Diversitas Journal
ISSN 2525-5215
Volume 9, Issue 2 (apr./jun. 2024) p. 0711 – 0729
https://diversitasjournal.com.br/diversitas_journal

Comics as an Assessment Tool for Learning Mathematics

MANALO, Liberty Gay C [1]

[1] 0000-0001-8909-838X; Rizal Technological University. Mandaluyong City, National Capital Region, Philippines. lgcmanalo@rtu.edu.ph

A B S T R A C T

This study investigates the utilization of comics as an evaluative instrument for acquiring mathematical knowledge, as perceived by pre-service teachers specializing in mathematics. The consequences of this phenomenon in the field of mathematics education were also examined. The study employed an exploratory-descriptive qualitative research strategy to investigate respondents' perceptions on the utilization of comics for evaluating their mathematics ability. This was accomplished through the administration of semi-structured interviews. The data analysis revealed themes such as effectiveness in conceptual understanding and demonstration, practical application and integration of mathematics, classroom utilization and knowledge sharing, development of creativity, critical thinking and research interest, facilitating discovery, learning and reflection, and learning improvement, knowledge sharing and ownership emanated when the data were analyzed thematically. The conversation revolved around the consequences of cultivating 21st century skills, including information media and technological skills, learning and innovation, and communication. Furthermore, the significance of comics as a genuine formative evaluation, as well as its function in self and peer evaluation, were also emphasized. Based on the initial findings pertaining to the utilization of comics as an evaluative instrument for mathematics education, it is recommended that further research be undertaken to investigate the potential application of comics as an assessment tool within a classroom setting.

RESUMO

Este estudo investiga a utilização de quadrinhos como um instrumento de avaliação para a aquisição de conhecimento matemático, como percebido por professores pré-serviço especializados em matemática. As consequências deste fenômeno no campo da educação matemática também foram examinadas. O estudo empregou uma estratégia de pesquisa qualitativa exploratório-descritivo para investigar as percepções dos respondentes sobre a utilização de quadrinhos para avaliar sua capacidade matemática. Isto foi conseguido através da administração de entrevistas semi-estruturadas. A análise de dados revelou temas como eficácia na compreensão e demonstração conceituais, aplicação prática e integração da matemática, utilização em sala de aula e compartilhamento de conhecimento, desenvolvimento de criatividade, pensamento crítico e interesse em pesquisa, facilitação da descoberta, aprendizagem e reflexão, e melhoria de aprendizado, partilha de conhecimento e propriedade emanada quando os dados foram analisados tematicamente. A conversa girou em torno das consequências do cultivo de habilidades do século XXI, incluindo mídia da informação e habilidades tecnológicas, aprendizagem e inovação, e comunicação. Além disso, a importância dos quadrinhos como uma verdadeira avaliação formativa, bem como sua função na auto-avaliação e na avaliação de pares, também foram enfatizadas. Com base nas descobertas iniciais relativas à utilização de quadrinhos como um instrumento de avaliação para a educação matemática, recomenda-se que mais pesquisas sejam realizadas para investigar a aplicação potencial de quadrinhas como uma ferramenta de classificação dentro de um ambiente de sala de aula.

ARTICLE INFORMATION

Article process:
Submitted: 03/18/2024
Approved: 05/23/2024
Published: 05/24/2024

Keywords:
Authentic Formative Assessment,
Digital Comics,
Exploratory Descriptive Qualitative Design.

Palavras-chave:
Authentic Formative Assessment,
Digital Comics,
Exploratory Descriptive Qualitative Design.

DOI: 10.48017/dj.v9i2.2960

Introduction

The global COVID-19 epidemic has had a significant and far-reaching influence on individuals around the globe, with the educational sector being particularly affected (Ablao et al., 2022). According to Gonzales (2023), educators were required to swiftly transition from in-person instruction to online, distance, or mixed instructional methods. Additionally, they were obligated to acquire proficiency in novel pedagogical, evaluative, and classroom management strategies. Amidst this unpredictable and dynamic setting, the routine difficulties of evaluating the content and methods of student learning have become increasingly intricate.

Education has always relied heavily on assessment, and current changes are changing not just what is taught but also how it is acquired and assessed. New forms of formative and summative evaluations that take into account each student's distinct place on the learning continuum are required in order to customize learning (Amua-Sekyi, 2016). These tests have to be in line with strict guidelines for college and job preparedness, which call for in-depth subject knowledge and sophisticated thinking abilities (Sigman & Mancuso, 2017).

Authentic assessment is a pedagogical approach that involves reflection on the teaching, learning, achievement, motivation, and attitudes of educators and learners throughout the educational process. Its purpose is to evaluate students' ability to apply acquired knowledge in real-world contexts (Sahera et al., 2022). Research suggests that evaluation is considered authentic when the tasks has practical significance and students engage in real-life activities (Sewagegn, et. al, 2020).

Comics have become instructional instruments in this changing environment, distinguished by their incorporation of informative and educational components, giving rise to the phrase "educational comics" (Karagoz, 2018; Senturk & Simsek, 2021). Comic books, whether made by hand or digitally, can be tailored to fit a variety of subjects, goals, and specifications. Beyond their educational value, comic books provide a distinctive viewpoint on actual events and foster original and creative thinking (Ilhan et al., 2024).

Using comics in the classroom does more than only impart knowledge; it also helps students become more creative and adaptable and closes the knowledge gap between theory and practice (Silva, 2017). Teachers who use cutting-edge approaches, such using comics, convert abstract ideas into instructional tools that support critical thinking and instructional decision-making (Bolton-Gary, 2012). In their 2022 study, Abdullah & Jafri investigate comics as a genuine evaluation instrument. They find that comics have a special quality that enables students of all skill levels to relate their own experiences and observations to the text and visuals, a freedom not found in conventional text-based tests.

