*., 2023), and assist teachers in customizing activity sheets to align with learning objectives and students' needs (Widiantho *et al*., 2023).

The Attention, Relevance, Confidence, and Satisfaction (ARCS) model fosters meaningful and engaging learning experiences by enhancing students' motivation (Sahanata & Dewi, 2022) which can trigger an increase in students' thinking power (Putri *et al*., 2023). Keller (1987) stated that the ARCS model serves as a framework for understanding learner motivation and applying effective motivational strategies. It focuses on capturing learners' attention, aligning content with their experiences, building their confidence, and promoting satisfaction in the learning process (Jatmoko *et al*., 2021).

The development of electronic teaching materials using specific approaches or learning models continues to progress, aiming to meet students' learning needs. Previous studies have developed ARCS-based e-Worksheet on various topics, such as Ion Equilibrium and the pH of Salt Solutions; Ion Equilibrium and Buffer Solutions; and Students Worksheets based on ARCS on the topics Immune System, resulting in teaching materials categorized as feasible and highly applicable in learning (Rery *et al*., 2022). Several studies also utilized Liveworksheets, which, as stated by Widiantho *et al*. (2023) support personalized learning with features such as immediate feedback, engagement, progress tracking, flexibility, and accessibility, enhancing both subject understanding and academic performance. However, while ARCS-based e-Worksheet developments using Liveworksheets have been widely explored, none have focused on acid-base materials.

Based on a pre-survey conducted at a high school in Pekanbaru, it was found that 54.05% of students did not meet the minimum competency standards (KKTP) for acid-base chemistry. This indicates significant difficulties in mastering the topic, which can stem from a lack of understanding of abstract concepts or limited access to interactive and engaging teaching materials. These challenges underscore the need for effective and innovative learning tools to support students in overcoming these obstacles. This research addresses the gap by developing E-Worksheet based ARCS using Liveworksheets for acid-base material. By integrating the motivational ARCS framework with Liveworksheets' interactive features, this study aims to create accessible and effective materials. Several studies confirm that integrating the ARCS model into teaching materials can positively impact the learning process. Asiani *et al*. (2017) stated that the ARCS model enhances student motivation and learning outcomes, while Maulidah *et al*. (2024) demonstrated its effectiveness in improving students' problem-solving abilities in mathematics. Moreover, Li & Keller (2018) highlighted

that ARCS model is applicable across various learning environments, student levels, and countries.

## METHOD

This research was conducted at a University in Riau, a Senior High School A in Pekanbaru, and 10 students from a Senior High School B in Pekanbaru, Indonesia. The research method employed was Research and Development (R&D), using the 4-D development model. The 4-D development model was chosen because its stages are systematic, adaptable to school needs and learner characteristics, flexible, and conditional (Wardani *et al*., 2019), time-efficient, and allow for small-scale trials (Cristy & Pamenang, 2023). This research was carried out up to the development stage, in line with the research objectives, namely to produce a product that is valid according to the validator and by the feasibility aspects, and to assess the users' responses. Data collection was conducted during the validation, trial, and revision stages using the following research instruments:

### Validation Sheet

The validation sheet is utilized to evaluate various components of the worksheet, including content, construct, language, and graphical aspects (Irham *et al*., 2017). The e-Worksheet validation process involves validators who provide suggestions and recommendations to improve the worksheets (Pratikno *et al*., 2020). If the e-Worksheet don't not meet the validity criteria, revisions are made based on the validators' feedback. These revisions aim to enhance the quality and effectiveness of the developed e-Worksheet. Once validated, the e-Worksheet can proceed to a limited trial phase. The e-Worksheet validation assessment component is based on a Likert scale with a score of 1-4 in Table 1.

Table 1. Validity Category

| Assessment Score | Category |
|---|---|
| 4 | SS: Agree |
| 3 | S: Quite agree |
| 2 | KS: Less Agree |
| 1 | TS: Disagree |

(Sugiyono, 2017)

The validation results are then assessed using the formula:

Validity (%) = obtained maximum × 100%

(Salsabila *et al*., 2023)

The validation percentage value is then analyzed to determine the feasibility criteria of the E-Worksheet that can be seen in Table 2.

Table 2. Validation Results Criteria

| Validity Percentage (%) | Criteria |
|---|---|
| 80.00 – 100 | Good/Valid/Eligible |
| 60.00 – 79.99 | Good Enough/Valid Enough/Eligible Enough |
| 50.00 – 59.99 | Less Good/Less Valid/Less Eligible |
| 0 – 49.99 | Not good (replaced) |

(Riduwan, 2012)

**User Respon Quistionnaires**

The questionnaire aims to determine the practicality level of the e-Worksheet during the learning process through a user response test. This practicality test consists of a one-on-one trial involving three students from a Senior High School B in Pekanbaru, with varying abilities and a small group trial comprising one chemistry teacher from a Senior High School B in Pekanbaru, one chemistry teacher from a Senior High School A in Pekanbaru, 10 students from a Senior High School B in Pekanbaru, and 10 students from a Senior High School A in Pekanbaru. The user response questionnaire is designed using a Likert scale ranging from 1 to 4. The assessment categories are in Table 3.

Table 3. User Response Questionnaire Assessment Category

| Assessment Score | Category |
|---|---|
| 4 | SS: Very Agree |
| 3 | S: Agree |
| 2 | KS: Quite Agree |
| 1 | TS: Disagree |

The user response results are then assessed using the following formula:

$$V : \frac{TS_e}{TS_h} \times 100\%$$

[a]

TSe =sum of the scores obtained

TSh = maximum total score

(Arkadiantika *et al*., 2020)

The average score of alternative positive user attitude statements was then converted into qualitative values based on the assessment criteria outlined in the Table 4.

