Developing Teaching Resources for Scientific Writing Based on Digital Comics

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Abstract. The teaching resources currently used by instructors are predominantly normative and verbally contextual. The language used is often challenging for students to comprehend, and these materials have not been integrated with modern technology like digital comics, especially in the scientific writing course. This study aims to investigate the suitability and effectiveness of digital comic-based teaching materials for scientific writing students in the English Education program. The research design for this study is Research and Development (R&D), utilizing the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). Fourth-semester students in the English Education program serve as the data source for this study. Data collection is carried out through observations, interviews, questionnaire distribution, and conducting group discussion forums. Data are analyzed through needs analysis and objective analysis, as well as validation and reliability assessments. The overall results of these analyses are used as a basis for designing and developing digital comic-based teaching materials for the scientific writing course. Based on the analysis, it was found that the validation results for the digital comics of media expert validation was 3.75 which categorized into valid and content expert validation were 3.63 of learning aspects, meanwhile 3.71 of content aspect which fall into valid criteria. The results of students response was 4.33 which categorized into highly practical. This indicates that digital comic teaching materials are highly suitable for use in the scientific writing course.

Keywords: Digital comic; Teaching resources; Scientific writing; Technology

1. Introduction

Education can be implemented through diverse methods, such as enhancing the curriculum, providing training for educators, and creating innovative teaching materials to serve as valuable learning resources for students (Hamka & Arsyad, 2015). During the process of teaching and learning, it is crucial to have access to teaching materials, which play a vital role in transmitting knowledge to students. As stated by Ahmadi in 2010, these teaching materials comprise a wide range of resources employed to aid educators in facilitating the teaching and learning experience within the classroom, and they can take the form of both written and non-written materials. Moreover, when students are provided with teaching materials tailored to their requirements, they will have an easier time comprehending a subject. A significant issue arises from the fact that many teaching materials utilized in the learning process do not align with their majors and fail to relate to the topics under discussion. The creation of successful and productive learning experiences is significantly impacted by the quality of instructional materials (Wati et al., 2021). Furthermore, a...
A considerable number of these teaching materials remain challenging for students to grasp due to their frequent use of excessively formal and scientific language, which hinders comprehension and communication. Naturally, this will have repercussions on students’ educational achievements, causing them to lose interest and eventually become disinclined to read, ultimately leading to a deficit in knowledge acquisition.

On the other hand, the learning process still heavily relies on teachers or instructors and teaching materials. Teachers are required to guide students to grow and develop physically, psychologically, attitudes, and other skills (Wahid, 2018). Regarding teaching materials in writing, particularly in the scientific writing course within the English Education program, instructors continue to use conventional materials such as textbooks, student worksheets, and instructional media. Educational media serves as a tool during the learning process to stimulate students’ abilities and promote engagement in the educational journey (Tafonao, 2018: 103). Media refers to anything that serves the purpose of transmitting information or messages from the communicator (teacher) to the communicant (students). Through the utilization of the senses, it proves advantageous for students (Farid & Yansyah, 2019). None of the instructors have diversified their teaching materials by incorporating modern technology. Digital comic-based teaching materials are one of the suitable options. Whether they like it or not, modern technology cannot be avoided at this point, and instructors or teachers must be capable of applying and integrating it into the learning process. The swift advancement of technology simplifies the process for educators to offer resources such as tools or media to support learning (Wahyuningsih, 2018, 2019; Wahyuningsih & Dewi, 2019).

Khotimah (2021) asserts that the utilization of digital technology in education has a positive impact on changes that not only affect student engagement but also visualization skills, graphic communication, the ability to adapt knowledge to solve problems, and motivation to continue learning. Based on the observations, instructors in the scientific writing course have yet to develop creative and innovative teaching resources using digital comics for the subject. The demand for such imaginative and inventive teaching materials is significant, given that writing is a challenging area of study that students often find daunting.

