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Assessing Pre-Service Teachers' Mathematics Performance through Online Created Comics

Liberty Gay C. Manalo
Rizal Technological University, Philippines
ORCID No: 0000-0001-8909-838X,
Email: lgcmanalo@rtu.edu.ph

Abstract

Assessing students' performance during these pandemic times is a challenge for every teacher. This study aims to explore the use of comics as an assessment tool in a mathematics classroom by comparing the self-assessed and peers-assessment performance ratings on online created comics and establishing a relationship to their metacognitive awareness on the use of comics in assessing their performance in mathematics .With the use of descriptive correlational design at alpha level 0.05, results showed that there is no significant difference in the self-assessed and peers-assessed performance of the respondents on the online created comics using the class constructed rubrics. There is a low positive significant relationship between the self-assessed performance and their level of metacognitive awareness towards the use of online comics as an assessment tool. Similarly, the peers-assessed performance also showed a significant low positive relation with their level of metacognitive awareness on the use of comics as an assessment tool. Based on the results we can conclude that self- and peer – assessments can be a powerful tool in assessing students' performance when properly integrated in lesson planning. Moreover, creating online comics can be a promising tool in assessing students' performance in mathematics and similar study is encouraged to determine the validity of results to other academic disciplines.

Keywords: *assessment, comics, constructivism, mathematics, metacognition*

Introduction

A crucial component of the teaching and learning process is student assessment. By comparing student performance to predetermined learning objectives, it helps teachers to analyze current difficulties in educational assessment and gauge effectiveness of their instruction. Evaluation of performance is essential since it tells us how well students are accomplishing the goals of the course. When the covid-19 pandemic struck, one of the problems encountered by an online teacher is how to conduct assessment to students on their subject. Although there are many advantages of distance education as we need to keep up with the changing social conditions, evaluating students' success and performance are some of its restrictions (Yilmaz, 2017). Dishonesty, infrastructure, coverage of learning outcomes, and commitment of students to submit assessments are the main challenges identified in remote assessment (Guangul et. al, 2020). Considering the specialty of each course, conducting tests remotely was very heterogenous as how to evaluate students in a clear and effective manner in courses whose initial evaluation approach was for relying only on written exams and how to assess subjects where laboratory work is a crucial element of extreme significance (Almeida & Monteiro, 2021).

Providing evidence that can be used to make decisions about or improve mathematics education is one of the main goals of assessment in mathematics education (Nortvedt & Buchholtz, 2018). Higher order thinking (HOT) has to be given more attention in the 21st century, and mathematics assessments should reflect this (Radmehr & Vos, 2020). Teachers need to be carefully considered how to best prepare children for assessment styles that activate HOT, which will necessitate a signif-

icant reworking of both assessment and education. It seems that the issue of preparing students for 21st century is not so much of an effort to determine the material information covered in the upcoming curriculum but more of overcoming the difficulties of providing knowledge and skills in a rich way that enhances students' learning result. From students' point of view, the 21st century curriculum places an emphasis on students' knowledge-based skills and knowledge-application whether they can judge reliability of the information that is offered to them as opposed to what information they learn (Toh et. al, 2017).

In the revised Bloom's Taxonomy by Anderson and Krathwohl (2001), creation became the highest and most advanced level as it includes reorganizing elements into a new pattern or structure through planning. Creativity and innovation together with critical thinking and problem-solving, communication and collaboration comprises the 4C's of the 21st century that is so essential and need to be included consistently on a daily basis (Chiruguru, 2020) and students have the chance to improve these 4Cs when they read or make their own comics (Seelow, 2020). Since they require students to study and interpret a variety of components, such as the panel layout, symbolism, and multiple visual and verbal elements, comics aid in the development of critical thinking in students. In order to express a single story, comics and arithmetic are unique in that they both use words and pictures (or graphs and figures). Students can develop their creative thinking skills when reading comics by analyzing the imagery, plot, characters, and themes to decipher the meaning. Students will be able to learn from one another while also developing their creative skills by making comics.

Materials and Methods

Conceptual Framework

When the covid-19 pandemic struck, one of the problems encountered by an online teacher is how to conduct assessment to students whether they have learned something and not just copy and paste from a source not just in mathematics but in all disciplines. For a pre-service teacher, it is a challenge not just learning the process of problem-solving but also on how to deliver or teach the concepts.

Comics has been a promising tool in a classroom. According to Oxford ELT (2019), comics can be used as a group activity, teach vocabulary, practice speaking skills and doing reading tasks. And when students learn how to make comics even the simple ones, they become stronger storytellers and gain confidence in their ability to be creative, more critical thinkers and more effective communicators (Ryder, 2020). Furthermore, whether through doodles, collages or digital composition, creating comics gives learners the opportunity to be active agents of their understanding. Manga or Japanese comics is a genre that is popular not only in Japan but around the world from Asia to the United States. The Manga Guides is a series of educational Japanese manga books with volumes that explains a particular subject in science or mathematics such as statistics, regression analysis, databases, calculus, physics, electricity, cryptography, molecular biology, linear algebra to name a few. Indeed, that comics are beneficial to learning in the classroom and not just a fun art-enrichment activity. But for this study, the researcher would like to explore on how comics can be used in assessing student's performance in a discipline like mathematics.

