

# **Educational Manga Series: Pseudo-Interactive Effect in Learning Mathematics through Modular Distance Learning**

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## **ABSTRACT**

The education disruption has had and will continue to have substantial effects beyond education. The closure of schools worldwide became a signal to implement distance or remote learning. However, online learning modalities were

associated with positive impact and effectiveness due to their feasible variables, such as assessment and interaction. Most learners still choose modular distance learning modality due to the lack of available materials and internet access. This study aims to develop an educational manga series in Mathematics that will minimize the learning gaps and create a pseudo-interactive effect on learners to increase their interest in reading and understanding printed modules. Mixed-Method Research Design, specifically sequential explanatory design, was used to ensure the successful implementation of the intervention continually. Data was collected and interpreted using google forms and a focus group discussion (FGD) afterward via google meet. Based on the findings, it was found that manga can help the learners grasp the meaning of the text better; as learning material, it can enhance understanding of the Mathematics concept and instruction better. The illustration and story help the learners increase their motivation and excitement due to their pseudo-interactive effect. This effect is described as the feeling of being part of the story. Therefore, it is recommended to use educational manga as learning materials in flexible learning options (FLOs) and courses that require practical experience.

**Keywords** — Education, Educational Manga, Mathematics, Mixed-Method Research Design, Pseudo-Interactivity, Philippines

## INTRODUCTION

Sustainable Development goals for elementary and secondary education were to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. This is relevant to providing free, publicly-funded, inclusive, equitable, quality primary and secondary education – of which at least nine years are compulsory, leading to relevant learning outcomes – should be ensured for all, without discrimination (UNESCO, 2021).

However, we are living in an unprecedented time. While none of us have experienced the specific details of the challenges before us, we are not without resources to help see us through. Together, we are facing the COVID-19 pandemic affecting all our families, businesses, communities, way of life, and vocations (OECD, 2015).

During this difficult time, we want to ensure that learning will continue, although our learners are in the comfort of their homes. In support of the international Mantra on the continuity of education, Department of Education

(DepEd) Secretary Leonor Briones said in the CNN article that instead of physical classes, the DepEd would implement distance or remote learning since there will be no face-to-face classes and sessions until the department was assured of the safety of our children and teachers, this method will deliver lessons through various ways, including online, television, radio, and printed materials (Nicholls, 2020).

Distance learning is a mode of delivery between learners and teachers who interact remotely during the teaching and learning process. The most commonly used distance learning modalities are printed modular distance learning and online distance learning. Printed modular Distance Learning involves individualized instruction that allows learners to use SLMs in printed format aside from textbooks and other materials for the study (Bacomo et al., 2022). While online distance learning features the teacher as a facilitator, learners can be more engaged in the instructions although they are remotely distant from each other (DepEd Order No. 12 s. 2020).

Most learners preferred printed modular distance learning due to the lack of available devices and stable internet. Although printed modular distance learning is the most accessible modality, most international study shows the advantage of online research compared to modular distance learning. Tartavulea et al. (2020) stated that students could quickly adapt to new trends during a crisis. Using mixed method instructions like synchronous and asynchronous adds to facilitate teaching and learning. However, questions as to the effectiveness of online instructions are factors to consider during the assessment.

On the other hand, this system of interaction and assessment cannot be provided by printed modular. As one of the newest popular interactive media, Manga, or Japanese comic books, started in Japan and is replicated and used in the United States. This book can make the market more accessible to readers (Terpstra, 2012). Manga is a form of sequential art that influences the reader to be more attached to comics and cinema (Horbinski, 2017). Japanese comics are globally popular, and the digital manga (e-manga) market is growing yearly (Narita et al., 2017). Manga, or comics, are works and materials that accommodate multimodal and diverse learners left behind due to pandemics (Aizawa et al., 2020). It is evidently shown that participants who read the books become attracted and attached to the materials until they develop a love for reading and a hunger for understanding since it may correlate to learning based on the following reasons. First, manga allowed struggling learners to grasp and absorb the materials better than the long content of the reading materials. It

gave the students great experiences to render vicarious experiences to express their ideas better using the text. Second, it gave a strong imagination to join in the pseudo materials where verbal and non-verbal as well as visual storytelling were characterized as fragmentary, which inspired the students to read and study better. Third, manga can provide a haven where the participants can find ways to escape anxiety and frustrations. Furthermore, it boosts the student's confidence to be a better reader (Tsai, 2015).

Ways of understanding human creations with artificial intelligence have increased; however, those are still known as one of the most difficult tasks. Our challenge is to find ways to understand the four-scene comics by Terauchi et al. (2019). Learning disparity between learners from online and printed modules will continuously increase during the pandemic. The researcher aims to develop an educational manga series in Mathematics to minimize the learning gap between distance learning modalities. These learning materials will create a pseudo-interactive effect on learners and increase their interest in reading and understanding printed modules.