Additionally, according to Fakhruddin, Amzah, and Nurchalis (2019), instructors and teachers are expected to have the ability to incorporate technology into the development of their instructional materials. Based on observations, students continue to face challenges in their scientific writing course. One contributing factor is the uninspiring and monotonous course materials, which discourage students from exploring them. Furthermore, instructors often rely on conventional teaching methods without introducing more engaging approaches when teaching scientific writing. Scientific Writing is a mandatory course within the English Education program, primarily because, upon completing their academic journey, students must compose a thesis and other scholarly documents. To excel in this, students need extensive writing practice, equipping them to consistently produce high-quality academic papers.

This research will investigate how to develop teaching materials for scientific writing using digital comics and assess the extent of the effectiveness of the digital comics developed for students in the English Education program. By conducting this research, it is ultimately hoped that students, especially in their scientific writing courses, will take responsibility for their achievements, both in terms of the process and the final product.

2. Literature Review

2.1 The Notion of Educational Materials

In the realm of education, it is imperative to possess educational tools that improve the learning experience, and among these tools are teaching resources. As defined by Prastowo (2014), teaching resources are systematically organized materials, encompassing information, tools, or written content, crafted to offer a thorough understanding of the competencies students must acquire. These resources are used in the instructional process for the purposes of strategizing and implementing teaching. Illustrations of such resources include textbooks, modules, handouts, worksheets, prototypes or models, audio educational materials, interactive teaching aids, and so on. Customizing teaching materials to meet students’ needs is essential for facilitating their

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Vol. 3 No. 1 Nov 2023
comprehension of the content. These materials should be in harmony with predetermined learning goals and objectives. Widodo and Jasmadi (2008) additionally highlight that the creation of teaching materials is intended to enhance both the quality and quantity of teaching and learning, aligning with the instructional objectives established for attainment.

2.2 The Objectives and Roles of Educational Materials

As outlined by Majid (2005:15), the goals of instructional materials encompass the following: 1) Aiding students in acquiring knowledge, 2) Offering a range of instructional choices, 3) Simplifying the teaching process for educators, and 4) Enhancing the appeal and engagement of learning activities. Additionally, as delineated in Prastowo's work (2015: 24-25), instructional materials play a dual role, serving both educators and learners. For educators, these materials fulfill the following functions: a) Streamlining the time educators spend on teaching, b) Shifting educators' roles from instructors to facilitators, c) Enhancing the learning process to make it more effective and interactive, d) Providing educators with a roadmap to guide all their activities during the teaching process, encompassing the fundamental competencies to be imparted to students, e) Serving as a tool for assessing learning outcomes. Moreover, as outlined by Prastowo in Lestari (2013), instructional materials serve different roles based on learning strategies, specifically in classical, individual, and group learning settings, as detailed below:

1) In classical learning, instructional materials function as follows: They act as the primary source of information, overseeing the learning process. They serve as auxiliary resources during the instructional process.

2) In individual learning, instructional materials perform the following roles: They serve as the principal medium for the learning process.

3) In group learning, instructional materials have the following functions: They integrate seamlessly into the group learning process by offering background information about the material, defining the roles of participants in group learning, and providing guidance for the group learning process itself.

2.3 Types of Instructional Materials

As previously mentioned, instructional materials are systematically organized educational resources used by both educators and students throughout the learning process (Pannen in Prastowo, 2014: 17). These instructional materials exist in various forms, with Amri and Ahmadi (2010:161) categorizing them as follows:

a. Visual Educational Resources: These materials, usually in paper format, are designed to facilitate learning and information delivery. Visual teaching materials encompass printed items like handouts, books, modules, student worksheets, brochures, leaflets, wallcharts, photos/images, as well as non-printed materials such as models/prototypes.

b. Auditory Educational Resources: This category includes systems that directly utilize radio signals that can be played or heard by individuals or groups. Examples include tapes, radios, vinyl records, and audio compact discs.

c. Audiovisual Educational Resources: These encompass any resources that enable the combination of audio signals with sequentially moving images. Examples encompass video compact discs and films.

d. Interactive Multimedia Educational Resources: These are combinations of two or more media that users can manipulate or interact with to control a presentation or simulate natural behaviors. Examples include interactive compact discs and web-based learning materials.