Students' learning can be improved through the use of peer and self-assessment. Students apply success criteria related to a learning goal in self-assessment, reflect on their efforts, identify improvements, and adjust the "quality" of their work, whereas in peer assessment, students evaluate the work of their peers in light of success criteria related to a learning goal and offer helpful criticism.

Attitude and perception are tightly intertwined (Pickens, 2005). When presented with a circumstance or stimulus, a person interprets it according to past experiences to make it meaningful to

them. However, what a person interprets or perceives could differ significantly from reality. And there are several researches showed that the students' perception affects their performance.

Figure 1 shows the conceptual framework of the study where respondents and their peers will assess the performance on writing skills, creativity, illustrating concepts, applying real-life applications, problem solving, and completeness and timeliness using a class developed rubrics for this activity. The perceptions of the respondents and their peers towards assessing the performance of the respondents towards the use of comics were also determined and find its relationship to the self-assessed and peer-assessed performance of the respondents.

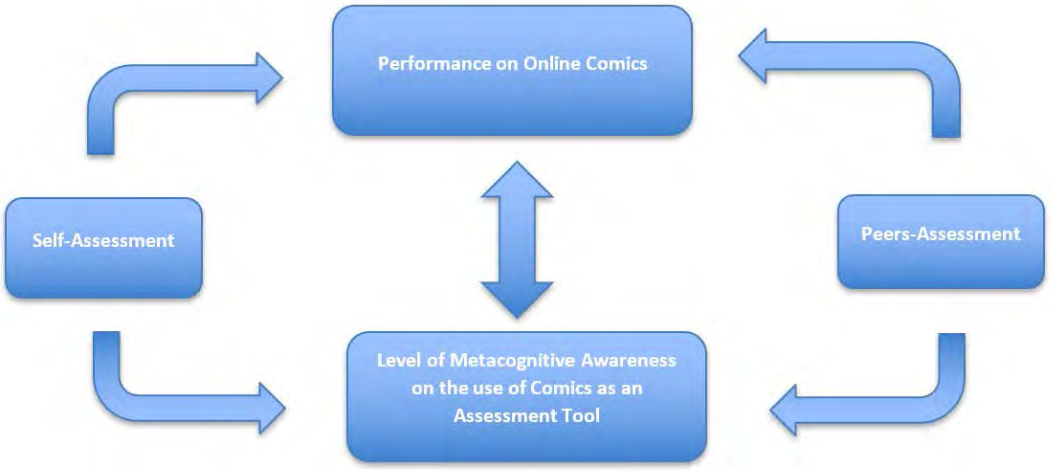

Figure 1. Conceptual Framework of the Study

Theoretical Frameworks

The study anchored on the following theories.

1. Edward Thorndike's Stimulus-Response Theory which sees that human behavior as a reaction to the stimulus. For this study the created comics will act as the stimulus and the perception of the respondents towards the use of that created comics will be the response.

2. John H. Flavell's Metacognition Theory is the awareness of your own cognitive processes. It is your capacity to direct your thought processes using a variety of techniques, such as planning, monitoring, and adjusting, as well as your capacity for reflection on the tasks or processes you engage in and the ability to choose and apply the necessary techniques for intercultural encounters. Knowledge, experience and strategies are the three components of metacognition which were reflected to the survey instrument used in determine the level of awareness of the respondents towards the use of comics in assessing their performance in mathematics.

3. Lev Vygotsky's Social Constructivist Theory which emphasizes the influences of cultural and social contexts in learning and supports a discovery model of learning. For this study where peers will also give rate to the created online comics of the respondents based on the given rubrics although they might be on the same level when it comes to the skill of creating online comics but guided by the rubrics they can somehow give unbiased rating which can be used as a foundation for collaborative works.

4. Jean Piaget's Cognitive Constructivism with ages and stages as its two major components that predicts what children can and cannot understand at different ages, and a theory of development that describes how learners develop cognitive abilities. With second year pre-service mathematics teachers as respondents, they can be able to create and develop their own online comics

guided by the rubrics. The cognitive theory of multimedia learning specifies five cognitive processes in multimedia learning: selecting relevant words from the presented text or narration, selecting relevant images from the presented graphics, organizing the selected words into a coherent verbal representation, organizing selected images into a coherent pictorial representation, and integrating the pictorial and verbal representations and prior knowledge (Mayer, 2014).

Research Design

The study utilized the descriptive correlational research design in to describe the self-assessed and peers- assessed performance of the respondents on their created comics in terms of writing skills, creativity, illustrating concepts, real-life application, problem solving, and completeness and timeliness based on the class developed rubrics. Respondents perceptions towards the use of comics as an assessment of their performance in mathematics were also described. A significant relationship between self-assessed and peers-assessed performances to their perception towards the use of comics in assessing mathematics performance were also determined.