Table 4. User Response Criteria

| Average Score (%) | Criteria |
|---|---|
| 75.00 - 100 | Very good |
| 50.00 – 74.99 | Good |
| 25.00 – 49.99 | Low |
| 0 – 24.99 | Not good |

(Yamasari, 2010)

## RESULTS AND DISCUSSION

The e-Worksheet were designed using Canva Pro to create an attractive design, CapCut to edit learning videos, and Google Forms. The final E-Worksheet were saved as a PDF and uploaded to the Liveworksheets website. Liveworksheets transform teaching materials into digital worksheets that can display content equipped with interactive images, games, and videos, thereby fostering an engaging and enjoyable learning process (Ratnawati *et al*., 2023). These e-Worksheet can be accessed via smartphone, laptop, or computer anytime and anywhere. Teresa & Febria (2023) in their research, stated that Liveworksheets can be used to create an effective breakthrough that enhances student engagement in learning. They also stated that Liveworksheets are ideal for assignments submitted simultaneously, helping to reduce paper usage. The front view of the E-Worksheet is presented in Figure 1, Figure 2, and Figure 3.


Figure 1. Cover e-Worksheet

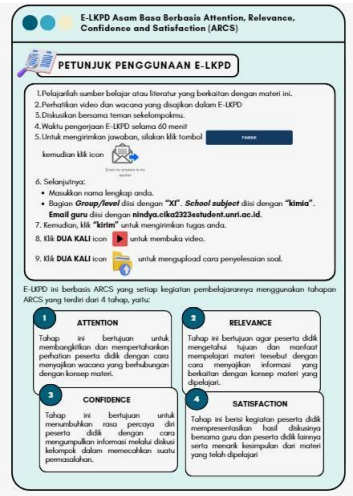


Figure 2. User Instruction of e-Worksheet


Figure 3. Independent Curriculum Learning Outcome

### 1. Validity of E-Worksheet

Validation is an assessment stage used to determine whether teaching materials are feasible and suitable for use in learning. The validation was conducted by three experts: two material experts and one media expert. Figure 2 shows the results of validation I, which received an assessment with valid criteria. According to Linda *et al*. (2018) , the validation process is considered complete if the developed product meets the valid criteria. Therefore, it is necessary to make improvements to perfect the E-Worksheet. The results of the material validation can be represented in Figure 4.

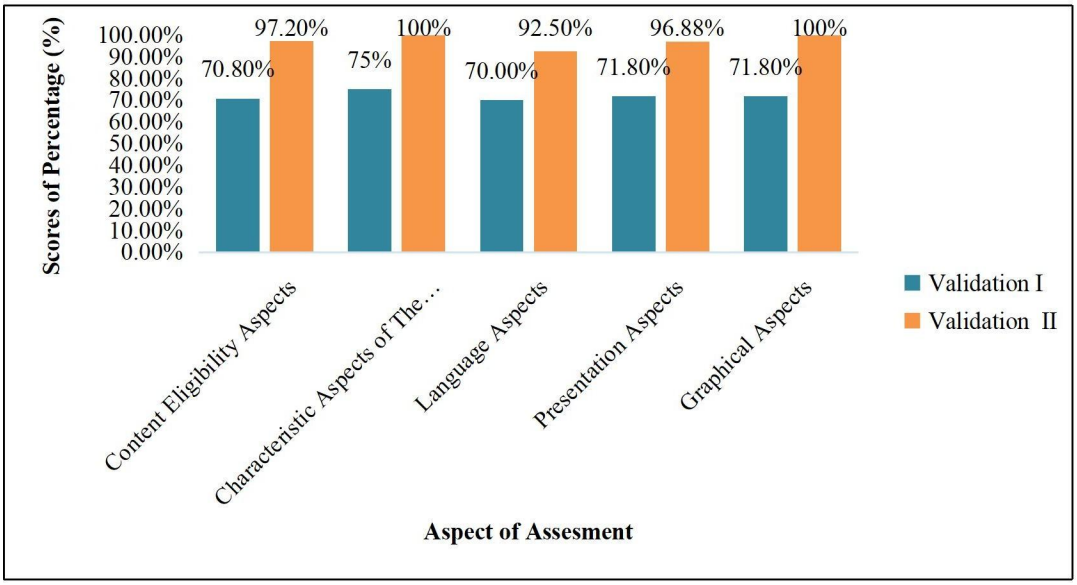


Figure 4. Diagram of Validator Assesment (Material)

Figure 4 illustrates the five aspects of the material validation assessment. Each aspect received a score categorized as "valid enough" in the validation I. Several suggestions for improvement were provided by the validators. The detail of Validator Assessment can be seen in Table 5.

