Development of STEAM-2C: Integrated Acid-Base Digital Book Based on Malang Local Wisdom

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Abstract. Contextual approach in learning acid-base concepts is proven to improve students' understanding. This is based on an initial survey of students regarding the acid-base concept, as many as 66.7% were interested in learning the concept if it is related to everyday life. Therefore, a contextual approach integrates contextual and real-world applications has been proposed to make the concept more meaningful to students. STEAM-2C which integrates aspects of (Science, Technology, Arts, Engineering, Mathematics, Culture, and Communication) is one application of a contextual approach that is proven to increase motivation, besides that students also need to explore the local wisdom around them. However, the problem is that no learning resource combines aspects of STEAM-2C based on local wisdom, one of which is in Malang City. Therefore, a learning media was developed in the form of a flipbook integrated with the STEAM-2C approach based on Malang's local wisdom, namely Malangan batik which is associated with the concept of acid-base. The method used in this research is the RnD (Research and Development) method with a modified ADDIE development model with restrictions into 3 stages, namely analysis, design, and development. The results showed that a digital-based flipbook in the form of an application had been compiled. The content in the flipbook includes chem-culture, chem-matter, chem-news, and chem-tech illustrating the integration of acid-base material with the STEAM-2C approach. Flipbook is packaged as an application with several main features, namely pre-test, learning video, flipbook, post-test, and games to support the student learning process. The integration of the STEAM-2C approach and local wisdom can familiarize students with social and cultural awareness characters that are closely related to 21st century skills, as well as make students able to solve problems better, creatively, independently, think logically, and introduce local wisdom values to students on acid-base material.

1 Introduction

Chemistry learning develops learning outcomes and skills in understanding concepts [1]. As much as 65.3% of chemistry materials in high school contain complex and abstract concepts in which various reactions are combined with mathematical calculations that are difficult for students to understand [2]. One of the chemical materials with low assertiveness, only 36.6%

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is acid-base [3]. This is in line with the author's initial survey; only 30.3% of 11th-grade high school students in 5 high schools in Malang Raya answered the questions on the concept of acid-based solution correctly.

The low completeness value is caused by many teachers who need help excitingly delivering acid-base material. Hence, students feel bored, and the class tends to be passive [4]. Teachers can relate it to everyday life to attract students' interest to produce meaningful learning. This is based on the researcher's primary data; as many as 66.7% are interested in learning the concept if it relates to everyday life. Therefore, a contextualized approach that integrates real-world contexts and applications has been proposed to make the concept more meaningful to students. The STEAM-2C approach integrates aspects of (Science, Technology, Arts, Engineering, Mathematics, Culture, and Communication) [5]. This is one of the applications of a contextual approach that is proven to develop the skills needed today, one of which is creative thinking [6].

In the cultural aspect, students need to explore acid-base materials relevant to local wisdom-based cultural heritage, for example, in the batik process [7]. This aspect creates an opportunity to preserve the heritage of local wisdom for students, including Malangan Batik. During the coloring [NS1] process of Malangan batik, the use of indigo vera natural dye will bring out its color [NS2] when dissolved with the help of NaOH and diazonium salt to provide an alkaline atmosphere; this can be further explained through the bronsted lowry theory [8]. Understanding how the natural coloring process in Malangan batik reacts in this alkaline atmosphere will allow students to engage more deeply with the concept of acid-base [9]. Through this approach, not only is the understanding of concepts improved but also a sense of pride in cultural heritage and local wisdom that can be learned through chemistry concepts. This illustrates how integrating the STEAM-2C approach stimulates cross-disciplinary understanding and provides a deeper emotional and social dimension in learning scientific concepts [10].

Contextualized acid-base learning media that have been on the market, such as the "Chemistry-Acid and Bases" and "Acids and bases in matter" applications, have shortcomings in the limited scope of the material presented, such as without delving deeper into the interaction of acids and bases in the context of everyday life. In addition, both media tend to be less interactive, affecting student engagement and motivation in the learning process. The lack of interactive elements such as simulations, games, or creative tasks can reduce the appeal of learning media [11]. Furthermore, this media does not integrate aspects of STEAM-2C based on local wisdom.