2.4 Digital Comics

Comics are a form of storytelling using easily comprehensible visual images, with the primary goal of conveying information to their readers. They adopt a cartoonish style, featuring characters and narrating stories through a sequence closely intertwined with illustrations, all with the aim of providing entertainment to their audience (Nana, 2013). Maharsi (2014) highlights that comics serve as a mode of visual communication, effectively delivering information in a popular and
easily understandable manner through the combination of text and images woven into a narrative. Then, Soedarso (2015:496) said that comics are classified into two categories: comic strips or serial comics, and comic books, also referred to as graphic novels. Furthermore, with the progression of technology, comics have transitioned into a digital format, commonly referred to as digital comics. These digital comics have the capacity to incorporate animations, games, and films that can be accessed and viewed online. As outlined by Nurgiyantoro (2018), comics come in various forms, including comic strips, comic books, humor comics, biography comics.

2.5 The Art of Scientific Writing and How to Learn It

The Scientific Writing course within the English Education program imparts the skills needed to produce a scientific paper, addressing both the procedural elements and the final outcome. During this course, students are offered comprehensive instruction regarding the various segments of a scientific paper, such as the background of the study, literature review, research methodology, data analysis, findings and discussion, conclusion and recommendations, and references. These components are elucidated with scholarly justifications that align with the paper's title. The course on Scientific Writing includes three to four parallel classes, each led by different educators. When there is a pair of instructors, they work together to divide teaching duties, ensuring that course content is delivered efficiently and creating a cohesive learning environment. Writing, though appearing deceptively simple, often instills fear and apprehension in many students. They grapple with a reluctance to write, even though they are obliged to acquire and comprehend this skill, particularly when it comes to crafting academic papers. As integral members of the academic community throughout their educational journey, students are held to the expectation of being proficient in producing papers, essays, observational or research reports, as well as composing theses and dissertations. These tasks all have a close association with scientific writing. Suadnyani (2009:2) contends that writing holds significant importance because it functions as a conduit for exploration, the generation of novel ideas, the refinement of organizational and elucidative skills concerning various concepts or notions, the cultivation of an objective perspective, assistance in the assimilation and processing of information, and the nurturing of active thinking. Within the Scientific Writing course, instructors continue to rely primarily on traditional teaching materials, with minimal integration of contemporary technology. Specifically, digital comic-based instructional resources have not been integrated into the course content.

3. Methodology

The research design includes evaluation research and development research. Based on the research issues and objectives, the suitable research design for implementing this study on the development of teaching materials based on digital comics for Scientific Writing students is evaluation research and development research. Gall, Gall, and Borg (2003) categorize this as "Educational Research and Development" (R&D). Specifically, Nunan (1992) includes it in the category of program evaluation research. Meanwhile, Akker, Gravemeijer, McKenney, and Nieven (2006) refer to research on educational development in this field as "Educational Design Research" (EDR). The development of teaching materials based on digital comics for 4th-semester students in the Scientific Writing program at the State University of Medan applies the ADDIE approach model (Branch, 2009) and the systems approach (Dick, Carey, and Carey, 2001). Both of these development models are suitable approaches for designing an educational program. The ADDIE approach model, in general, can be illustrated in the following diagram.

The data collection techniques employed in this study included interviews, validation, and the distribution of questionnaires to students. In the interview technique, students were provided with a list of questions regarding digital comic teaching materials and answered the questions provided. During the validation process, media and material validators assessed the digital comic teaching materials based on their judgment of the developed materials. In the questionnaire section, students were given questionnaires to obtain their responses regarding the use of digital comic-based teaching materials for scientific writing.

In data analysis, an effectiveness analysis was conducted, determining the effectiveness of the developed instructional material based on digital comic scientific writing through responses or feedback from students who were interviewed after using the material. A practicality analysis was conducted by evaluating the practicality of the instructional material based on digital comics with students, lecturers, and experts. The analysis results indicated the practicality of the teaching material was 0.73. A practicality value of 0.73 is categorized as "practical". A practicality value close to 1 indicates that the teaching material is practical in its application and can be implemented in the classroom.
performed on each validated comic-based instructional material, which was tested by validators using a validation sheet, with or without changes, and deemed practical. The average practicality ratings were summarized and interpreted based on practicality categorization criteria.