Table 5. Material Validation Assessment on Each Aspect

| No. | Assesment Indicator | Validation I (%) | Validation II (%) |
|---|---|---|---|
| **Content Eligibility Aspect** | | | |
| 1. | e-Worksheet in accordance with Learning Outcomes (CP) | 75 | 100 |
| 2. | e-Worksheet is in accordance with the Learning Objectives (TP) | 75 | 100 |
| 3. | The title of the e-Worksheet is in accordance with the material in it | 75 | 100 |
| 4. | The correctness of acid-base concepts | 62.5 | 100 |
| 5. | The discourse presented in the e-Worksheet is correctly related to the subject matter of acid-base | 62.5 | 100 |
| 6. | e-Worksheet has activities that allow students to be active (raise curiosity, have questioning skills, and express opinions in learning activities) | 75 | 87.5 |
| 7. | e-Worksheet contains acid-base concepts related to daily life | 75 | 100 |
| 8. | The questions in the e-Worksheet on the subject of acid-base are correct and in accordance with the learning objectives and encourage students to understand the concept. | 75 | 100 |
| 9. | The usefulness of e-Worksheet as independent teaching material | 75 | 87.5 |
| **Characteristic Aspect of The ARCS Model** | | | |
| 1. | The attention stage facilitates learners to increase and maintain learners' attention on the subject of acid-base | 75 | 100 |
| 2. | The relevance stage on the subject of acid-base facilitates learners to know the benefits of the knowledge learnt | 75 | 100 |
| 3. | The confidence stage on the subject of acid-base facilitates students to increase self-confidence by carrying out information gathering activities through discussions to solve the problems given | 75 | 100 |
| 4. | The satisfaction stage on the subject of acid-base facilitates students to present the results of problem solving to other | 75 | 100 |

| No. | Assesment Indicator | Validation I (%) | Validation II (%) |
|---|---|---|---|
| | students | | |
| **Language Aspect** | | | |
| 1. | The language used is in accordance with the General Guidelines for Indonesian Spelling (PUEBI) | 75 | 100 |
| 2. | e-Worksheet uses language that is appropriate to the ability level of students | 75 | 87.5 |
| 3. | The language used is interesting and communicative | 62.5 | 87.5 |
| 4. | The density of ideas and information presented is clear and easy for learners to understand | 75 | 87.5 |
| 5. | e-Worksheet uses a clear sentence structure | 62.5 | 100 |
| **Presentation Aspect** | | | |
| 1. | Completeness of e-Worksheet format (Title, Learning Outcomes, e-Worksheet instructions/learning guides, learning objectives to be achieved, materials, exercises, and bibliography) | 75 | 100 |
| 2. | e-Worksheet provides enough space to allow learners to write or illustrate things that learners want to convey | 62.5 | 87.5 |
| 3. | Appropriateness of the use of illustrations with the material on the e-Worksheet | 75 | 100 |
| 4. | Clarity of writing and images on the e-Worksheet | 75 | 100 |
| **Graphical Aspect** | | | |
| 1. | e-Worksheet has an attractive display design | 75 | 100 |
| 2. | e-Worksheet uses a good and attractive font type and size | 75 | 100 |
| 3. | e- Worksheets has an attractive layout | 75 | 100 |
| 4. | e- Worksheets have good illustrations/images, photos and are related to the concept. | 62.5 | 100 |

The content eligibility aspect received a score of 70.8% in validation I. Revisions focused on indicators such as the accuracy of material substance and questions. For the question accuracy indicator, improvements were made by replacing several questions to align with the Learning Objectives of the Independent Curriculum for acid-base material. Regarding the indicator of the truth of the material's substance, coffee, initially used as an example of a basic compound, was replaced with bitter melon. According to Febrianti *et al*. (2019), robusta coffee has a pH of 6.9, while arabica coffee is around 5.15. Similarly, Zainuri *et al*. (2023) found arabica coffee has a pH range of 5.33–5.8, and robusta coffee ranges from 5.4–5.6. Since these values do not align with basic compound properties, coffee was deemed unsuitable. Bitter melon, containing 0.232% alkaloid momordicin was chosen as a more appropriate replacement (Muharram, 2010; Alfitroh *et al*., 2021). Pineapple, initially used as an example of an acidic compound, was also replaced due to its variable sweetness, which could cause misconceptions. Starfruit was chosen instead, as its ripe form has a pH of 3.71, and its half-ripe form has a pH of 3.03 (Basena *et al*., 2019). According to Shamsudin *et al*. (2007), pineapple fruit has a pH of 3.2-4. While Food and Agricultural Products states that pineapple has a pH of 3.3-5.2. Other improvements include replacing the pH meter example with a more accurate tool and adding practicum activities. Regarding the accuracy indicator of

the questions, the validator gave suggestions on replacing and adding questions so that they are in accordance with learning objectives. According to Prastowo (2015), practice questions include elements of teaching materials that are useful for seeing the achievement of learner competencies. After making improvements, the results of validation II reached 97.2% with valid criteria.

The linguistic aspect includes the construction requirements of teaching materials. The results of validation I were obtained at 75% and 65% with valid enough criteria. Teaching materials act as a means of transferring knowledge to students. If the language used is not communicative, ineffective, unstructured, and ambiguous, it can cause misconceptions for students. As stated by Hikmah *et al*. (2023), the linguistic aspect is crucial in writing student worksheets. Similarly, Supardi (2020) emphasized that the use of language unfamiliar to students renders teaching materials ineffective. Improvements made are related to communicative indicators and sentence structure accuracy indicators, namely by improving the narrative on questions, discourse, material summaries, changing diction and rearranging sentence structure. After making improvements, the results of validation II reached 100% and 85% and got valid criteria. The characteristic aspect of the ARCS learning model has received a good assessment from the validator and did not get suggestions for improvement with a score of 100%. The percentage results on validation II show that the application of syntax in each stage of the activity on the e-Student Worksheets is appropriate and can facilitate and positively influence learning.