A complete strategy to concerns such as plagiarism and cheating is necessary, as demonstrated by the difficulties that the Covid-19 epidemic presented for online learners (Meccawy et al., 2021). This comprehensive approach consists of increasing student

awareness, providing teachers with training on how to spot cheating techniques, and institutionalizing rules of conduct with strict penalties. On the other hand, Beleumi (2022) emphasizes how online tests can support sophisticated teaching techniques. The study conducted by Rahman et al. (2022) on an online English Speaking II course highlights the increasing popularity of role play and presentation as efficient online evaluation techniques.

Building on the findings of Demir et al.'s (2023) investigation of manga comics in the setting of Linear Algebra, this study explores the viewpoints of second-year pre-service math teachers using comics as a novel form of evaluation. With this unique approach, formative assessment takes place while participants actively create their own webcomics.

Specifically, this study aims to answer the following questions:

1. What are the perceptions of mathematics pre-service teachers towards the use comics in assessing their performance?
2. What implications arise from the utilization of comics as an assessment tool within mathematics education?

Materials and Methods

Research Design

Following the methodology described by Hunter et al. (2019), the research used an exploratory-descriptive qualitative (EDQ) design to explore and explain participants' experiences on the phenomenon under inquiry. A semi-structured questionnaire with seven questions was used to gather data and find out how respondents felt about the use of comics as an evaluation tool in math classes. The study carefully followed the phases of the Maguire & Delahunt (2017) recommended thematic analysis approach, which included familiarizing oneself with the data, creating preliminary codes, looking for themes, evaluating themes, identifying themes, and completing write-ups. The EDQ design was carefully chosen because of its built-in flexibility, which allowed the researcher to go in new directions in figuring out how deeply and intricately participants felt about the use of comics as an assessment tool in math classes. This design was developed to provide a deeper comprehension of the subject matter by capturing subtle insights that go beyond just quantitative measurements.

Sample of the Study

The research was conducted in the Rizal Technological University Linear Algebra course (Math 112), which is designed for the cohort of second-year pre-service math instructors enrolled in the second semester of the 2020–2021 academic year. Using basic random sampling, 30 participants were chosen from the broader group of second-year mathematics pre-service teachers; Hunter et al. (2019) recommends this sample size for qualitative research.

Data Gathering Tools

A semi-structured questionnaire consisting of open-ended interview questions was utilized to explore various aspects of the participants' viewpoints concerning the use of comics as an evaluation instrument in mathematics education. In order to examine the wider educational impact of mathematics, the questionnaire is designed with inquiries that aim to explore topics like teaching and learning dynamics, the integration of mathematics, the educational benefits associated with making comics, motivation and interest considerations, assessment and reflection practices, as well as the practical application and appreciation of mathematics.

Data Gathering Procedures

The data was gathered during the respondents' final period where CRAFTS model was used by their teacher as an authentic performance-based assessments of thier performance in thier Linear Algebra subject. Figure 1 shows the process of implementing the CRAFTS model in the study.

Table 1. CRAFTS Performance Task Assessment using Online Created Comics

Steps	Instructions
C-omic Strip Development	Students will choose one of the subjects covered in Linear Algebra.
R-ole as Instructor	Students will take on the role of a teacher who teaches Linear Algebra in class.
A-udience Adaptation	The comics will be developed for students who are unable to attend synchronous classes.
F-ormat Utilization	Create an online comic with at least 12 panels using their preferred comic creation program (e.g., Canva, Pixton, Picsart).
T-opic Application	Use a comic strip to demonstrate Linear Algebra's practical applications.
S-cenario Implementation	The online comics that are generated will be evaluated using rubrics defined in class.

Table 2 below shows the class developed rubrics that was used to assess students performance in developing thier comics in every step.

Table 2. Rubrics Assessment for CRAFTS

Step	Excellent (3)	Good (2)	Needs Improvement (3)
Comic Strip Development	The comic strip captivates the reader with its engaging storyline, richly developed characters, and creative use of imagery.	The comic strip captivates the reader with its engaging storyline, well-developed characters, and skillful use of imagery.	The comic strip lacks engagement, with a weak plot, underdeveloped characters, and ineffective use of graphics.
Role as Instructor	Assumes the role of an effective	Captures the role of a mathematics	Fails to fulfill the role of a mathematics

	mathematics instructor, providing clear explanations, examples, and guidance throughout.	instructor well, providing explanations, examples, and some guidance throughout.	instructor, offering vague explanations, irrelevant examples, and no guidance.
Audience Adaptation	Tailors the comic strip effectively to the needs of students who cannot attend synchronous classes, ensuring clarity and relevance.	Tailors the comic strip adequately to the needs of students who cannot attend synchronous classes, with mostly clear content.	Fails to tailor the comic strip to the needs of students who cannot attend synchronous classes, with unclear and irrelevant content.
Format Utilization	The comic strip format is utilized effectively, with a clear layout, suitable panel sequencing, and visually appealing design.	The comic strip format is used effectively, with a clear layout, appropriate panel sequencing, and an appealing design.	Lacks effective use of the comic strip format, with unclear layout, inappropriate panel sequencing, and visually unappealing design.
Topic Application	Successfully integrates the chosen topic into the comic strip, providing clear explanations of its importance and applicability.	Integrates the chosen topic into the comic strip, providing explanations of its relevance and applicability.	Doesn't quite manage to seamlessly incorporate the chosen topic into the comic strip, missing out on providing clear explanations of its significance and practicality.
Scenario Implementation	Effectively conveys lesson content through comic strips, showcasing clear communication, captivating storytelling, and seamless integration of concepts.	Effectively conveys lesson content through engaging comic strips, showcasing clear communication, captivating storytelling, and seamless integration of concepts.	Effectively communicates lesson content through comic strips, with clear communication, engaging storytelling, and seamless concept integration.