Therefore, it is necessary to develop learning media in the form of flipbooks integrated with the STEAM-2C approach based on Malang's local wisdom, namely Malangan batik, which is associated with the acid-base concept. This aims to produce meaningful learning, especially now that the independent curriculum is based on culture as a philosophical foundation for realizing the Pancasila Student Profile [12].

2 Methods

Digital-based flipbooks in the form of applications are made using Android Study 3.0.1, while UI / UX materials are made using the Figma website. The flow chart of digital-based flipbook development in general can be seen in Figure 1.

The procedures carried out in this development are adapted from the steps of the Research and Development (R&D) approach. This is used to make or develop a product and to test the effectiveness of the product that has been made. The development model used by the author with ADDIE consists of five main stages: analysis, design, development, implementation, and evaluation. An explanation of the steps and results of the ADDIE stages is explained in depth in the results and discussion section.

Digital-based application flipbooks use Android Study 3.0.1, while UI / UX materials use the Figma website. The flow chart of digital-based flipbook development in general can be seen in the following figure 1. The population of this study was A state Madrasah Aliyah school in Batu, East Java. Students with sample selection using a proportional stratified random sampling technique. The population was grouped into a sub-population of technology-savvy students, then regrouped students with low and high learning outcomes. Then, 20 people were taken to be the research sample.

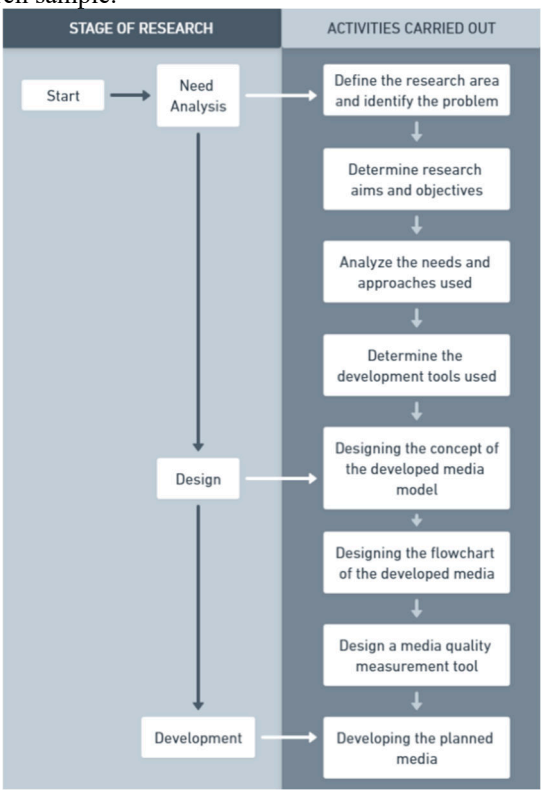

Fig. 1. Flowchart of digital-based flipbook development.

3 Discussion

The development of digital-based flipbooks with the STEAM-2C Approach based on Local Wisdom is carried out using the ADDIE Method. There are five stages: analysis, design, development, implementation, and evaluation. In this study, it is still in the development stage, in the future the implementation and evaluation stages will be carried out. The stages carried out for the development of the digital-based flipbook are as follows:

3.1 Analysis

The needs analysis begins with identifying the problems of the sources (students) using a questionnaire data collection technique. The results of the questionnaire were analyzed. Some important questions asked to respondents are: "Do you have references related to the type of learning you want?". The results of the questionnaire answers can be seen in Figure 2.