A validity analysis involved data obtained through student questionnaires using this digital comic-based instructional material as initial data for developing digital-based scientific writing instructional material. The purpose of the questionnaire was to determine the validity of instructional material. The average validity ratings were summarized and interpreted based on validity classification criteria. An effectiveness analysis of comic-based instructional material involved evaluating the effectiveness of the material by collecting feedback from individual students who were interviewed after using the instructional material. The success of the learning experience was measured by assessing the recorded outcomes on interview sheets with the students.

4. Findings

In this phase, an analysis is conducted to collect data related to the issues present in the scientific writing course and the teaching materials that have been used so far. The purpose of this phase is to identify all the existing problems that will be studied in order to develop digital comic-based teaching materials. During this analysis phase, interviews were conducted with the course instructors and students involved in the scientific writing course. The teaching materials that have been used so far have been found to be unengaging and boring for the students. The language used is highly formal, making it difficult for students to comprehend the materials within these teaching materials. Instructors have not developed innovative and creative teaching materials to facilitate students' understanding of scientific writing content. Additionally, the teaching methods applied by instructors in the classroom have not been engaging enough to captivate students' interest in delving into the scientific writing course. This analysis phase includes interview activities, setting the objectives of the scientific writing course, analyzing Learning Achievements of and course learning outcomes and developing a development program. Based on these issues, it is necessary to innovate and develop digital comic-based teaching materials for scientific writing, which has never been done before. The innovation in developing teaching materials involves transforming them from the formal and rigid format into an engaging and enjoyable digital comic format. Furthermore, in the development innovation, static images are transformed into animated images within the digital comic. The language used is also refined into shorter and simpler forms, making it easier for students to understand.

Next, in this analysis phase, interviews were conducted with both instructors and students regarding their needs in using scientific writing teaching materials. The following describes the results of interviews with instructors and students.

Table 1. Scientific writing lecturer results of interview

<table>
<thead>
<tr>
<th>Components</th>
<th>Result of Interview</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching materials in the scientific writing course</td>
<td>The teaching materials used in the scientific writing course are in the form of a book.</td>
</tr>
<tr>
<td></td>
<td>The lack of supporting teaching materials other than course books, such as digital comics, is not available.</td>
</tr>
<tr>
<td>Scientific writing comics as teaching materials.</td>
<td>Digital comics can be used as supplementary teaching materials to enhance students' knowledge.</td>
</tr>
<tr>
<td></td>
<td>Digital comics can be used as teaching materials to enhance students' knowledge.</td>
</tr>
</tbody>
</table>

Table 2. Results of students’ interview

<table>
<thead>
<tr>
<th>Components</th>
<th>Result of Interview</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching materials in the scientific</td>
<td>Students still face difficulties in scientific writing.</td>
</tr>
<tr>
<td></td>
<td>The lack of teaching materials in the form of digital comics is not</td>
</tr>
</tbody>
</table>
writing course. available.

Scientific writing comics as teaching materials.

Digital comic teaching materials can be used to supplement and enhance students' knowledge.

Digital comic teaching materials are used as the primary teaching materials for students in the scientific writing course.

The teaching materials currently used are too formal and rigid, making it difficult for students to understand.

The images in the teaching materials currently used are not in animated form yet.

Students strongly support the development of digital comic-based teaching materials for scientific writing.

Tables 1 and 2 display the outcomes of interviews conducted with both educators and students, focusing on the analysis of data and information collection. The findings indicate that, in the scientific writing course, digital instructional materials, particularly digital comics, have not been employed. Students express a preference for teaching materials that incorporate captivating images and illustrations, along with vibrant colors. Moreover, students favor instructional content characterized by straightforward language and easily comprehensible sentences, while still presenting a challenge that encourages critical thinking and self-motivation for proficient academic writing. This is of utmost importance since, as students reach the culmination of their academic journey, they must possess the ability to compose a thesis, a prerequisite for obtaining their academic qualifications.