Subsequent to the production of comics, the researcher solicited voluntary participation from thirty (30) randomly selected pre-service math teachers. With each responder, the researcher scheduled a virtual conference using Google Meet at a time that worked best for them. The following questions make up the semi-structured questionnaire:

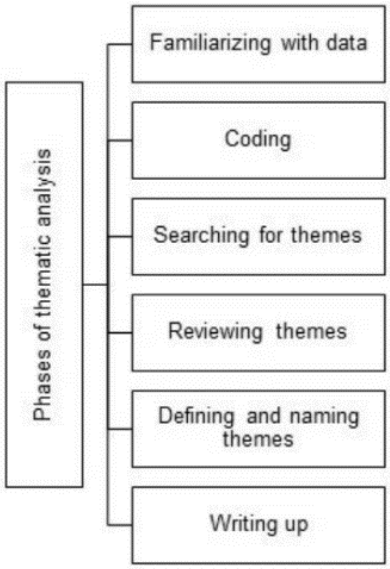
1. *How successful are comics at improving mathematics understanding?*
2. *Can you share your experiences using real-world circumstances in comics to teach math?*
3. *Do you plan to use comics in class to engage students and provide knowledge?*
4. *How do comics help math students develop creativity and critical thinking?*
5. *How do you see comics aiding math discovery and learning?*
6. *Do you think comics will boost math education? Why/why not?*

Treatment of Data

Data gathered from the interview were analyzed following the Braun &Clarke's six phase framework for doing a thematic analysis as shown in figure 2 cited in the study of Elhers et. al (2020).

Figure 1.

Braun & Clarke's Six Phase for Thematic Analysis



Ethical Considerations

The researcher has implemented rigorous protocols to protect participant confidentiality and privacy. The data management protocols followed the institution's Research and Development Center's (RDC) ethical guidelines before being put into effect. Recognizing its obligations under Republic Act No. 10173, also referred to as the Data Privacy Act of 2012, the researcher is dedicated to handling personal data with ethics. This includes all aspects of data management, such as gathering, logging, organizing, storing, retrieving, updating, modifying, consulting, using, consolidating, blocking, erasing, or destroying data. Interviewees maintain the strictest secrecy about any personal or sensitive information they collect or record, and any processing of such material is used only for research.

Delimitation of the Study

The present study aims to examine the application of comics as an evaluative instrument and its ramifications in the context of mathematics education. The study included junior mathematics pre-service teachers who were in their second year of study at Rizal Technological University during the academic year 2020-2021. The study did not consider the demographic profiles of the respondents as a significant distinguishing feature. The study issues were exclusively addressed via qualitative data analysis. Considering that the

conclusions were exclusively based on the participants' responses, it is advisable to undertake more research in order to substantiate the applicability of the findings.

Results and Discussions

A. *Comics as an Assessment Tool*

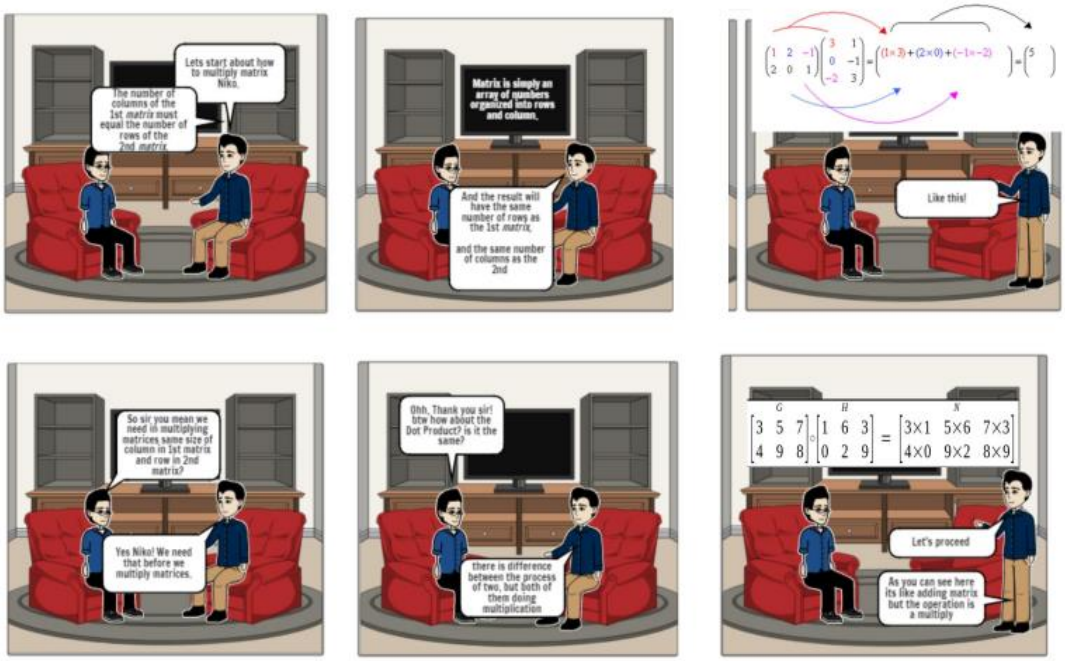
The researcher groups the respondents' opinions about using comics as an assessment method for learning mathematics into the following thematic areas based on insights gleaned from the participant data gathered:

Theme 1: Effectiveness in Conceptual Understanding and Demonstration

Based on responses from a few respondents, they emphasized how effective comics are at clearly elucidating mathematical concepts, breaking down procedures, and drawing connections between related ideas.

R_1: I can use comics to explain math stuff really well.
R_4: Comics help me show how to do math things in a detailed way.
R_9: With comics, I can draw connections between math ideas that go together.