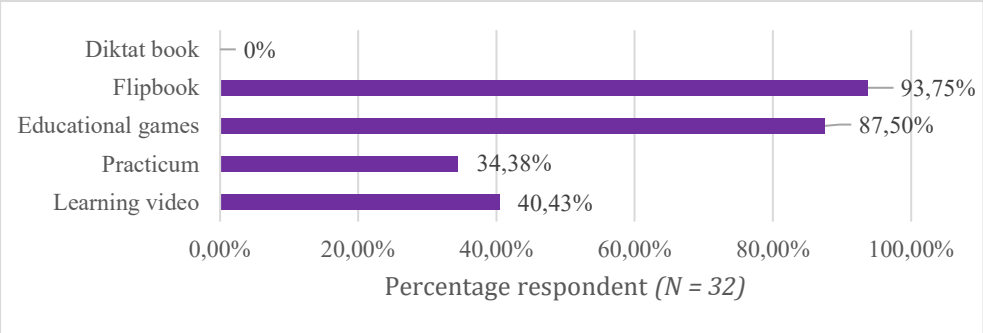

Fig. 2. Preference of desired learning media.

Figure 2 shows that most students tend to like using flipbooks, educational games, and learning videos as their learning tools. In this era of technology, this reaction is understandable if some students feel more connected to the learning material when presented through more interactive and visual media. Flipbooks provide a new dimension to learning, where students can scroll through the pages with the touch of their fingers and directly interact with the content presented [13]. This not only provides a more enjoyable learning experience but can also improve understanding through a robust visual experience. Flipbooks in electrolysis material in Class XI students of SMA Negeri 2 Pare are proven to increase student learning motivation by 88.45% [14]. In addition, the use of flipbooks is more flexible to be used in various learning models in the classroom, one of which is guided inquiry [1].
Meanwhile, educational games are used to capture students' attention and motivate active participation. With elements of challenge, competition, and reward, educational games help maintain students' focus on the learning material while honing their cognitive and problem-solving skills. Some teachers also often use games as enrichment materials because they are seen as creating a more exciting learning atmosphere [15].
Learning videos also appeal significantly, as they can convey information in a more dynamic format. Displayed in visual and audio form, videos can illustrate complex concepts more clearly, making them easier to digest for different types of learners [16]. Therefore, in designing technology-based learning, there needs to be a variety of media options tailored to individual needs and learning styles. This can help create an inclusive and effective learning environment for all students [17].
The widespread use of smartphones and the rapid growth of applications on various platforms make using ICT-based media and applications very relevant to the direction of digital learning [18]. Furthermore, respondents' questions and answers regarding the use of smartphones and Android apps for learning can be seen in Table 1.

Table 1. Students' habits in using smartphones for learning.

No.	Question	Yes	No
1	Can you use your smartphone well?	30	0
2	Are you an active smartphone user?	27	3
3	Do you have adequate access to a smartphone and stable internet access?	27	3
4	Are you allowed to use a learning smartphone at school?	30	0
5	Do you use apps to learn chemistry?	18	12
6	Do you use apps to learn acid-base materials?	7	23

Table 1 shows that all respondents are active smartphone users, meaning that all respondents are used to using smartphones for various needs. Of the 30 students, 18 (60%) often use

applications to learn chemistry concepts. Only seven students used the application to learn acid-base material, while the majority never used the application to learn the concept. In this question, students were free to write applications that they often use to learn acid-base material. Most students used Chemistry acids and bases in matter applications. In addition, this result also shows that there are still few specific applications in the field of chemistry that students can use to learn.

The results of the analysis that has been carried out obtained the need for the development of flipbooks that combine aspects of educational games and application-based learning videos. Therefore, the development of applications in the field of chemistry for acid-based material is urgent so that students have a variety of choices in acid-based educational applications to improve their understanding.

Analysis of acid-base material is carried out to get the integration of the STEAM approach in learning based on Malangan batik as the local wisdom raised. This approach connects STEAM-2C in order to provide a real picture of the learning process carried out, especially in producing products by integrating seven disciplines. An explanation of each aspect of the STEAM-2C approach in Malangan Batik on acid-based material can be analyzed in Table 2.

Table 2. Integration of STEAM-2C approach in acid-base material.