The graphic and presentation aspects are technical requirements for teaching material. Overall, the results of validation I were 89.8% and validation II were 100%. The aspects of media validation assessment are: 1) e-Student Worksheets size, 2) e-Student Worksheets cover design, and 3) e-Student Worksheets content design. The results of the media validation can be represented in Figure 5.

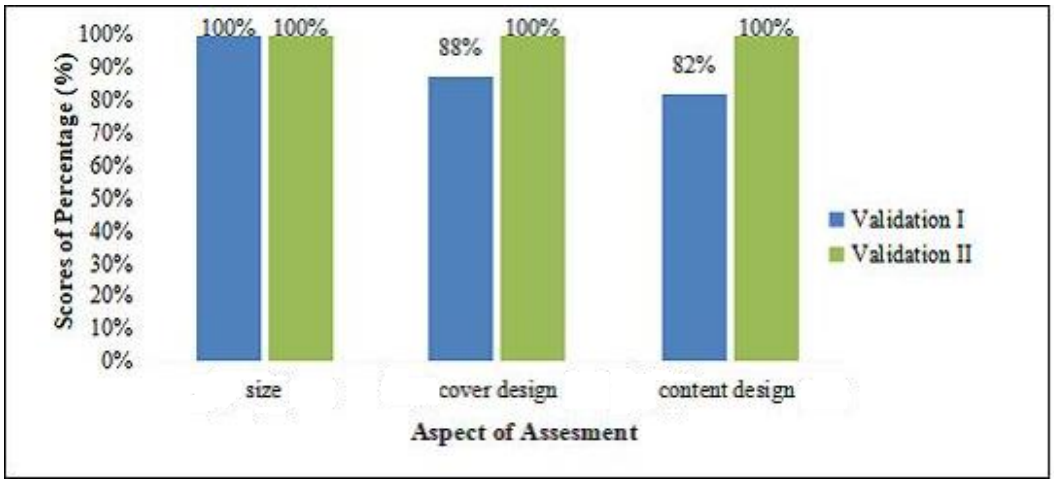


Figure 5. Diagrams of Validator Assesment (Media)

Overall, the media validation aspects have achieved valid criteria. For example, the size aspect of the e-Student Worksheets received a score of 100% in both validation I and validation II. However, the cover and content design aspects of the e-Student Worksheets received suggestions for improvement on several indicators. The evaluation of the e-Student Worksheets for each indicator can be seen inTable 6.

Table 6. Media Validation Assessment on Each Aspect

| No. | Assesment Indicator | Validation I (%) | Validation II (%) |
|---|---|---|---|
| **e-Worksheet Size Aspect** | | | |
| 1. | The suitability of E- Worksheets size with ISO | 100 | 100 |
| 2. | Size compatibility with E-Worksheet content material standards | 100 | 100 |
| **e-Worksheet Cover Design Aspect** | | | |
| 1. | The font used is attractive and easy to read | 50 | 100 |
| 2. | Does not use too many letter combinations | 100 | 100 |
| 3. | Illustration of the cover of E-Worksheet | 100 | 100 |
| 4. | The colours of the layout elements are harmonious and clarify functions | 100 | 100 |
| 5. | The letters used are attractive and easy to read | 50 | 100 |
| **e-Worksheet Content Design Aspect** | | | |
| 1. | Layout consistency | 100 | 100 |
| 2. | Layout elements are complete | 50 | 100 |
| 3. | Placement of decorations/illustrations as a background does not interfere with titles, text, and page numbers | 50 | 100 |
| 4. | Typography of E- Worksheets contents of simple | 100 | 100 |
| 5. | The use of letters in the E-Worksheet | 100 | 100 |
| 6. | The quality of the video presented in the E- Worksheets | 50 | 100 |
| 7. | The use of buttons used in the E-Worksheet | 100 | 100 |
| 8. | Colour composition of E-Worksheet | 50 | 100 |
| 9. | The quality of the images presented in the E-Worksheet | 100 | 100 |
| 10. | The use of media in E-Worksheet | 50 | 100 |
| 11. | Practicality of using acid-base E-Worksheet | 100 | 100 |

If traced based on the indicators of each aspect, the cover design and content design aspects get suggestions and comments for improvement. In the cover design aspect of the e-Student Worksheets, the improvements included enlarging and bolding the letters on the e-Worksheet cover. These improvements were aimed at clarifying the developer's information displayed on the e-Worksheet cover. The selection of fonts and ease of reading greatly affects students' interest in reading (Erfariyah *et al*., 2024). After the improvements were made, there was an increase in the validation score from 87.5% to 100%, shows that there are improvements in the e-Student Worksheets for this aspect. The changes can be seen in Figure 6.


Figure 6. Before Revision (Left); After Revision (Right)

In the content design aspect of the e-Worksheet, several improvements were made. First, the validator gave suggestions to adjust the narration and icon in the e-Worksheet instructions to avoid misunderstandings. The usage instructions are intended to provide guidance for both teachers and students to ensure the proper use of the e-Worksheet. The changes can be seen in Figure 7.