Sampling

Purpose sampling was used in selecting respondents of the study who can provide in-depth and detailed information about the phenomenon under observation and this includes second year pre-service teachers enrolled in Math 111 (Linear Algebra) during the 2nd semester of AY 2020-2021. These seventy-seven (77) students have never been exposed to online creation of comics and their first-hand experiences will give us a more authentic result of the assessment when it comes to assessing their performance and others performance in online creation of comics as their summative assessment for the midterm period. Their perceptions towards the use of their created online comics in assessing performance in mathematics.

Data Gathering

Figure 2 below shows the data gathering process of the study.

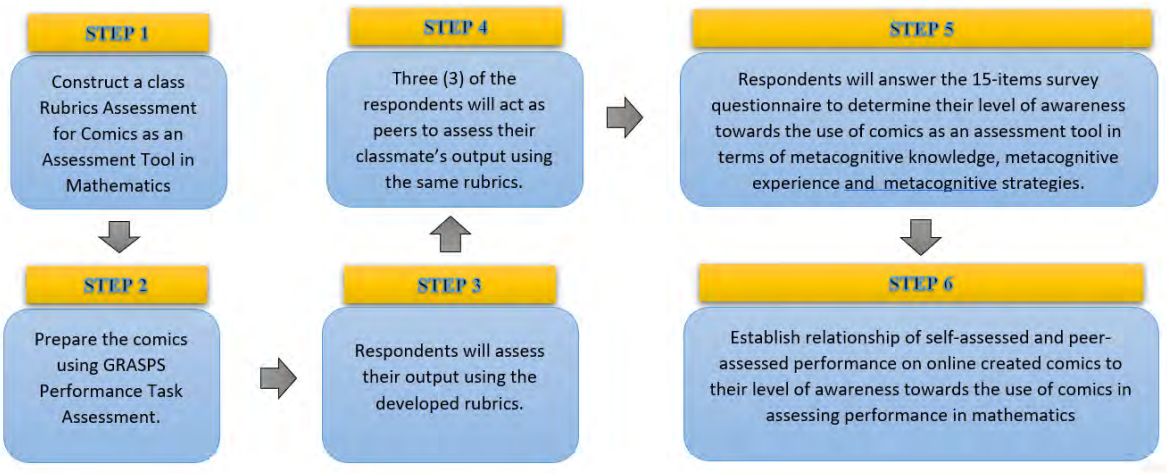

Figure 2. Data Gathering Process of the Study

The class developed rubric to assess their own performance in terms of writing skill, creativity, illustrating concepts, understanding real-life applications, problem-solving and completeness and timeliness on their comics creation. Table 1 below shows the class developed rubrics used to self-assessed respondents' performance on their online created comics. The same instrument was used by three (3) of their peers to assess the same output.

Table 1.Class Developed Rubrics for Online Created Comics

CRITERIA	VERY GOOD (3)	GOOD (2)	NEEDS IMPROVE-MENT (1)	Score
Writing Skill	Student organizes the story well and explains the situation clearly	Student explains the situation clearly	Students misses some parts necessary for the communication of the story	
Creativity	Student's ideas are sophisticated, humorous and original.	Student's ideas are humorous and original	Student's ideas are not original	
Illustrating concepts	Student often and correctly illustrated concepts	Student correctly illustrated some of the concepts	Student never uses or misuses concepts	
Understanding real-life applications	Student shows evidence of clearly understanding real-life applications	Student shows partially of understanding real-life applications	Student shows little evidence of understanding real-life applications	
Problem Solving	All details needed to solve the problem are clearly illustrated in the comics.	Some details needed to solve the problem are clearly illustrated in the comics.	Most details needed to solve the problem are not clearly illustrated in the comics.	
Completeness and Timeliness	Required elements are complete and output is submitted on the allotted time.	Some of the elements are missing but submitted the output on time.	Most of the elements are missing and submitted the output on time.	
			Total Score	

Comics was used as a summative assessment of students' performance during their midterm period following the GRASPS Performance Task Assessment model designed by Jay McTighe and Grant Wiggins (2010).