Elements	Description
Science	**Factual:** Analyze the acid and base reactions involved in the coloring process of Malangan batik. **Conceptual:** Connecting the acid-base concept in the coloring process and activating coloring materials in Malangan batik. **Procedural:** Design batik coloring procedures using acids or bases as solvents.
Technology	- Use technology in measuring and monitoring the pH of acid-base solutions involved in batik dyeing experiments or processes. - Apply AR technology to determine acid-base reactions and pH analysis to obtain accurate results.
Engineering	- Design or modify the batik coloring system by considering using acids or bases in dissolving coloring materials. - Innovative use of night paste in the batik process
Art	- Analyze and model the relationship between dye density, solution pH, and color yield in batik. - Design a batik motif for an individual project
Mathematics	- Calculating the quantity composition of natural materials to produce colors suitable for batik - Use mathematical formulas to calculate the pH of acidic or basic solutions used in batik dyeing.
Culture	Promoting Malangan Batik and its noble values as one of Malang's local wisdoms.
Communication	Communicating problems from batik activities such as waste generated and solutions to the community

3.2 Design

After the needs analysis stage is complete, the next step is design or design. The first activity carried out is the design of the concept of the media model developed. Furthermore, the

process of compiling a description of the material that you want to display is displayed on a digital-based flipbook in the form of an application. The activity of compiling material descriptions begins with analyzing the material achievements and flow of learning objectives in accordance with the independent curriculum, then examining the relationship between the STEAM-2C approach and acid-base material from several references. Next, make an initial design of the flipbook display which can be seen in Figure 3.

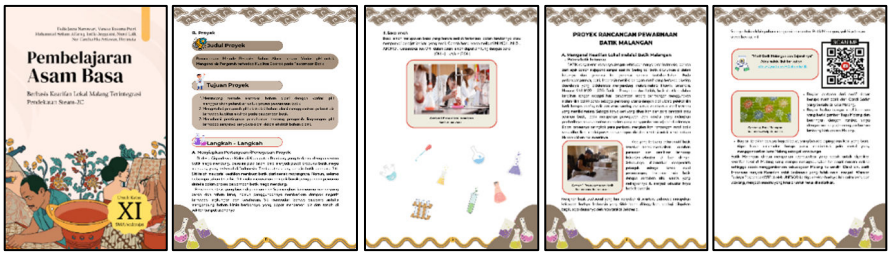

Fig. 3. Flipbook designs.

Part of the flipbook consists of several main parts including

a. Chem-Culture, this section will link the concept of acid-base with culture or examples in everyday life. For example, revealing the coloring process of Malangan batik from the perspective of Bronsted Lowry's theory.
b. Chem-Matter, this section will explain the basic concepts of acid-base, such as the definition of acids and bases, indicators, pH, typical properties of acidic and basic substance.
c. Chem-Video, this video can be a demonstration of acid-base reactions, an interactive explanation of pH, introducing Malangan batik.
d. Chem-News, related to technology and the latest developments in the field of acid-base chemistry, this section can present the latest news or new discoveries in the field. For example, the discovery of a new way to measure pH more accurately or the use of acid-base materials in environmentally friendly technology.
e. Chem-Tech, this section connects acid-base concepts with technology. For example, how pH meter technology works or how the chemical industry uses acid-base reactions in production.

The STEAM-2C approach connects scientific concepts with various aspects of life and more holistic learning [19]. There are efforts to integrate the STEAM-2C approach in learning with Malangan batik as local wisdom, so students can be more involved and in-depth in learning the concept of acid-base. Digital-based flipbook development is poured in the form of applications to facilitate users in terms of accessibility and ease of sharing, assist in efficient navigation in accessing specific content more quickly, and periodic content updates easily [20]. User Interface (UI) design using Figma can be seen in Figure 4.

Fig. 4. User Interface (UI) design.

3.3 Development

The development of a digital-based flipbook in the form of this application is carried out in accordance with the information at the design stage. The application is made using Android Studio to produce an application with the APK extension. An application has a workflow commonly referred to as the flow of activities from opening the application to closing it so that it shows the number of activities owned by the application. Complex and large applications usually have many activities and various displays such as scroll down, slide, and dropdown.