Moreover, based on the interview findings, it is evident that students require materials with a focus on practical implementation. They lean towards content characterized by straightforward language and succinct sentences to facilitate comprehension. Consequently, opting for instructional materials based on digital comics proves to be an appropriate decision for shaping the curriculum of the scientific writing course. This choice is in harmony with the course's aim of amplifying students' comprehension and interest in scientific writing-an area often viewed with trepidation due to its inherent difficulty. The development of instructional content for scientific writing, leveraging digital comics, is accomplished by drawing from learning resources like e-journals, e-books, and pertinent reference materials.

Considering these challenges, there is a call for groundbreaking advancements in developing instructional materials for scientific writing using digital comics-a path not explored previously. This innovation encompasses the transformation of conventional and rigid instructional formats into a captivating and enjoyable digital comic style. Furthermore, the innovation in development extends to the transformation of static images into dynamic animated illustrations within the digital comic. The language employed is streamlined to be concise and straightforward, with the objective of improving students' understanding.

4.1 The Phase of Designing Digital Comics

During this phase of design, various tasks are undertaken, including the creation of a storyboard, the development of validation tools, and the construction of surveys for both educators and students. The storyboard is crafted to represent a narrative sequence and functions as a roadmap in the creation of compelling digital comic instructional materials. At this juncture, designs are formulated based on the issues and weaknesses identified in the analysis phase. The researcher devises designs for the instructional materials in development. Additionally, suitable teaching methods, strategies, and models for the scientific writing course are applied, such as the utilization of project-based learning or problem-based learning. The implementation plan for lessons is also adjusted and enhanced in alignment with the preferences of the students.

In this instance, the instructional material takes the form of a comic, and the selection of image designs is based on canva templates. The narrative design aligns with the subjects covered in the scientific writing course, and the total number of comic pages is predetermined. Every page of the
comic is crafted for maximum effectiveness. The instructional material, presented in comic format, aims to be captivating, ensuring that students can concentrate on the content of scientific writing. Previous materials consisted solely of lengthy, formal, and uninteresting explanations. The current scientific writing instructional material incorporates animated images with attractive coloring. It is also enriched with engaging conversations and discussions on topics like paraphrasing and summarizing in scientific writing. The digital comic format is intentionally compact, featuring a manageable number of pages, to encourage students to read and comprehend the entire instructional content.

Additionally, the varied animated image designs in this comic format include depictions of individuals in both Muslim and non-Muslim attire. This illustrates the diverse range of religions among the students in the course, and the animated designs in the comic are crafted to be inclusive of all these religious backgrounds. In terms of content design, the comic takes the form of a narrative that addresses scientific writing topics, including the concept of scientific writing, literature review, research methods, and various examples of scientific writing problems suitable for collaborative work, group activities, and individual tasks. The total number of comic pages has been predetermined, with each page meticulously designed for optimal effectiveness. The images within the comic are intentionally kept at a moderate size. The animated designs in the comic depict individuals in Muslim attire and students participating in discussions within the classroom. Simultaneously, the narrative content design in the comic encompasses scientific writing topics such as elucidating the issue's background, presenting theoretical studies, detailing research methods, expounding on data analysis, discussing findings, and explaining conclusions and references.

The research instrument design is created with the digital comic in mind. In a developmental study, data is collected to assess the validity, practicality, and effectiveness of the developed product. In relation to these three parameters, instruments are specifically crafted to address their respective indicators. To ensure the validity of the product, instruments are customized to align with the requirements of both the scientific writing course and the digital comic study. The validation format includes two components: one for media experts and another for content experts. The media expert validation format considers appearance and learning elements, with parameters crafted in reference to the comic. Conversely, the content expert validation format evaluates learning elements and content, incorporating parameters linked to digital comics. The validation instruments and response questionnaires adhere to the criteria outlined in the instrument matrix. These tools are utilized by two validators to validate the scientific writing instructional material. Simultaneously, the response questionnaire is administered to various scientific writing instructors and students.