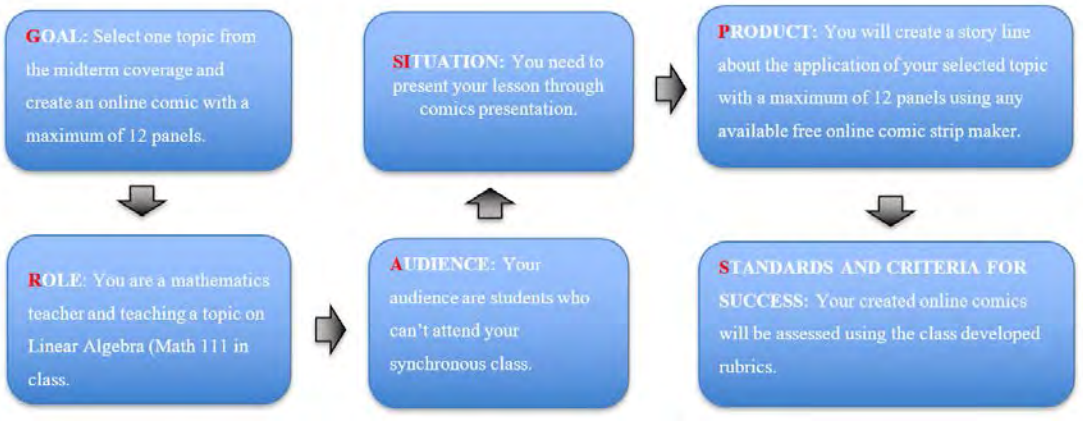

Figure 3. Online Comics Creation GRASPS Performance Task Assessment

Figure 3 shows the flow chart for GRASPS Performance Task Assessment on the use creation of online comics as a form of summative assessment among 2nd year mathematics pre-service teachers enrolled in Linear Algebra (Math 111) during the 2nd semester of AY 2021-2022 at Rizal Technological University.

Respondents and their peers' level of awareness towards the use of comics as an assessment to in mathematics in terms of metacognitive knowledge, metacognitive experiences and metacognitive strategies were determined using a fifteen (15) items researcher-made survey questionnaire with 0.955 Cronbach's alpha for internal consistency interpreted as excellent as shown in Table 2 below.

Table 2. Level of Awareness Survey Questionnaire's Cronbach' Alpha Result

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.955	.955	15

Table 3 shows the Cronbach's alpha result for the items used to determine the level of awareness on metacognitive knowledge using the comics as a tool for assessing mathematics performance with 0.882 Cronbach's alpha for internal consistency interpreted as good items.

Table 3. Metacognitive Knowledge Items Cronbach' Alpha Result

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.882	.882	5

Table 4 shows the Cronbach's alpha result for the items used to determine the level of awareness on metacognitive experiences using the comics as a tool for assessing mathematics performance with 0.892 Cronbach's alpha for internal consistency interpreted as good items.

Table 4.Metacognitive Experiences Items Cronbach' Alpha Result

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.891	.892	5

Table 5 shows the Cronbach's alpha result for the items used to determine the level of awareness on metacognitive strategies using the comics as a tool for assessing mathematics performance with 0.876 Cronbach's alpha for internal consistency interpreted as good items.

Table 5. Metacognitive Strategies Items Cronbach' Alpha Result

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.875	.876	5

Normality Test for Self and Peers Assessment on Performance using Online Created Comics

Table 6 shows the result of normality test for self- and peers- assessment on performance using online created comics in terms of writing, creativity, illustrating concepts, understanding real-life application, problem solving and completeness and timeliness.

Table 6.Normality Test on Self and Peers Performance Assessment

Tests of Normality							
	Respondents	**Kolmogorov-Smirnov[a]**			**Shapiro-Wilk**		
		Statistic	df	Sig.	Statistic	df	Sig.
Writing	Self-Assessment	.535	73	.000	.306	73	.000
	Peers-Assessment	.527	73	.000	.361	73	.000
Creativity	Self-Assessment	.494	73	.000	.481	73	.000
	Peers-Assessment	.468	73	.000	.536	73	.000
Illustrating Concepts	Self-Assessment	.494	73	.000	.481	73	.000
	Peers-Assessment	.481	73	.000	.510	73	.000
Understanding Real-life Application	Self-Assessment	.500	73	.000	.464	73	.000
	Peers-Assessment	.494	73	.000	.481	73	.000
Problem-solving	Self-Assessment	.494	73	.000	.481	73	.000
	Peers-Assessment	.511	73	.000	.428	73	.000
Completeness and Timeliness	Self-Assessment	.535	73	.000	.306	73	.000
	Peers-Assessment	.522	73	.000	.385	73	.000
a. Lilliefors Significance Correction							

Based on table 6, the p-values for Kolmogorov-Smirnov and Shapiro-Wilk on writing, creativity, illustrating concepts, understanding real-life application, problem solving, and completeness and timeliness between self-assessment and peers- assessment is less than 0.05 alpha level of significance. This implies that the data is not distributed normally which means that we will use nonparametric test for these data. Wilcoxon signed rank test was used to determine significant differences in the assessed performance of the respondents and their peers on their created online comics and Spearman rho was used to determine significant relationship of the self-assessed and peers-assessed performance towards their level of awareness on the use of comics in assessing their performance in mathematics.

Results and Discussion

Self ***-Assessment on the Level of Performance using Online Created Comics***

Table 7 below shows the frequency and percentage distribution, weighted mean and interpretation of respondents' self-assessment on the level of performance on online created comics using the class developed rubrics on writing skills, creativity, illustrating concepts, understanding real-life application, problem-solving, and completeness and timeliness.