Figure 2.
Explaining Math Concepts



Consistent with Marces' (2019) research, this study confirms that comics are a powerful tool for developing conceptual understanding and subject mastery. Samosa (2021) highlights that it serves as a strategic intervention tool, but Sani et al. (2022) show that it is just as successful as conventional whiteboard techniques, especially when using basic characters and balloon bubbles. Moreover, Tatalovic (2009) has shown that comics are a valuable tool for

helping students memorize concepts, and Zhang-Kennedy et al. (2016) has provided evidence that comics are an effective way to communicate complicated subjects. The research conducted by Apostolou et al. (2023) indicates that the development of digital comics not only improves students' efficiency in acquiring content, but also offers a novel and efficient means of fostering artistic skills in students, as noted by Bongco (2014).

Theme 2: Practical Application and Integration of Mathematics

It is evident from the participants' responses that they understand the value of comics in showing how mathematical principles are applied in real-world contexts and in fusing mathematics with other subject areas.

R_{16}: Comics let me draw and explain how math is used in real life.
R_{20}: In comics, I can draw and explain how math is connected to other subjects that we learn.

Figure 3.
Math in Real-life

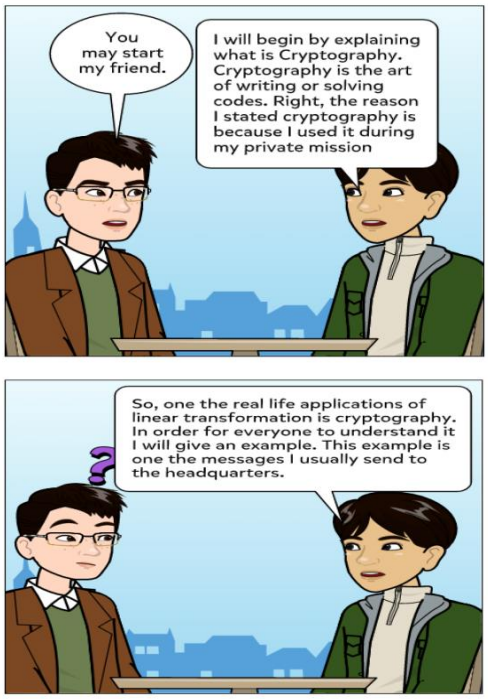
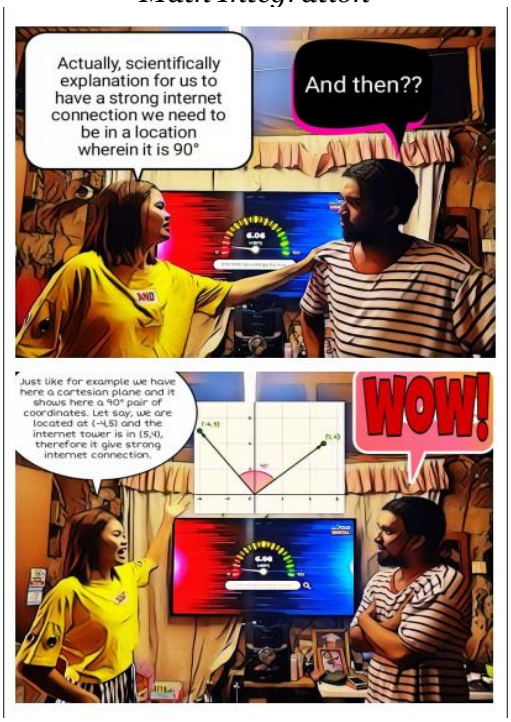


Figure 4.
Math Integration



According to research by Musa et al. (2020), using comics as a teaching method significantly improved students' arithmetic achievement while also improving their mathematical logic (Johar et al., 2023). Students' characters are positively shaped by the incorporation of moral principles like discipline and hard effort into math comics (Ahmadi et al., 2021). Toh et al. underline that using comics as a teaching method in math classes mimics real-world situations (2023). As a result, comic book production and development become a valuable instructional tool for science and math education (Aprilia et al., 2023).

Theme 3: Classroom Utilization and Knowledge Sharing

Participants show that they are open to using comics as a teaching tool and are willing to use them to share what they have learned in the classroom. From the responses of the following participants, this may be deduced.

R_6: I can use comics to share what I've learned with my classmates.
R_{13}: Comics can be a cool way to teach lessons in class.

Figure 5.

Sharing Experiences

Figure 6.

Attitude in Learning

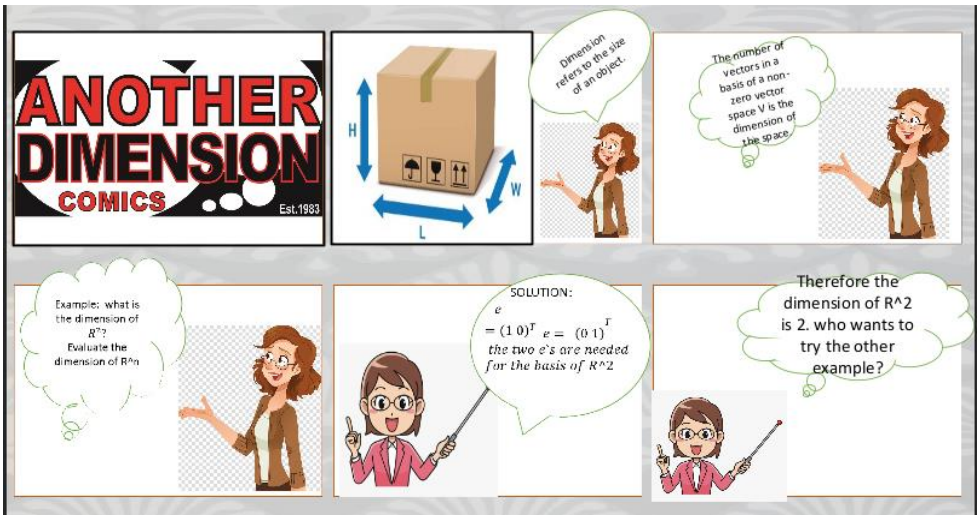
According to Weber et al. (2013), there is a great deal of promise for improving students' knowledge and comprehension when comics are included into the classroom. According to Azman et al. (2014), the categorization of comic development tools is based on certain usage criteria. When incorporated into the classroom, editorial cartoons have the potential to pique students' interests (Toledo et al., 2014). Furthermore, comic strip comedy combined with knowledge sharing and exchange can effectively support learning in the classroom (Amaral et al., 2021).