The practicality instrument utilizes a questionnaire for gathering students' responses, assessing elements such as learning aspects and presentation, with parameters derived from the created digital comic animations. In terms of the effectiveness instrument, it entails a set of questions aimed at students to evaluate the efficacy of reading the comic text. The digital comic that has been developed is termed a prototype.

4.2 The Development Phase

During this phase, tasks such as generating digital comics, validating their content, and making necessary revisions are undertaken. The creation of digital comics is executed through the canva platform, which offers templates for constructing comics. The author selects a template that corresponds to the predetermined storyboard. In this step, characters for the scientific writing comic are crafted, encompassing both educators and students involved in learning scenarios, along with subjects pertinent to scientific writing lectures. The researcher proceeds to produce and fill comic panels with images and dialogue bubbles, aligning with the previously outlined content review. The illustration process takes place on canva, with adjustments made to fit the book's dimensions.

Comic illustrations are crafted to align with the predetermined narrative focusing on topics addressed in scientific writing lectures, such as the background of the issue and literature review. Subsequently, the comic is formatted into book size, undergoing a series of stages that commence

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Vol. 3 No. 1 Nov 2023
with manual sketches on canva. Diverse colors are incorporated to elevate visual appeal during the design process. The canva processing encompasses specific actions, including pattern creation, coloring, and the integration of dialogue text. This medium is conceptualized as a self-contained visual tool, eliminating the need for additional facilities or infrastructure. Its effectiveness and efficiency enable it to be carried and accessed conveniently in accordance with students' requirements.

The comic cover is meticulously designed for maximum attractiveness, featuring vibrant coloring and bearing the title "Theory and Practice Based on Comic." The cover, adorned in a light blue hue, showcases two students in graduation attire on the back, a bookshelf with assorted titles, and two students engrossed in reading on the front. This design aims to inspire and captivate students, fostering their engagement in reading and comprehending the scientific writing instructional material. Below is the finalized and colored comic cover, titled "Scientific Writing, a Comic Edition." Additionally, the instructional book showcases various instances of comic image designs presented in sketch form both before and after narrative incorporation, as well as before and after the application of colorization.

![Figure 1. Sketches of digital comics](https://ejournal.altsacentre.org/index.php/asiantj)

![Figure 2. Comic post-coloring](https://ejournal.altsacentre.org/index.php/asiantj)

![Figure 3. Comic following the addition of narration](https://ejournal.altsacentre.org/index.php/asiantj)

### 4.3 Design Validation Outcomes

#### 4.3.1 Media expert validation

In order to assess the digital comic product with media experts, both the product and an evaluation tool are presented. The evaluation tool includes aspects related to appearance, covering color selection, front cover design, comic background, comic layout, and font size. Regarding learning aspects, it assesses the ease of using the comic, its alignment with teaching materials, the sufficiency of the question quantity, and the difficulty level of the questions. The outcomes of the media expert validation are displayed in the table below.

**Table 3. Media expert validation**

<table>
<thead>
<tr>
<th>No</th>
<th>Description</th>
<th>Validator Scores</th>
<th>Average (Items)</th>
<th>Average (Total)</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Appearance Aspect</td>
<td>V1</td>
<td>V2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>1. Precision in choosing colors for the</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3.75</td>
</tr>
</tbody>
</table>
As depicted in the table above, the outcomes of the media validators' evaluation on the visual components of instructional materials based on digital comics, when averaged, amount to 3.75. Likewise, for the learning aspect, the score is 3.75, meeting the criteria for validity. The comprehensive data from the media expert review is 3.75, indicating the appropriateness of the digital comic instructional material.

### 4.3.2 Content expert validation

To validate the digital comic product with content experts, the product and an assessment instrument are provided. The assessment instrument comprises learning elements such as the alignment of practice questions used in the comic with learning outcomes of alumni and course learning outcome, the alignment of practice questions used in the comic with learning objectives, the alignment of material with student abilities, ease of understanding the material in the comic, accuracy of comic selection, and so on. The content elements consist of the accuracy of the material in the questions found in the comic, clarity of the material in the comic, alignment of the comic reflecting the character of honesty, alignment of the comic reflecting the character of responsibility, hard work, and character values of discipline. Below are the results of the content expert review.