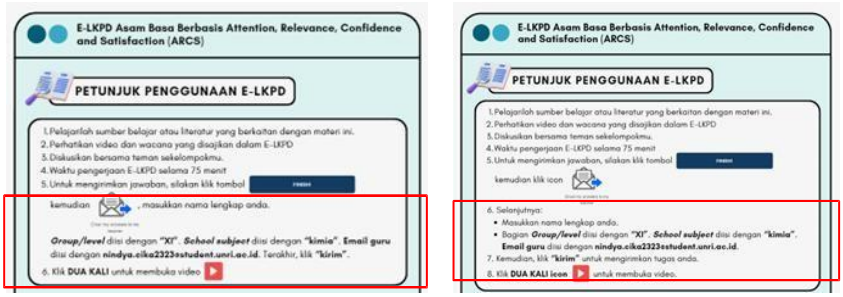


Figure 7. Before Revision (Left); After Revision (Right)

Second, the improvement involved changing the color of the e-Worksheet question box to make it more eye-catching, thereby attracting students' attention. Following Supardi (2020), what is conveyed by teaching materials that are full of eye-catching images and colours can attract the attention of students to learn it. Chang *et al*. (2018) also stated that information presented with colour visualization can better support knowledge acquisition compared to monochromatic information. The changes can be seen in Figure 8.

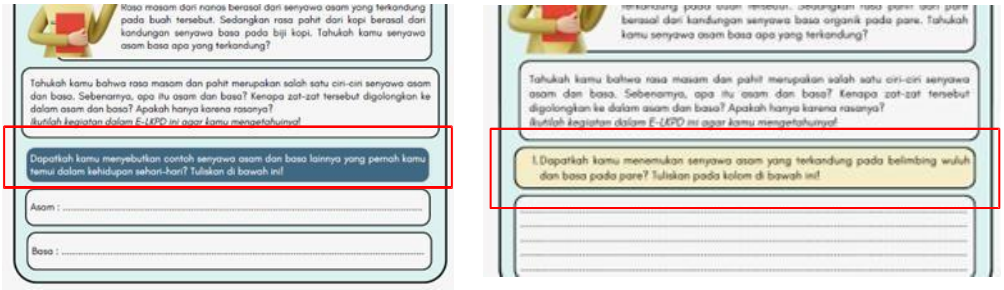


Figure 8. Before Revision (Left); After Revision (Right)

Another improvement was made by linking the task submission process through Google Forms, allowing students to complete assignments that require writing chemical formulas and performing calculations. Improvements were also made to the learning videos included in the e-Worksheet. Dewi *et al*. (2022) highlight digital worksheets as an alternative for supporting science learning through simple self-experimentation. Similiarly, Ahmed *et al*. (2024) emphasize that using audiovisuals in learning enhances students' experiences and simplifies complex concepts. Thus, ensuring the functionality of instructional videos is essential to help students effectively understand materials and laboratory activities. The results of validation II for this aspect achieved a score of 100%, meeting the valid criteria. Overall, the e-Worksheet in this aspect is good, attractive, and suitable for use in accordance with the subject matter. This aligns with Magdalena *et al*. (2021), who stated that attractive designs and colors can increase students' interest in using the e-Worksheet, while a coherent and systematic presentation helps guide students in learning and utilizing it as a learning resource. After receiving validation from the validators, the ARCS-based e-Worksheet on acid-base topics is ready to proceed to the user response test.

**2. Practicality Test of E-WORKSHEET**

The practicality test was conducted after the e-Worksheet was declared valid. Haviz (2016) suggests that user assessments play a key role in determining the practicality of a product. This test aimed to gather responses from teachers and students. Teaching material is categorized as practical if it is easy to operate, simple to understand, and efficient in terms of time and usability. Hanifah (2021) also stated that the practicality aspects could only be fulfilled if: (1) experts and practitioners confirmed that the development could be applied, and (2) real-world implementation demonstrated that the developed product was applicable.

The results of the practicality test at the one-on-one test stage on three students from a Senior High School B in Pekanbaru obtained positive comments. The purpose of a one-on-one trial is to gather user reactions to the product and identify errors in its usage. The identified issues included answer columns that could not be filled and some confusing question narratives, which required revision. Students also provided suggestions indicating that the e-Worksheet was clear, easy to understand, and simple to operate. Practice questions and materials were well-received, aided by the inclusion of learning videos, while the e-Worksheet design was deemed visually appealing overall.

The results of the practicality questionnaire analysis obtained a score of 95.3% from the teacher and 89% from the students in the very good criteria. In the aspect of clarity of content and language, the teacher gave a score of 93.75%, which was within the very good criteria.

The scores obtained mean that the material in the e-Worksheet has been presented clearly, uses structured language, and is easy to understand. The characteristics aspect of the ARCS model obtained a score of 100% from teachers and students, which was 88%, according to very good criteria. The score indicates that the syntax in the e-Worksheet has a positive influence on students' learning. The scores from the teachers also show that the application of syntax is in accordance with the material taught in the e-Worksheet. In the aspect of attractiveness, the score obtained from the teacher was 87.5%, and from students was 86.8%, with very good criteria. The practicality aspect from students obtained a score of 89.5%, and the teacher obtained a score of 100%. The percentage result shows that e-Worksheet can be operated easily and used repeatedly. As stated by Haviz (2016), the indicator of practicality is seen from the ease of material understood and can be used by teachers and students. Overall, the e-Worksheet developed includes very good criteria, which means that it is easy to use, interesting, and contains clear material.

## CONCLUSION

E-Worksheet based on Attention, Relevance, Confidence, and Satisfaction (ARCS) about acid-base using Liveworksheets developed was declared valid and user responses from teachers and students were obtained with very good criteria. The ARCS-based acid-base E-Worksheet using Liveworksheets can be continued with a broad trial and used in the learning process.