Digital-based flipbooks in the form of applications are developed with a limited number of activities and only adopt the click-button UI because it is simpler and easier to develop. In addition, the UI development model using button clicks is more user-friendly and minimizes errors caused by complicated coding. The activity flow chart of the E-Lite application can be seen in Figure 5

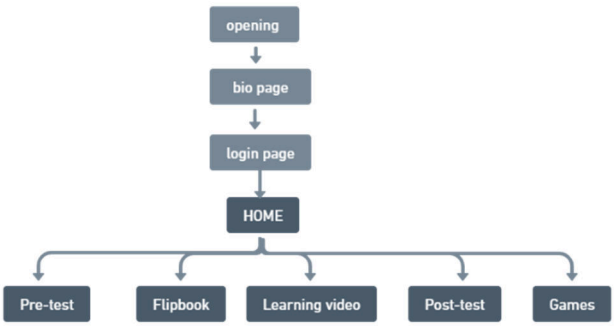

Fig. 5. Application flow chart.

Figure 5 shows the flow chart of the application for the developed digital-based flipbook. Flipbook has been developed into a digital form that is an innovative application that includes five main pages, namely:

a. Introductory video of local wisdom contains history, manufacturing process, and noble values. This video helps students to understand the context and importance of the learning material.
b. starting. A pre-test is used to determine students' knowledge before they start learning.

c. Flipbook, containing teaching materials that are attractively presented with visual, audio, and animation support to improve student understanding.
d. Post-test contains practice questions to evaluate the extent to which students understand the material and assess the level of learning success.
e. Games as interactive enrichment to attract student attention, in addition to deepening student understanding in a fun way.

With the combination of these five menus, this digital-based flipbook in the form of an application is not only a learning tool, but also an interesting, interactive, and effective tool in helping students understand and appreciate learning materials about local wisdom.

3.4 Advantages of Digital-Based Flipbook for Acid-Base Material

The following are the advantages of digital-based flipbooks in the form of applications when compared to other acid-base material learning applications, namely chemistry acid and bases and acids and bases in the matter, as in Table 3.

Table 3. Comparison of digital-based flipbooks with similar applications [21].

No	Comparison Indicator	Digital-based flipbooks	*Chemistry-Acid and Bases*	*Acids and bases in matter*
1.	Interactive and visually appealing	Yes	No	Yes
2.	Accessibility on various devices	Yes	Yes	No
3.	Contains multimedia content (audio, video, animation, infographics)	Yes	No	Yes
4	STEAM-2C approach	Yes	No	No
5.	Local wisdom information	Yes	No	No
6.	Tests in the form of pre-test, post-test, and LKPD	Yes	Yes	No
7.	Flipbook of acid-base material based on local wisdom	Yes	No	No

Based on the Table 2 comparison above, digital-based flipbooks have advantages as local wisdom-based learning applications. Students not only learn about chemistry but also have a comprehensive understanding of acid-based material and increase their cultural literacy. The impacts that students will get after using digital-based flipbooks are

a. Comprehensive understanding of acid-base concepts through STEAM-2C
b. Adding to the love of Indonesian native culture by preserving local wisdom is shown in the selected Malangan batik.
c. Supporting learning to foster cultured character in accordance with Number 87 of 2017 concerning Strengthening Character Education in students.
d. Contribute to realizing the Malang Government's regulation for the implementation of regional excellence-based education 4.

4 Conclusion

Efforts to improve the effectiveness of chemistry learning, especially on acid-base materials, developing learning applications based on local wisdom, and the STEAM-2C approach. Applying this approach brings advantages in integrating scientific concepts with cultural values, resulting in more meaningful and comprehensive learning. It is developing a digital-based flipbook integrated with the STEAM-2C approach and Malang's local wisdom, namely Malangan batik. This has resulted in a digital-based flipbook in the form of an innovative and interactive learning application. Students can understand the acid-base concept comprehensively and deeply through introductory videos, material content, learning videos, educational games, and tests. This flipbook also provides an exciting learning experience and a sense of pride in cultural heritage and local wisdom. In line with the direction of learning directed by the independent curriculum, developing this digital-based flipbook for acid-base material also supports a culture-based approach. It enriches the learning process with local wisdom.

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