Theme 4: Development of Creativity, Critical Thinking and Research Interest

Based on their responses, it is evident that participants understand the benefits of creating comics in terms of developing creativity and critical thinking abilities as well as igniting interest in conducting research.

R_{14}: Making online comics not only makes me more creative but also helps me think really well.
R_{24}: Making online comics helps learn new things.

Figure 7.
Learning New Things



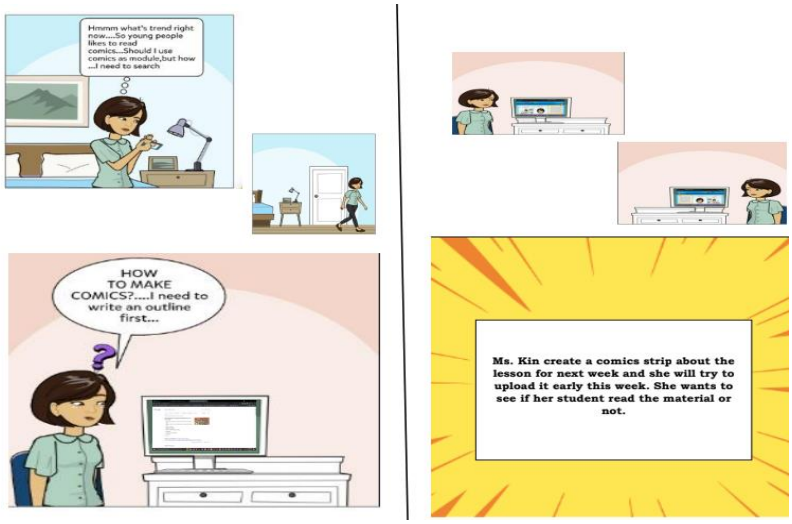
Higher-order thinking skills like critical and creative thinking can be fostered by electronic media, which will pique students' interest in learning mathematics (Rasiman et al., 2014). Comics stand out from other teaching methods because of their unmatched capacity to hold students' attention (Sharma, 2020). Students' interest in reading can be encouraged by comics, which also helps them comprehend abstract ideas or formulas and improves their critical thinking, creative thinking, teamwork, and communication skills (Darmayanti et al., 2022).

Theme 5: Facilitating Discovery, Learning and Reflection

Online comic creation is associated by participants with promoting self-discovery, ongoing education, and offering a contemplative instrument for evaluating their educational advancement. These can be taken from the following participants' responses.

R_{22}: Making online comics can be another way for me to show what I've learned.
R_{30}: Creating online comics helps me think about how much I've learned.

Figure 8.
Alternative Mode of Learning



According to Newbigging (2018), teachers who want to foster critical thinking in their pupils can start by drawing on their personal experiences. By utilizing comics, we can effectively depict their tales as robust and educational counternarratives. Marces (2020) highlights that exposing students to comics can potentially improve their conceptual understanding. This improvement is ascribed to their capacity to compile and analyze data, write a screenplay, and arrange multimedia components (such as pictures, videos, audio, and text) in a logical and instructive way, even while discussing difficult subjects (Zamora, 2021). Moreover, Buchori and Setyawati (2015) have observed that utilizing an educational model based on e-comic characters not only increases students' enthusiasm to learn but also enhances their character education.

Theme 6: Learning Improvement, Knowledge Sharing and Ownership

As evidenced by the responses of the following participants, participants recognize the threefold advantages of making online comics: they enhance their own learning, they spread knowledge, and they foster a sense of ownership over the process.

R_{12}: Making online comics helps me get better at learning and sharing what I know.
R_{15}: Creating online comics makes me feel like I really own what I'm learning.
R_{28}: Creating comics helps me see how math is used in everyday life and appreciate it more.

Figure 9.
Real-life Applications

One especially useful strategy for enabling students to generate new knowledge is the use of comics, both as creators and consumers (Apostolou et al., 2023). According to study by Toh et al. (2017), using comics as a teaching strategy not only keeps students interested in learning mathematics but also helps them build 21st-century skills. This success is ascribed to comics' innate beauty, non-threatening character, captivating element, and pleasurable

element. Furthermore, Fitria et al.'s research highlights that comics that incorporate situations from ordinary life improve easy comprehension and engagement among children (2023).

B. Implications of Comics as an Assessment Tool

Below are some of the implications of using comics as an assessment tool in learning mathematics.

1. *Information media and technology, learning and innovation and communication are the three (3) identified 21st century skills that are important in the Philippines (Scoular, 2020) that can be developed among students when online comics is to be used as an assessment tool.*

With the use of free comic maker softwares such as Canva, Pixton and Picsart, students develop proficiency in these digital tools and softwares that enhances digital literacy. They learn how to navigate through the interface of the software, utilize various features such as drawing tools, text formatting options, and image editing functions. With these experiences, students interest increases and this directly influence their attitude and eventually performance in mathematics as comparable to the study of Serevina et. al. (2021) who found out that the use of digital comics as simple learning media develops the interest of the students in learning and there is value in applying digital comic media in online learning (Habiddin et. al, 2022). Similarly, results of the study of Linardatos et. al. (2023) showed that students' preference for digital comics creation directly influenced by perceived enjoyment, perceived usefulness and perceived ease of use.