## REFERENCES

Achmad, A. A., Zulfiani, Z., & Solihin, S. (2024). Development of Live Worksheet Based on Project-Based Learning to Promote Creative Thinking and Ecopreneurship on Biotechnology Concepts. *International Journal of STEM Education for Sustainability*, *4*(2), 1-26. https://doi.org/10.53889/ijses.v4i2.409

Ahmed, S., Baloch, M. A., & Karim, H. (2024). Investigating the Impact of Teaching-Learning Materials on Students' Academic Performance in Government Primary Schools in the Naseerabad Division, Balochistan, Pakistan. *Journal of Development and Social Sciences*, *5*(I), 538–545. https://doi.org/10.47205/jdss.2024(5-i)49

Alfitroh, I., Suhatri, S., & Rivai, H. (2021). Phytochemical Test of Bitter Melon (*Momordica charantia* L) Herb and its Effect on Rat Blood Sugar Levels. *International Journal of Pharmaceutical Sciences and Medicine*, *6*(7), 153–163. https://doi.org/10.47760/ijpsm.2021.v06i07.010

Alhanif, M. R., Lengkana, D., Setiyarini, M., & Herlina, K. (2024). The Importance of E-Worksheet Based on Problem Based Learning Activity to Improving Student's System Thinking Skills: Science Teacher's Perspective. *International Journal of Current Science Research and Review*, *07*(05), 2578–2583. https://doi.org/10.47191/ijcsrr/v7-i5-17

Arkadiantika, I. Ramansyah, W. Effindi, M. A. & Dellia, P. (2020). Pengembangan Media Pembelajaran Virtual Reality pada Materi Pengenalan Termination dan Splicing Fiber Optic. *Jurnal Dimensi Pendidikan Dan Pembelajaran Universitas Muhammadiyah Ponorogo*, *Special Issues, SEMNASDIKJAR 2019*, 29–36.

Asiani, A., Harini, & Nugroho, J. A. (2016). Penerapan Model Attention, Relevance, Confidence, and Satisfaction 9ARCS) untuk Meningkatkan Motivasi dan Hasil Belajar Siswa Kelas X Pemasaran 1 SMK Negeri 1 Surakarta. *BISE: Jurnal Pendidikan Bisnis dan Ekonomi*, *3*(1), 1–11. https://doi.org/https://doi.org/10.20961/bise.v3i1.14452

Badeleh, A., & Sheela, G. (2020). The Effects of Information and Communication Technology Based Approach and Laboratory Training Model of Teaching on Achievement and Retention in Chemistry. *Contemporary Educational Technology*, *2*(3), 213–237. https://doi.org/10.30935/cedtech/6055

Basena, N. K., KV, J., & Rafed, R. (2019). Physico-chemical properties of starfruit (Averrhoa carambola). *International Journal of Chemical Studies*, *7*(5), 1258–1260.

Budhwar, K. (2017). The Role of Technology in Thana-Capitalism. *International Journal of Engineering Applied Sciences and Technology*, *2*(8), 55–57. https://doi.org/10.4018/978-1-7998-3473-1.ch015

Carstens, K. J., Mallon, J. M., Bataineh, M., & Al-Bataineh, A. (2021). Effects of Technology on Student Learning. *TOJET: The Turkish Online Journal of Educational Technology*, *20*(1), 105–113. https://files.eric.ed.gov/fulltext/EJ1290791.pdf

Chang, B., Xu, R. & Watt, T. (2018). The Impact of Colors on Learning. *Conference Proceedings*, *10*, 1–6.

Cristy, L. V. R. & Pamenang, F. D. N. (2023). Development of Ethnoscience-Based Student Worksheets of Redox Reactions, Volta Cells, and Corrosion Using Liveworksheets. *Jurnal Pendidikan Kimia (JPKIM)*, *15*(3), 182–190. https://doi.org/10.24114/jpkim.v15i3.51211

Dewi, A. K., Slamet, S. Y., Atmojo, I. R. W., & Syawaludin, A. (2022). The Influence of Interactive Digital Worksheets Based on Level of Inquiry Towards Science Process Skills in Elementary School. *Pegem Journal of Education and Instruction*, *13*(1), 251–258. https://doi.org/10.47750/pegegog.13.01.27

Dharmayanti, N. M. D., Putra, I. N. A. J., & Paramartha, A. A. G. Y. (2021). Developing Displayed Flipbook as Teaching Material for Assisting Teacher to Teach English in Online Learning for the Fourth Grade Elementary School Students. *Indonesian Journal Of Educational Research and Review*, *4*(1), 113. https://doi.org/10.23887/ijerr.v4i1.35314

Erfariyah, A., Jaenudin, D., & Permana, I. (2024). Development of Conservation E-Books Based on Local Potential to Improve Eco-literacy of Junior High School Students. *International Journal of STEM Education for Sustainability*, *4*(2), 267–292. https://doi.org/10.52889/ijses.v4i2.443

Febrianti, D., Handono, S., Prastowo, B., & Supriadi, B. (2019). Pengaruh Suhu dan Waktu Terhadap Fermentasi Biji Kopi. *FKIP e-Proceeding*, *4*(1), 54–56.

Gita, R. S. D. (2024). *Pengantar Teknologi Pembelajaran*. PT. Literasi Nusantara Abadi Group.