Table 4. Content experts validation

<table>
<thead>
<tr>
<th>No</th>
<th>Description</th>
<th>Validators’ scores</th>
<th>Average (Items)</th>
<th>Average (Total)</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>V1</td>
<td>V2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Learning aspects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Consistency of practice questions utilized in the comic with the outcomes of graduate learning and course learning objectives</td>
<td>3</td>
<td>4</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Alignment of practice questions used in the comic with learning objectives</td>
<td>4</td>
<td>3</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Alignment of material with student abilities</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Consistency of the comic's format with the attributes of the material</td>
<td>3</td>
<td>4</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Ease of understanding the material in the comic</td>
<td>4</td>
<td>3</td>
<td>3.5</td>
<td></td>
</tr>
</tbody>
</table>
The table above displays the validation outcomes from content validators regarding the instructional aspects of digital comic-based educational materials, with an average score of 3.63. Simultaneously, the content aspect garners an average of 3.71, meeting the valid criteria. The cumulative data from the content expert review is 3.67, signifying the suitability of the digital comic instructional material. Moreover, the validators offer recommendations for refining the comic instructional material product, as illustrated in the subsequent table.

**Table 5. Digital Comic Revision**

<table>
<thead>
<tr>
<th>Elements</th>
<th>The revised section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital comic</td>
<td>Inappropriate characters have been identified and should be replaced to align with the learning process. Additionally, it is recommended to introduce more variety in the exercise questions.</td>
</tr>
</tbody>
</table>

In response to the recommendations provided in the table, the researcher made revisions to the suggested sections to enhance the quality of the developed digital comic instructional material product.

**4.4 Design Revision**

Subsequently, the researcher carried out revisions and reviewed the overall feedback provided by the validator. The changes made are as follows.

Before the revision:

![Figure 4. Comic before revision](https://ejournal.altsacentre.org/index.php/asiantj)

Vol. 3 No. 1 Nov 2023
After Revision:

4.5 Small Class Trial Phase

The small class trial phase is conducted after the digital comic-based scientific writing instructional material product is validated by the validators and revised. The next step is to conduct a trial of the product in a small class. This small class trial involves 10 students who participate in the lecture process. The selected students are given the digital comic-based instructional material product to read, and afterward, they are instructed to provide feedback through a questionnaire given to them. Here are the results of the student responses.

Table 6. Results of the student response questionnaire

<table>
<thead>
<tr>
<th>No</th>
<th>Description</th>
<th>Student response scores</th>
<th>Average (Item)</th>
<th>Average (Total)</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Engaging comic display</td>
<td>4 5 5 4 4 5 4 4</td>
<td>4.375</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>This comic is user-friendly</td>
<td>4 5 3 4 4 5 5 4</td>
<td>4.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>The instructions in the comic are easily comprehensible.</td>
<td>5 5 5 4 4 5 4</td>
<td>4.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Class activities become more enjoyable.</td>
<td>4 4 4 5 5 4 5 4</td>
<td>4.375</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Appealing color selection in the comic.</td>
<td>3 3 5 4 4 5 5</td>
<td>4.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Correct layout and arrangement of fonts.</td>
<td>3 5 4 5 4 5 4</td>
<td>4.125</td>
<td></td>
<td>4.33</td>
</tr>
<tr>
<td>7</td>
<td>Attractive design neatness.</td>
<td>5 5 3 5 3 4 5 4</td>
<td>4.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>The choice of animations in the comic is commendable</td>
<td>5 3 4 5 3 5 4</td>
<td>4.125</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Attractive form and color.</td>
<td>3 3 4 5 4 5 5</td>
<td>4.125</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>The comic has the potential to boost enthusiasm for</td>
<td>4 3 5 3 5 4 4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
lectures.