With the use of the class constructed rubrics in assessing respondents' performance on their online created comics, we can infer on table 7 that most of the respondents gave themselves good ratings on writing skills and completeness and timeliness with weighted means of both 2.92. Similar

on creativity, illustrating concepts, understanding real-life application and problem solving with the same weighted mean of 2. 81.

Table 7. Self – Assessment on the Level of Performance using Online Created Comics

Category	Good (3)	Fair (2)	Poor (1)	Total	Weighted Mean	Verbal Interpretation
Writing Skills	67 (87.67%)	6 (12.33%)	0 (0.00%)	73 (100.00%)	2.92	Good
Creativity	59 (80.82%)	14 (19.18%)	0 (0.00%)	73 (100.00%)	2.81	Good
Illustrating Concepts	59 (80.82%)	14 (19.18%)	0 (0.00%)	73 (100.00%)	2.81	Good
Understanding Real-Life Application	59 (80.82%)	14 (19.18%)	0 (0.00%)	73 (100.00%)	2.81	Good
Problem Solving	59 (80.82%)	14 (19.18%)	0 (0.00%)	73 (100.00%)	2.81	Good
Completeness and Timeliness	67 (87.67%)	6 (12.33%)	0 (0.00%)	73 (100.00%)	2.92	Good
Grand Weighted Mean				73	2.85	Good

In general, with a grand weighted mean of 2. 85 which can be interpreted as good. The respondents believed that they are good in organizing their story well and explains the situation clearly on their online created comics. They also have presented ideas that are sophisticated, humorous and original. They used correct illustration of the concepts and show evidences of their clear understanding of mathematics in real-life situations on their output. They also presented all the details needed to solve the problem on their comics and make sure that they have meet all the criteria needed in a comics' and submitted their output on time.

Peers-Assessment on the Level of Performance using Online Created Comics

Table 8 below shows the frequency and percentage distribution, weighted mean and interpretation of respondents' peers-assessment on the level of performance on online created comics using the class developed rubrics on writing skills, creativity, illustrating concepts, understanding real-life application, problem-solving, and completeness and timeliness.

Table 8. Peers – Assessment on the Level of Performance using Online Created Comics

Category	Good (3)	Fair (2)	Poor (1)	Total	Weighted Mean	Verbal Interpretation
Writing Skills	64 (87.67%)	9 (12.33%)	0 (0.00%)	73	2.88	Good
Creativity	55 (75.34%)	18 (24.66%)	0 (0.00%)	73	2.75	Good
Illustrating Concepts	57 (78.08%)	16 (21.92%)	0 (0.00%)	73	2.78	Good
Understanding Real-Life Application	59 (80.82%)	14 (19.18%)	0 (0.00%)	73	2.81	Good

Problem Solving	62 (84.93%)	11 (15.07%)	0 (0.00%)	73	2.85	Good
Completeness and Timeliness	64 (87.67%)	9 (12.33%)	0 (0.00%)	73	2.88	Good
Grand Weighted Mean				73	2.83	Good

With the use of the class constructed rubrics in assessing respondents' performance on their online created comics by their peers, we can infer on table 8 that most of the respondents gave themselves good ratings on writing skills, creativity, illustrating concepts, understanding real-life application, problem solving, and completeness and timeliness with weighted means 2.88, 2.75, 2.78, 2.81, 2.85 and 2.88 respectively.

In general, with a grand weighted mean of 2. 83 which can be interpreted as good. Peers assessed their classmates' online created comics also good in organizing their story and explains the situation clearly on the online created comics. They also agreed that their classmates presented their ideas that are sophisticated, humorous and original. They also correctly illustrate the concepts and evidently showed clear understanding of mathematics in real-life situations on their output. They also presented all the details needed to solve the problem on the comics and have meet all the criteria needed in a comics' which they also submitted on time.

Test of Normality on Over-all Self and Peers- Assessed Performance

Table 9 shows the result of test of normality on self and peers- assessed performance on the online created comics.

Table 9 Result of Normality Test on Over-all Self and Peers Assessment on Online-comics

	Kolmogorov-Smirnov[a]			**Shapiro-Wilk**		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
Self-assessed performance on comics	.306	73	.000	.729	73	.000
Peers-assessed performance on comics	.115	73	.018	.865	73	.000
a. Lilliefors Significance Correction						

We can observe from table 9 that the p-values both in self- and peers-assessed performance are less than 0.05 alpha level of significance. This means that the data obtained deviate from the normal. To test the significant difference between self and peers-assessment, Wilcoxon signed rank test was used.