Hanifah, H. (2021). Practicality test of student worksheet (SWS) based on: Action, Process, Object, Schema (APOS model) assisted on Geogebra the subject of Riemann sum. *Journal of Physics: Conference Series*, *1731*(1). https://doi.org/10.1088/1742-6596/1731/1/012035

Haviz, M. (2016). Research and Development: Penelitian di Bidang Pendidikan yang Inovatif, Produktif, dan Bermakna. *Ta'dib*, *16*(1), 28–43. https://doi.org/10.31958/jt.v16i1.235

Hikmah, S. I., Tukiran, & Nasrudin, H. (2023). Validity of Student Worksheets Based on Model Argument Driven Inquiry Integrated by STEM to Train Students' Argumentation Ability and Self-Efficacy in Chemical Equilibrium Material. *IJORER : International Journal of Recent Educational Research*, *4*(4), 416–433. https://doi.org/10.46245/ijorer.v4i4.300

Huynh, V., Le, H., & Prabjandee, D. (2023). A Review of the Website Liveworksheets.com. *Computer Assisted Language Learning Electronic Journal CALL-EJ)*, *24*(1), 269–279.

Irham, S. M., Mr. M., & Oktavia, B. (2017). *The Development of Guided Inquiry-based Worksheet on Colligative Properties of Solution for Chemistry Learning*. *57*(ICMSEd 2016), 38–42. https://doi.org/10.2991/icmsed-16.2017.9

Jatmoko, D., Susanto, A., Yudi Purwoko, R., & Arifin, Z. (2021). The Implementation of ARCS Learning Model to Improve Students Learning Activities and Outcomes in Vocational High School. *Tarbawi: Jurnal Ilmu Pendidikan*, *17*(2), 137–144.

Keller, J. M. (1987). Strategies for Stimulating the Motivation to Learn. *Performance & Instruction, 26*(8), 1-7.

Khastini, R. O., Rohmah, W. S., & Sahida, A. N. (2023). The Effectiveness of the e-Student Worksheets to Improve Students' Learning Outcomes and Critical Thinking Skills on Digestive System Concepts. *International Journal of Biology Education Towards Sustainable Development*, *3*(1), 52–61. https://doi.org/10.53889/ijbetsd.v3i1.160

Khoirunnisa, F., Subroto, H., Arochman, T., Prima, C., & Karma, F. (2024). *The Effectiveness of Using Liveworksheets on Students ' Reading Skill of Narrative Text at MAN Temanggung*. *4*(4), 0–7.

Kiong, J. F. (2022). The impact of technology on education. *Journal of Education Review Provision*, *2*(2), 65–75. https://doi.org/10.18225/inc.soc.v17i2.6993

Kosasih. (2021). *Pengembangan Bahan Ajar*. Jakarta: BumiAksara.

Lee, C., D. (2014). Worksheet Usage, Reading Achievement, Classes' Lack of Readiness, and Science Achievement: A Cross-Country Comparison. *International Journal of Education in Mathematics, Science and Technology*, *2*(2), 96–106. https://doi.org/10.18404/ijemst.38331

Li, K., & Keller, J. M. (2018). Use of the ARCS model in education: A literature review. *Computers and Education*, *122*(May 2017), 54–62. https://doi.org/10.1016/j.compedu.2018.03.019

Linda, R. Herdini, H. S, I. S. & Putra, T. P. (2018). Interactive E-Module Development through Chemistry Magazine on Kvisoft Flipbook Maker Application for Chemistry Learning in Second Semester at Second Grade Senior High School. *Journal of Science Learning*, *2*(1), 21–25. https://doi.org/10.17509/jsl.v2i1.12933

Magdalena, M., Putra, A. P., & Winarti, A. (2021). The Practicality of E-WORKSHEET Materials on Environmental Pollution to Practice Critical Thinking Article Information Abstract Keyword: Development Electronic-Student Worksheets Environmental Pollution Critical thinking skills. *BIO-INOVED: Jurnal Biologi-Inovasi Pendidikan*, *3*(3), 210–215. https://doi.org/10.20527/bino.v3i3.11099

Maiti, M., Priyaadharshini, M., & S, H. (2023). Design and Evaluation of a Revised ARCS Motivational Model for Online Classes in Higher Education. *Heliyon*, *9*(12). https://doi.org/https://doi.org/10.1016/j.heliyon.2023.e22729

Marpaung, A. Muchtar, Z. & Nurfajriani, N. (2023). Development of E-Worksheet Assisted by Liveworksheets Based on HOTS in Chemistry Materials of Grade X Senior High School Even Semester of Merdeka Curriculum. *Proceedings of the 8th Annual International Seminar on Transformative Education and Educational Leadership (AISTEEL)*. https://doi.org/10.4108/eai.19-9-2023.2340420

Maulidah, G. A., Kurniawan, D., & Prabawati, M. N. (2024). Penerapan Model Pembelajaran ARCS (Attention, Relevance, Confidence, and Satisfaction) Untuk Meningkatkan Kemampuan Pemecahan Masalah dalam Pembelajaran Matematika. *ELIPS, 5*(2), 183-189. https://doi.org/10.47650/elips.v5i2.1400

Muharram. (2010). Isolasi dan Uji Bioaktivitas Senyawa Metabolit Sekunder Ekstrak N-Heksan Daun Pare 70 Isolasi dan Uji Bioaktivitas Senyawa Metabolit Sekunder Ekstrak N-Heksan Daun Pare (*Momordica charantia* L.) (Isolation and Bioactivity Test of Secondary Metabolites of Bittermelon (Momordica charantia L.) Leaves N-Hexane Extract. *Bionature*, *11*(2), 70–78. https://doi.org/https://doi.org/10.35580/bionature.v11i2.1380

Murad, M., Razzaque, A., Hamdan, A., & Benhamed, A. (2019). Impact of Educational Technology on Students' Performance. *International Conference E-Learning*, 163–170.