By integrating mathematical concepts into comics, students are encouraged to think creatively and innovatively. Due to digital environment's use-friendliness, students can able to create their own original comics with relative ease while designing comics. They explore different ways to visually represent mathematical ideas, fostering creative expression and innovation. In the study of Damopolii et.al, (2021) showed that there is a significant difference in the cognitive learning outcomes between comic and non-comic assisted online learning in favor of comic assisted online learning conditions during COVID-19. Osman et. al. (2024) suggest that number of trainings to support teachers' digital skills in designing and using materials such as comics, for the younger generations can be increased.

Comics are a visual medium, making them an effective tool for communicating mathematical concepts. Students learn how to consider the audience' perspective, anticipate questions or misunderstandings, and address them effectively through their comic narratives and visuals. In the study of Fatimah et. al. (2019) on the use of ToonDoo, a digital comic, as an innovative media technology tool for teaching English short story showed that this digital comic tool can be used to promote students speaking skill, produce better learning experience and create good classroom atmosphere. Likewise, in the study of Fitria et. al, (2023) showed

that the use of digital media like comics, can effectively increase the achievement of the students and further suggest that more diverse studies are needed to ensure the sustainability of the effects of using digital comics on students' literacy.

2. *Comics can be used as an authentic formative assessment in learning mathematics concepts.*

Formative assessment according to Cisse et. al, (2021) is seen now as a means to help student in the process of learning, to progress and develop the targeted skills in order to succeed and authentic assessment plays a great role in enhancing students' learning and makes them competent in their study area (Sewagegn et. al, 2020). And comics can be used as an authentic formative assessment because it promotes creative expression (Al Faruque, 2023), visualize concepts (Seelow, 2019), engage students (Matuk et.al, 2019), integrate language skills (Wijaya et. al, 2021), fostering critical thinking (Mena Araya, 2020), accommodating differentiation (Stromberg, 2022), encouraging reflection and feedback (Kirtley et. al, 2020) and facilitating collaboration (Zamora et.al, 2021) and peer learning (Rutta et. al, 2021). By leveraging the unique qualities of comics, educators can create meaningful and enriching learning experiences that support students' mathematical learning and development.

3. *With the co-creation of rubrics among students guided by their teacher, aside from developing students' metacognition, self and peer assessment can be encouraged.*

The collaborative process of students, under the guidance of their teacher, in creating rubrics promotes the growth of metacognitive abilities (Choiriyah & Hidayah, 2023), self-evaluation (Lian, 2023), and peer evaluation skills (Hernaiz-Agreda et. al, 2024) in the field of mathematics. Through active engagement in the process of rubric building, students acquire a more profound comprehension of assessment criteria and standards, assume responsibility for their own learning, enhance their ability to evaluate their own work, and offer constructive comments to their peers. This cooperative method of evaluation cultivates a nurturing educational setting in which students actively participate in introspective analysis, effective communication, and cooperative resolution of problems, ultimately facilitating more profound comprehension and advancement in mathematics.

Final Considerations

The results of this study clearly show that using comics as a method for assessment in mathematics education improves the efficacy and clarity of presenting difficult mathematical ideas. The majority of participants agree that comics are a powerful tool for explaining ideas, breaking down steps, and creating visual connections between unrelated concepts. The affirmative answers from the participants confirm the usefulness of comics in demonstrating the real-world applications of mathematical principles. Comics are recognized

for their ability to seamlessly integrate mathematics with other disciplines, which highlights their potential to offer a comprehensive and multidisciplinary learning experience.

There's a positive attitude toward the use of comics as a teaching aid in the classroom, as seen by the participants' high agreement that they would be willing to use them for knowledge transfer and instruction. It is clear that comics have the potential to be used as a teaching tool, offering a viable way to improve student participation and communication in the classroom. The fact that the participants saw how making comics may help them strengthen their critical thinking abilities and creativity while also igniting their interest in research speaks to the wider effects of artistic endeavors on cognitive growth. According to the study, introducing comics production into the classroom can benefit kids' general cognitive development as well as their comprehension of mathematics.

Comics have the capacity to support student-driven learning, as evidenced by the consensus about their role in encouraging self-discovery, continuous learning, and offering a reflecting tool for self-assessment. The correlation that exists between the production of comics and many facets of the educational process indicates a dynamic and multifarious influence on the learning process. The importance of student-generated content is highlighted by the favorable feedback regarding the advantages of making online comics, such as enhanced learning outcomes, knowledge sharing, and the growth of a sense of ownership in the learning process. This feature supports the notion that allowing students to participate in the development of instructional materials results in a more individualized and powerful learning process.

In conclusion, this study's findings offer strong evidence in favor of using comics as a method for evaluation in math instruction. The themes reveal positive impressions and associations that demonstrate the efficacy of comics in teaching mathematical concepts. Additionally, they shed light on the comics' wider influence on student engagement, creativity, critical thinking, and sense of ownership over the learning process. This study highlights comics' potential to enhance the teaching and learning process and calls for more investigation and integration of comics within the framework of mathematics education.

REFERENCES

Abdullah, D., & Jaffri, H. (2022). *Authentic assessment using comics: A pedagogical experiment*. Conference: International Universitiy Carnival on Elearning (IUCEL) 2022. https://www.researchgate.net/publication/364955824

Ablao, C., Diaz, D., & Macapagal, J. (2022). *Challenges of Distance Education Assessment in the Health Professions during the COVID-19 Pandemic: A Philippine Reflection in the Rapid Review of International Context*. https://actamedicaphilippina.upm.edu.ph/index.php/acta/article/download/3145/2401/

Al Faruque, S. N. (2023). *The Unique Power of Comics: A Comprehensive Exploration of the VisualVerbal Medium and Its Impact on Storytelling, Communication, and Culture*. International Journal Of English and Studies (IJOES). https://www.ijoes.in/papers/v5i10/1.IJOES-Sadiya(1-11).pdf