Significant Difference on Self and Peers Assessed Performance

Table 10. Significant Difference on Self-Assessment and Peers-Assessment using Online Created Comics

Category	**Z-value**	**p-value**
Writing Skills	-0. 632	0.527
Creativity	-0.853	0.394
Illustrating Concepts	-0.471	0.637
Understanding Real-life Application	-0.258	0.796
Problem Solving	-0.832	0.405
Completeness and Timeliness	-0.832	0.405

Table 10 shows the summary of results on determining significant differences on self-assessed and peers-assessed performance using online created comics using Wilcoxon Signed Rank Test.

Based on table 10 results of Wilcoxon signed-rank test, it shows that there are no significant differences in the self-assessment and peers-assessment using the online created comics on writing skills (Z= -0.632, p=0.527), creativity (Z= -0.853, p=0.394), illustrating concepts (Z=-0.471, p=0.637), understanding real-life application (Z= -0.258, p=0.796), problem-solving (Z= -0.832, p=0.405) and completeness and timeliness (Z= -0.832, p=4.05).

The activity of co-creating the rubrics utilized with students can be credited for the lack of a discernible difference in the self and peer judged performance on the online created comics. With this inclusive teaching strategy, educators promote full participation from all students and give them the opportunity to voice their own opinions. According to Chowdhury (2018), instructors should use rubrics while assigning any task in the class to help students understand their evaluation methodology. Additionally, using online created comics to evaluate students' performance in this study is an example of how rubrics can assist professors make their educational aims clear to their students. Likewise, rubrics can help students assess their own work and determine whether it meets the standards they laid out under the guidance of their instructor. They can also give students specific comments on their strengths and shortcomings. The use of this rubric can provide explanations for student scores.

According to Gurbanov (2016), student self and peer assessment is a useful tool to reduce assessment anxiety, it increases students' sense of responsibility for their own learning, it fosters a culture where students are able to evaluate their own and/or peers' work critically, student self and peer assessment rubrics minimize subjectiveness and maximize objectivity, and rubrics created together overcome the mistrust in peers' objectivity.

Ndyoe (2017) asserts that the advantages of self and peer assessment can also be utilized if activities are created so that students can use their evaluative abilities. These evaluation techniques will assist students in comparing their own and others' work to predetermined performance standards, enabling them to become active learners and better prepared for participation in lifelong learning. According to Nawas (2020), instructors may be able to reduce students' hesitancy and boost the accuracy of their assessments by comprehending the nature of their worry and providing them with a thorough rubric.

It is advised that faculty think about creating standards and rubrics to serve as benchmarks for formative assessment and that communication with students about the goal and advantages of frequent assessments could mitigate these negative effects, according to Mussawy et. al (2021) study on examining students' perceptions of classroom assessment as students acknowledged formative assessment and student involvement, such as peer assessment Vaessen et. al (2017).

Respondents of Awareness Towards Online Created Comics as an Assessment

Table 11 shows the mean and interpretation of self-assessed level of awareness towards the use of online created comics in assessing performance in mathematics.

Table 11 shows that in terms of metacognitive knowledge, respondents strongly believe that they can communicate mathematical topics in a clear, correct, and thorough manner through online-created comics, with an over-all mean of 3.64. Additionally, they fervently concur that comics can serve as an alternate method of evaluation of their learning because it fosters knowledge sharing and learning improvement. They also firmly concur that using comics to impart a lesson in math class can increase students' sense of control over their education.

Table 11. Respondents Level of Awareness on using Online Created Comics as an Assessment Tool

Statements	SD (1)	D (2)	A (3)	SA (4)	Total	WM	VI
A. METACOGNITIVE KNOWLEDGE							
1. I can explain and illustrate mathematical concepts clearly, accurately and comprehensively using comics.	1 *(1.37%)*	0 *(0.00%)*	19 *(26.03%)*	53 *(76.60%)*	73 *(100.00%)*	**3.70**	**SA**
2. Creating online comics can be an alternative mode of assessing my learnings.	1 *(1.37%)*	1 *(1.37%)*	24 *(32.88%)*	47 *(64.38%)*	73 *(100.00%)*	**3.60**	**SA**
3. Creating online comics helps me to improve my learning and sharing knowledge.	1 *(1.37%)*	1 *(1.37%)*	22 *(30.14%)*	49 *(67.12%)*	73 *(100.00%)*	**3.63**	**SA**
4. Comics can be used to teach lessons in the class.	1 *(1.37%)*	2 *(2.74%)*	21 *(26.03%)*	49 *(67.12%)*	73 *(100.00%)*	**3.62**	**SA**
5. Creating online comics develops my sense of ownership to learning.	1 *(1.37%)*	1 *(1.37%)*	23 *(31.51%)*	48 *(65.75%)*	73 *(100.00%)*	**3.64**	**SA**
					Over-all Mean	**3.64**	**SA**
B. METACOGNITIVE STRATEGIES							
1. With the use of comics, I can demonstrate mathematical procedures in detailed.	1 *(1.37%)*	4 *(5.48%)*	23 *(31.51%)*	45 *(61.64%)*	73 *(100.00%)*	**3.53**	**SA**
2. I can show the connections through comics between mathematical concepts that are related to one another.	1 *(1.37%)*	1 *(1.37%)*	21 *(28.77%)*	50 *(68.49%)*	73 *(100.00%)*	**3.64**	**SA**
3. Through comics, I can illustrate the application of mathematical concepts and procedures.	1 *(1.37%)*	3 *(4.11%)*	26 *(35.52%)*	43 *(58.90%)*	73 *(100.00%)*	**3.52**	**SA**
4. With the use of comics, I can demonstrate mathematical procedures in detailed.	1 *(1.37%)*	0 *(0.00%)*	23 *(31.51%)*	49 *(67.12%)*	73 *(100.00%)*	**3.64**	**SA**
5. Creating online comics helps me to discover and learn new things.	1 *(1.37%)*	1 *(1.37%)*	18 *(24.66%)*	53 *(72.60%)*	73 *(100.00%)*	**3.68**	**SA**