Norris, D. M., & Lefrere, P. (2011). Transformation through expeditionary change using online learning and competence-building technologies. *Research in Learning Technology*, *19*(1), 61–72. https://doi.org/10.1080/09687769.2010.549205

Owoseje, F. (2023). Impact of Technology on Education: Analysis, Implications, Solutions. *Journal of Humanities & Social Sciences*, *6*(7), 214–220.

Prastowo, A. (2015). *Panduan Kreatif Membuat Bahan Ajar Inovatif*. Yogyakarta: Diva Press.

Pratikno, P., Suyono, S., & Agustini, R. (2020). The Validity of Student Worksheets and Student Textbooks Inquiry Training Model on The Colligative Properties of Solution. *International Journal for Educational and Vocational Studies*, *2*(11), 935–941. https://doi.org/10.29103/ijevs.v2i11.3006

Putri, F., Yerizon, Arnawa, I. M., & Syafriandi. (2023). Pengembangan Perangkat Pembelajaran Berbasis ARCS Memuat Soal HOTS untuk Meningkatkan Kemampuan

Berpikir Kritis Peserta Didik Kelas VIII SMP/MTs. *Daya Matematis: Jurnal Inovasi Pendidikan Matematika*, *11*(2), 123–133.

Raja, R. & Nagasubramani, P. C. (2018). Impact of Modern Technology in Education. *India Journal of Applied and Advanced Research*, *3*, 33–35. https://doi.org/https://doi.org/10.21839/jaar.2018.v3iS1.165

Ratnawati, Y., Imron, A., Widowati, T., & Purwaningsih, H. (2023). The Development of Liveworksheet by Implementing Project Method in Teaching Narrative Text for Ten Grade Students. *International Journal of Multicultural and Multireligious Understanding*, *10*(5), 471. https://doi.org/10.18415/ijmmu.v10i5.4581

Rery, R. U., Herdini, H., & Marinsi, D. (2022). Pengembangan e-LKPD Berbasis Attention, Relevance, Confidence, and Satisfaction Menggunakan Liveworksheets Pada Materi Kesetimbangan Ion dan pH Larutan Garam. *Hydrogen: Jurnal Kependidikan Kimia*, *10*(2), 89-97. https://doi.org/https://doi.org/10.33394/hjkk.v10i2.5548

Riduwan. (2012). *Rumus dan Data dalam Analisis Statistika*. Bandung: Alfabeta

Sahanata, M. & Dewi, K. F. (2022). The Effect of Application of the ARCS Learning Model on Motivation Learn Maths Students. *Journal of Curriculum and Pedagogic Studies (JCPS)*, *1*(1), 1–11. https://doi.org/https://doi.org/10.30631/jcps.v1i1.1360

Salsabila, A. H., Iriani, T., & Handotyo, S. S. (2023). Penerapan Model 4D Dalam Pengembangan Video Pembelajaran Pada Keterampilan Mengelola Kelas. *Jurnal Pendidikan West Science*, *01*(08), 495–505.

Shamsudin, R., Daud, W. R. W., Takriff, M. S., & Hassan, O. (2007). Physicochemical properties of the Josapine variety of pineapple fruit. *International Journal of Food Engineering*, *3*(5). https://doi.org/10.2202/1556-3758.1115

Shishakly, R., Almaiah, M. A., Lutfi, A., & Alrawad, M. (2024). The influence of using smart technologies for sustainable development in higher education institutions. *International Journal of Data and Network Science*, *8*(1), 77–90. https://doi.org/10.5267/j.ijdns.2023.10.015

Sugiyono. (2017). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. Bandung: CV. Alfabeta.

Supardi. (2020). *Landasan Pengembangan Bahan Ajar*. Mataram: Sanabil.

Sutiani, A., Muchtar, Z., Dibyantini, R. E., Sinaga, M., & Purba, J. (2022). Analisis Kemampuan Guru-Guru Kimia SMA Sumatera Utara Dalam Mengintegrasikan TPACK. *Jurnal Inovasi Pembelajaran Kimia*, *4*(2), 112–131.

Teresa, A., & Febria, D. (2023). Promoting Live Worksheets To Raise Senior High Students' Speaking Confidence and Motivation. *Dialectical Literature and Educational Journal*, *8*(1), 11–20. https://doi.org/10.51714/dlejpancasakti.v8i1.93.pp.11-20

Wardani, D. L., Degeng, I. N. S., & Cholid, A. (2019). Developing Interactive Multimedia Model 4D for Teaching Natural Science Subject. *International Journal of Educational Research*, *7*(1), 63–72.

Widiantho, Y., Hia, N. V., & Sinar, T. S. (2023). Enhancing Learning with Liveworksheet: Perceptions, Advantages, Disadvantages, and Impacts. *LingPoet: Journal of Linguistics and Literary Research*, *4*(3), 42–49.

Yamasari, Y. (2010). Pengembangan media pembelajaran matematika berbasis ICT yang berkualitas. *Seminar Nasional Pascasarjana* X-ITS, 979(1), FMIPA Unesa.

Zainuri, Paramartha, D. N. A., Fatinah, A., Nofrida, R., Rahayu, N., Anggraini, I. M. D., & Utama, Q. D. (2023). The Chemical Characteristics of Arabica and Robusta Green Coffee Beans From Geopark Rinjani, Indonesia. *Biotropia*, *30*(3), 318–328. https://doi.org/10.11598/BTB.2023.30.3.1940