<table>
<thead>
<tr>
<th></th>
<th>The comic features engaging content.</th>
<th>4</th>
<th>4</th>
<th>5</th>
<th>5</th>
<th>3</th>
<th>5</th>
<th>4</th>
<th>5</th>
<th>4.375</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>The content is easy to understand</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>4.375</td>
</tr>
<tr>
<td>12</td>
<td>The language in the comic is easy to understand.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>4.375</td>
</tr>
<tr>
<td>13</td>
<td>The font used is simple and easy to read.</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>4.125</td>
</tr>
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</tbody>
</table>

Based on the outcomes of the student response questionnaire mentioned earlier, it can be deduced that the average rating for students' feedback on instructional materials based on digital comics is 4.33, classifying it as highly practical. Additionally, this comic instructional material is deemed effective, as supported by interviews with several students. The instructional material proves to boost students' motivation during lectures, particularly when addressing the exercise questions embedded in the material.

5. Discussions

Educational materials play a vital role in the effectiveness of the learning process. When students are provided with instructional materials that cater to their specific needs, it enhances their understanding of the subject matter. However, a considerable number of educational materials utilized in the learning process may not be pertinent to students' academic disciplines or the subjects under discussion. Moreover, several instructional materials pose challenges for students due to their use of formal and excessively academic language, resulting in difficulty in comprehension and a lack of communicative effectiveness.

The development of digital comic-based instructional materials for scientific writing goes through several research stages. The goal is to produce instructional materials that are appropriate, effective, and efficient in the academic learning process, specifically aimed at enhancing student learning outcomes in scientific writing courses. Additionally, it aims to take responsibility for the achievement of both process and product outcomes. Another objective is to increase students' responsibility, interest, and motivation in the Scientific Writing course.

Based on the analysis provided by content experts, data was obtained regarding the comic instructional material based on learning aspects such as the alignment of practice questions used in the comic with learning outcomes of graduates and course learning outcomes, the alignment of practice questions used in the comic with learning objectives, the alignment of material with student abilities, the alignment of the comic's form with the characteristics of the material, and so on, scoring 3.63, falling into the valid category. Meanwhile, for the content or material aspect, including the clarity of the material in the comic, the alignment of the comic reflecting the character of honesty, the alignment of the comic reflecting the character of responsibility, and hard work character, a score of 3.71 was obtained, with a total average score of 3.67, falling into the valid category.

Meanwhile, the assessment from media experts reveals that the digital comic-based instructional material product obtained a score of 3.75 for the appearance aspect, including the accuracy of color selection on the front cover of the comic, consistency in selecting the comic's background color, accuracy of color selection in comic animations, neatness of comic design, and quality of comic-making materials. For the learning aspect, which includes the ease of using the comic, alignment with teaching material, adequacy of the number of questions, and the difficulty level of the questions, it received a score of 3.75, with an average score of 3.75 falling into the valid category.

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Vol. 3 No. 1 Nov 2023
The student response to the comic instructional material product also received excellent results, classified as highly practical with an average score of 4.33.

6. Conclusions

In the development study of digital comic-based teaching materials for scientific writing, it was found that based on the analysis of the collected data, these materials meet the criteria for suitability, specifically in terms of validity, practicality, and effectiveness. The validation results conducted by both content experts and media experts indicated that the digital comic teaching materials met the criteria for validity and suitability with only minor revisions, which have already been addressed based on the feedback provided.

Based on interviews with students after using the digital comic-based teaching materials, it can be concluded that the use of learning resources in the form of comics has had a positive and beneficial impact. It is evident that the availability of learning resources in the form of digital comics has increased students' interest and motivation in the scientific writing course, which students previously considered difficult and dull. The strategy of using digital comic teaching materials in the teaching process not only adds an educational element but also entertainment, making students more engaged and motivated to actively participate in the learning process. Furthermore, since students are required to be more careful when completing various writing assignments, the use of digital comics to teach scientific writing concepts also helps strengthen their writing skills and their ability to construct sentences using their own ideas and concepts.

References


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Vol. 3 No. 1 Nov 2023

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