					Over-all Mean	**3.60**	**SA**
C. METACOGNITIVE EXPERIENCES							
1. In comics, I can show how mathematics can be integrated with other curricular areas.	1 *(1.37%)*	3 *(4.11%)*	19 *(26.03%)*	50 *(68.49%)*	73 *(100.00%)*	**3.62**	**SA**
2. Creating online comics helps me to develop not just my creativity but also my critical thinking skills.	1 *(1.37%)*	0 *(0.00%)*	19 *(26.03%)*	53 *(72.60%)*	73 *(100.00%)*	**3.70**	**SA**
3. Creating online comics sparks my interest in doing research	1 *(1.37%)*	1 *(1.37%)*	31 *(42.47%)*	40 *(54.79%)*	73 *(100.00%)*	**3.51**	**SA**
4. Through online comics creation, I can be able to reflect how much I've learned.	1 *(1.37%)*	2 *(2.74%)*	18 *(24.66%)*	52 *(71.23%)*	73 *(100.00%)*	**3.66**	**SA**
5. Creating comics helps me to appreciate the use of mathematics in daily life.	1 *(1.37%)*	1 *(1.37%)*	16 *(21.92%)*	55 *(75.34%)*	73 *(100.00%)*	**3.71**	**SA**
					Over-all Mean	**3.64**	**SA**
					Grand Mean	**3.65**	**SA**

Respondents strongly agree that through online-created comics, they can illustrate the application of mathematical concepts and procedures, demonstrate mathematical procedures in detail, illustrate the connections between mathematical concepts that are related to one another, and assist people in discovering and learning new things, with an overall mean for metacognitive strategies of 3.60.

With an overall mean of 3.64 on the metacognitive experiences scale, respondents firmly concur that through online-created comics they can demonstrate how mathematics can be integrated with other academic disciplines, help develop creativity and critical thinking abilities, spark interest in conducting research, be able to reflect on how much they have learned, and appreciate the use of mathematics in everyday life.

In general, the level of awareness of the respondents in terms of metacognitive knowledge, metacognitive strategies and metacognitive experience with grand over-all mean of 3.65 shows that students strongly aware about the usefulness of comics as an assessment tool of their performance in mathematics in term of their knowledge, strategies and experiences.

Testing Normality Assumptions

Table 12 shows the result for test of normality on the metacognitive awareness of the respondents towards the use of comics in assessing performance in mathematics.

Based on table 12 with p-value less than 0.05 alpha level of significant for the Kolmogorov-Smirnov and Shapiro-Wilk, data significantly deviate from a normal distribution. To test the signifi-

cant relationship between the self and peers assessed performance on comics to the metacognitive awareness of the respondents a nonparametric Spearman rho was used.

Table 12 Result of Normality Test on Metacognitive Awareness on Comics as an Assessment

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Respondents Metacognitive Awareness	.211	73	.000	.740	73	.000
a. Lilliefors Significance Correction						

Relationship Between Self- and Peers-Assessed Performance to Level of Awareness on Metacognitive Knowledge

Table 13 shows the relationship between the self- assessed performance on comics to their metacognitive awareness.

Table 13. Relationship of Self- and Peers-Assessed Performance to Metacognitive Awareness

Spearman's rho		Metacognitive Knowledge	Metacognitive Strategies	Metacognitive Experiences	Respondents Metacognitive Awareness
Self- assessed performance	Correlation Coefficient	.412**	.429**	.455**	.484**
	Sig. (2-tailed)	.000	.000	.000	.000
	N	73	73	73	73
Peers assessed performance	Correlation Coefficient	.343**	.419**	.406**	.431**
	Sig. (2-tailed)	.003	.000	.000	.000
	N	73	73	73	73

**. *Correlation is significant at the 0.01 level; (2-tailed)*

Table 13 shows that although they can be interpreted as low positive, metacognitive experiences, metacognitive strategies, and metacognitive knowledge are found to be significantly related to the self-assessed performance. These correlation coefficient values are 0.455, 0.429, and 0.412, respectively. In general, at 0.05 alpha level of significance, there is a significant low positive relationship between the respondents' metacognitive awareness of the use of comics as a tool of assessment on their mathematics performance (0.484 coefficient value) and their self-assessed performance on their online created comics.