Amua-Sekyi, T. E. (2016). Assessment, Student Learning and Classroom Practice: A Review. In *Journal of Education and Practice.7(21)*. https://files.eric.ed.gov/fulltext/EJ1109385.pdf

Apostolou, D., & Linardatos, G. (2023). Cognitive Load Approach to Digital Comics Creation: A Student-Centered Learning Case. *Applied Sciences*, *13*(13), 7896. https://doi.org/10.3390/app13137896

Ayşe Arzu Arı, & Demir, B. (2023). An Innovative Approach to Linear Algebra Course: Using Manga Comics. *Shanlax International Journal of Education*, *11*(S1-Oct), 29–38. https://doi.org/10.34293/education.v11is1-oct.6371

Beleulmi, S. (2022). *Challenges of online assessment during Covid-19 Pandemic: An experience of Study Skills teachers.7(2).49-62*. Afak for Science Journal (ASJP). https://www.researchgate.net/publication/359992791

Bolton-Gary, C. (2012). *Connecting Through Comics: Expanding Opportunities for Teaching and Learning*. US-China Education Review. https://files.eric.ed.gov/fulltext/ED533545.pdf

Choiriyah ,H., & Hidayah, R. (2023). Validity of Digital Comics to Train Metacognitive Skills on Thermochemical Materials. *Hydrogen : Jurnal Kependidikan Kimia*, *11*(4), 401–401. https://doi.org/10.33394/hjkk.v11i4.8237

Cisse, F., Ndinga, P., Vieux, M., & Sane, L. (2021). Challenges Related to the Practice of Formative Assessment in the Context of the Competency- Based Approach in Quebec. *International Journal of Innovation and Research in Educational Sciences*, *8*, 2349–5219. https://www.ijires.org/administrator/components/com_jresearch/files/publications/IJIRES_1847_FINAL.pdf

Damopolii, I., Lumembang, T., & İlhan, G. O. (2021). Digital Comics in Online Learning During COVID-19: Its Effect on Student Cognitive Learning Outcomes. *International Journal of Interactive Mobile Technologies (IJIM)*, *15*(19), 33. https://doi.org/10.3991/ijim.v15i19.23395

Ehlers, U. - D., Volungeviciene , A., & Tereseviciene, M. (2020). When is Open and Online Learning Relevant for Curriculum Change in Higher Education? Digital and Network Society Perspective. *The Electronic Journal of E-Learning*, *18*(1 Jan 2020). https://doi.org/10.34190/ejel.20.18.1.007

Fatimah, A. S., Santiana, S., & Saputra, Y. (2019). Digital Comic: An Innovation of Using ToonDoo as Media Technology for Teaching English Short Story . *English Review: Journal of English Education*, *7*(2), 101. https://doi.org/10.25134/erjee.v7i2.1526

Fitria, Y., Malik, A., Mutiaramses, M., Halili, S. H., & Amelia, R. (2023). Digital comic teaching materials: It's role to enhance student's literacy on organism characteristic topic. *Eurasia Journal of Mathematics, Science and Technology Education*, *19*(10), em2333. https://doi.org/10.29333/ejmste/13573

Gonzales, R. DLC. (2023). From Face-to-Face to Virtual Student Assessment: Changes in Student Assessment Practices during COVID-19 Among Filipino Teachers. *European Journal of Education and Pedagogy*, *4*(1), 159–164. https://doi.org/10.24018/ejedu.2023.4.1.579

Habiddin, H., Ashar, M., Hamdan, A., & Nasir, K. R. (2022). Digital Comic Media for Teaching Secondary School Science. *International Journal of Interactive Mobile Technologies (IJIM)*, *16*(03), 159–166. https://doi.org/10.3991/ijim.v16i03.28967

Hernaiz-Agreda,N., Soto-González, M. D., & Rodríguez-López, R. (2024). Development of Transdisciplinary and Complex Learning in Inclusive Educational Practices. *Education Sciences*, *14*(3), 222–222. https://doi.org/10.3390/educsci14030222

Hunter, D., Mccallum, J., & Howes, D. (2019). *Defining Exploratory-Descriptive Qualitative (EDQ) research and considering its application to healthcare*. https://eprints.gla.ac.uk/180272/7/180272.pdf

İlhan, G., Osman, & Şin, M. (2024). Reflections of "Use of Comics in Social Studies Education" Course: The Opinion and Experiences of Teachers. *SANE Journal: Sequential Art Narrative in Education*, *2*. https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1072&context=sane

Kirtley, S., Garcia, A., & Carlson, P. (2020). *With Great Power Comes Great Pedagogy : Teaching, Learning and Comics*. https://www.upress.state.ms.us/content/download/87755/1065558/version/1/file/With+Great+Power+Comes+Great+Pedagogy+excerpt.pdf#page=37

Lian, S. (2023). The Transformation of the Comic Strip Industry in Beijing. *BRILL EBooks*, 18–29. https://doi.org/10.1163/9789004541603_003

Linardatos, G., & Apostolou, D. (2023). Investigating high school students' perception about digital comics creation in the classroom. *Education and Information Technologies*. https://doi.org/10.1007/s10639-023-11581-3

Maguire, M., & Delahunt, B. (2017a). Doing a thematic analysis: A practical, step-by-step guide for learning and teaching scholars. *AISHE-J: The All Ireland Journal of Teaching and Learning in Higher Education*, *9*(3). http://ojs.aishe.org/index.php/aishe-j/article/view/335

Maguire, M., & Delahunt, B. (2017b). Doing a Thematic Analysis: a Practical, Step-by-Step Guide for Learning and Teaching Scholars. *. *Doing a Thematic Analysis: A Practical, Step-By-Step Guide for Learning and Teaching Scholars.*, *3*(3), 3351. https://ojs.aishe.org/index.php/aishe-j/article/download/335/553/1557