Peer-assessed performance also displayed a substantial low positive link with these elements of metacognition, with correlation coefficient values for metacognitive strategies, metacognitive experiences, and metacognitive knowledge, respectively, being 0.419, 0.406, and 0.343. The metacognitive awareness of peers of the usage of comics in evaluating their classmates' online-created comics generally demonstrated a significant low positive link with their judgment at 0.05 alpha level of significance, with a coefficient value of 0.431.

But although respondents showed no significant difference in their level of metacognitive awareness towards the use of comic in assessing their performance in mathematics, what an individual interprets or perceives may be substantially differ from reality (Pickens, 2005). Self- and peer – assessments can be a powerful tool in assessing students' performance when properly integrated in lesson planning.

Cognitive awareness has a favorable impact on achievement, and students who are highly metacognitively aware outperform those who are less so (Rahman et al., 2010); Ozcakmak et. al, 2021). These findings indicate a method for enabling students to succeed in academic contexts because the level of metacognitive awareness can be raised with teaching (Ward & Butler, 2019).

Entwistle and Karagiannopoulou (2014) assert that while experiences of a "meeting of minds" where teachers, teaching, and assessment are in tune with one another will improve the quality of personal understanding, negative emotions sparked by the experience of destructive friction are likely to obstruct any attempts to develop personal understanding. According to research by Alkharusi et. al (2013), student consultation, alignment with intended learning, and openness in the evaluation process all made a substantial difference in how well students performed academically.

We can observe that for self-assessment, the metacognitive experiences have the highest correlation to the performance while for peers-assessment is on the metacognitive strategies. This shows that self and peers although assessing the same output they might be different in the way of assessing each other's performance and this could be a start of collaborative learning among them.

As study of Nawas (2020) showed that although students recognized the significance of acting as peer assessors, they believed self-assessment to be more advantageous. Peer, student instructor, and faculty assessments are not always comparable but may provide different and useful feedback to students, according to the study of Lanning et al (2011) when analyzing self, peer-group, student instructors, and faculty assessments on communication skills instruction.

There are also significant differences when comparing teacher and peer assessment as well as teacher and self-assessment scores in the study of De Grez (2012) on the effectiveness of self and peer assessment of oral presentation skills compared with teacher's assessment supported by the result of the study of Ashraf & Mahdinezhad (2015) where peer-assessment has more significant effect on EFL learners' autonomy and speaking skill than self-assessment.

Conclusions and Recommendations

The results of this can serve as a foundation for a deeper understanding of how students view the roles that peer and self-assessment play in their learning. The findings of this study showed that students can strengthen their sense of responsibility for their learning by becoming more aware of the requirements and expectations of the course, as well as by developing their evaluative skills and strategies to fill any identified learning gaps that were noticed during the creation of the rubrics to be used in evaluating their own and others' outputs. Educators who want to give their students the opportunity to engage in peer and self-assessment activities, as this study did through the use of online generated comics, must also be aware of students' thoughts and attitudes of the advantages of such activities.

Online comics creation is a promising tool in assessing students' performance in mathematics as perceived by the respondents in the study. With the class developed rubrics in assessing their performance in different areas in which comics can be use to develop skills such as writing skills, creativity, illustrating concepts, understanding real-life applications, problem solving and completeness and timeliness.

The study only focused on the use of online created comics as a form of a summative assessment among the 2nd year pre-service teachers enrolled in Linear Algebra (Math 112) during the 2nd semester of the academic year 2021-2022 at Rizal Technological University. Self and peers assessed performance on the online created comics of the respondents were determined with the use of class prepared rubrics in terms of writing skills, creativity, illustrating concepts, understanding real-life application, problem solving and completeness and timeliness. Their perceptions towards the use of comics in assessing performance in mathematics were determined using a validated survey questionnaire. Significant difference on the assessed performance and perception towards the use of comics as a form an of assessment between the respondents and their peers were determined. Relationship between the assessed performance and the perceptions was also established. The instructor's assessment for the online created comics is not included in a study.

For future studies, the researcher recommends to explore thoroughly the effectiveness of the use of comics as an alternative assessment tool assessing students' performance not just in mathematics but in other discipline either as a formative or summative form of assessment and compare which is more effective. Instructor's assessment for the online created comics can also be considered to test its significant relation on the assessment made by self and peers which is not covered in the study. Significant differences in the performance when grouped according to other profile variables such as age, gender, socio-economic status, GWA, exposure on utilizing any available online comic strip maker can also be a new interest of study. Collaborative learning and feedback among learners can also be explored using comics creation with the aid of technology. A comparison on the performance of the respondents using the traditional form of assessment to the use of comics as an authentic assessment tool in assessing students' performance in mathematics.

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