Matuk, C., Hurwich, T., Spiegel, A., & Diamond, J. (2019). How Do Teachers Use Comics to Promote Engagement, Equity, and Diversity in Science Classrooms? *Research in Science Education*, *51*(3). https://doi.org/10.1007/s11165-018-9814-8

Meccawy, Z., Meccawy, M., & Alsobhi, A. (2021). Assessment in "survival mode": student and faculty perceptions of online assessment practices in HE during Covid-19 pandemic. *International Journal for Educational Integrity*, *17*(1). https://doi.org/10.1007/s40979-021-00083-9

Mena Araya, A. E. (2020). Critical Thinking for Cvic Life in Elementary Education: Combining Storytelling and Thinking Tools. *Revista Educación*, 23–43. https://doi.org/10.15517/revedu.v44i2.39699

National Academy of Education. (2021). *Educational Assessments in the COVID-19 Era and Beyond*. https://naeducation.org/wp-content/uploads/2021/02/Educational-Assessments-in-the-COVID-19-Era-and-Beyond.pdf

Ozudogru, G. (2021). Problems faced in distance education during covid-19 pandemic. *Participatory Educational Research*, *8*(4), 321–333. https://doi.org/10.17275/per.21.92.8.4

Price, J., Pierson, E., & Light, D. (2011). *Using Classroom Assessment to Promote 21 st Century Learning in Emerging Market Countries*. https://cct.edc.org/sites/cct.edc.org/files/publications/Using%20Classroom%20Assessment.pdf

Rahman, M. A., Novitasari, D., Handrianto, C., & Rasool, S. (2022). Challenges In Online Learning Assessment During The COVID-19 Pandemic. *KOLOKIUM Jurnal Pendidikan Luar Sekolah*, *10*(1), 15–25. https://doi.org/10.24036/kolokium.v10i1.517

Rutta, C. B., Schiavo, G., Zancanaro, M., & Rubegni, E. (2021). Comic-based Digital Storytelling for Content and Language Integrated Learning. *Educational Media International*, 1–16. https://doi.org/10.1080/09523987.2021.1908499

Sahera, A.-S., Jehad , A. M., Najwand, F., & Amanic , A. (2022). Traditional versus authentic assessments in higher education. *Pegem Journal of Education and Instruction*, *12*(1). https://doi.org/10.47750/pegegog.12.01.29

Scoular, C. (2020). *Analysis of 21st Century Skills Integration as applied in the Philippines K to 12 program Final Report*. https://research.acer.edu.au/cgi/viewcontent.cgi?article=1000&context=curriculumdevelopment

Seelow, D. D. (2019). Lessons Drawn: Essays on the Pedagogy of Comics and Graphic Novels. In *Google Books*. McFarland. https://books.google.com.ph/books?hl=en&lr=&id=sCqVDwAAQBAJ&oi=fnd&pg=PT61&dq=comics+promotes+visual+concepts+&ots=shtehke62S&sig=3-T1QYOEPJ3PgJM5lqyycSLIDDo&redir_esc=y#v=onepage&q=comics%20promotes%20visual%20concepts&f=false

Şentürk, M. (2021). Educational comics and educational cartoons as teaching material in the social studies course. *African Educational Research Journal*, *9*(2), 515–525. https://doi.org/10.30918/aerj.92.21.073

Serevina, V., Astra, I. M., & Syahida, A. F. (2021). The Development of Digital Comic As Learning Media Based On Picture-And-Picture Learning Model On Global Warming Materials During Distance Learning. *Journal of Physics: Conference Series*, *2019*(1), 012014. https://doi.org/10.1088/1742-6596/2019/1/012014

Sewagegn, A. A., & Diale, B. M. (2020). Authentic Assessment as a Tool to Enhance Student Learning in a Higher Education Institution. *Assessment, Testing, and Measurement Strategies in Global Higher Education*, 256–271. https://doi.org/10.4018/978-1-7998-2314-8.ch013

Sigman, D., & Mancuso, M. (2017). *Designing a Comprehensive Assessment System*. https://www.wested.org/wp-content/uploads/2017/03/resource-designing-a-comprehensive-assessment-system.pdf

Silva, A. B. D., Santos, G. T. D., & Bispo, A. C. K. D. A. (2017). The Comics as a Teaching Strategy in Learning of Students in an Undergraduate Management Program. *RAM. Revista de Administração Mackenzie*, *18*, 40–65. https://doi.org/10.1590/1678-69712017/administracao.v18n1p40-65

Strömberg, F. (2022). *Comics and the Middle East-Representation, Accomodation, Integration*. School of Arts and Communication, Malmo University. https://www.diva-portal.org/smash/get/diva2:1638071/FULLTEXT01.pdf

Toh, T. L., Cheng, L. P., Ho, S. Y., Jiang, H., & Lim, K. M. (2017). Use of comics to enhance student's learning for the development of twenty-first century competencies in the mathematics classroom. *Asia Pacific Journal of Education*, *37*(4), 437–452. https://doi.org/10.1080/02188791.2017.1339344

Wijaya, E. A., Suwastini, N. K. A., Adnyani, N. L. P. S., & Adnyani, K. E. K. (2021). Comics Strips for Language Teaching: The Benefits and Challenges According to Recent Research RESEARCH. *ETERNAL (English, Teaching, Learning, and Research Journal)*, *7*(1), 230. https://doi.org/10.24252/eternal.v71.2021.a16

Wilson, S. (2017). *Northwestern College, Iowa NWCommons Exploring the Importance of Using Formative Assessment in Informing Instruction to Improve Student Learning*. https://core.ac.uk/download/pdf/217030666.pdf

Zamora, L. P., Bravo, S. S., & Padilla, A. G. (2021). Production of Comics in POWTOON as a Teaching-Learning Strategy in an Operations Research Course. *European Journal of Contemporary Education*, *10*(1). https://doi.org/10.13187/ejced.2021.1.137