## **OBJECTIVE OF THE STUDY**

The study aimed to develop instructional learning materials in Mathematics that will enhance the performance of learners in the modular distance learning modality. Specifically, it aims to (1) determine the teacher's and learner's evaluation of the educational manga materials in terms of content and pedagogy, textual and design, and pseudo-interactivity effect, (2) to identify the effective printed learning materials be attributed to learning performance, (3) to analyze how do pseudo-interactive effects relate to learning performance, and (4) to integrate mathematical concepts into illustrated learning materials such as educational manga series.

## **FRAMEWORK**

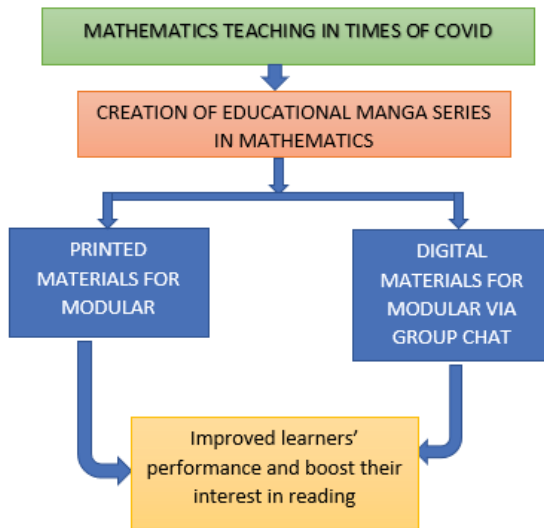
This chapter takes account-related reading materials from books, journals, magazines, and abstracts, which the proponent of the study deemed helpful in attaining an in-depth discussion of the research problem and development of the research framework.

Academics like Darko Suvin have successfully defended science fiction (SF) as literature that depicts political alternatives by focusing on cognitive

processes. This view of science fiction downplays the significance of character emotions, which has led to criticism from individuals who support the view that SF is a mirror of people's larger psychological issues. It demonstrates how, when appropriately contextualized within alternate SF worlds, the portrayal of emotions in science fiction, even those seen as "commonplace" or "everyday," can become political. Emotion can broaden the range of options for investigating political alternatives in SF, whether employed to communicate political views or as a tool to highlight SF situations (Li, 2015).

The best way to comprehend manga's history as one of the three great world sequential arts traditions is to compare it to comics and band dessinées to more accurately assess the local conditions in Japan. This will show how various factors in each nation resulted in various outcomes and developmental trajectories for each medium as part of the global history of the 20th century. Taking into account a variety of manga-related factors, such as its status as a type of Japanese mass media, its international standing as one of several global sequential art traditions and its unique history as an expressive medium in which fans and creators have at various points played equally significant, and at times not easily divisible, roles. To tell the story of manga's beginnings as it moves into its next hundred years. Specifically, discussing the history of rival publishing platforms and formats during the growth of manga shows that manga's popularity in Japanese society was more a result of the affordances offered by the platforms and formats than it was due to any inherent qualities of comics. Manga audiences grew as what started as a political satire medium for adults in the 1950s and 1960s evolved to include children and later young adults. This led to changes in the platform and format. Finally, since 1975, the *dōjin* sphere, an unauthorized but highly significant site of manga production, has grown to dominate the professional manga business, even if the manga has devolved into a minor part of other media (Horbinski, 2017).

Figure 1. Framework of the Study



## RESEARCH METHODOLOGY

### Research Design

This study used the Mixed Method Research Design, specifically sequential explanatory research design. According to (Wilson, 2016), mixed-methods is a research approach whereby researchers collect and analyze quantitative and qualitative data within the same study. According to Edmonds and Kennedy (2017), the explanatory-sequential approach is a sequential approach and is used when the proponent is interested in following up the quantitative results with qualitative data. Thus, the qualitative data is used in the subsequent interpretation and clarification of the results from the quantitative data analysis.

### Research Site

Eduardo Barretto Sr. National High School (EBS NHS), was located at Brgy. Pansol is known for its Hot Spring Resorts. Since the City of Calamba is continuously establishing its place in the Tourism Industry, Eduardo Barretto Sr. National High School affirmed to continue nurturing diverse learners' interests and be able to use these interests beneficial to themselves and the community as a whole.

Despite challenges and shortcomings due to man-made and natural disturbances like family feud, flood, and the like, the school manages to have good harvests in different levels of competitions, namely: International Silver Medalist in the International Mathematics Competition (Singapore), International Bronze Medalist in the Hong Kong International Mathematics Olympiad, International Silver Medalist in Thailand Mathematics Olympiad, International Silver Medalist in Chess (Malaysia), consistent Regional Finalist in Wellness Campus, Regional Finalist in Campus Journalism, Buhayani Festival Placer, Regional Representative in Sports Competitions, 3<sup>rd</sup> in 2018 Ms. DepEd in the division (teacher category), and among others. To conclude, the school is bound by its moral obligation to continue providing its clientele with the best services because of its Mantra, “Sa Galing at Talino, Pandayan ang Barretto!”

### **Participants**

The sample of the study was composed of five (5) Mathematics teachers and six hundred sixty-seven (667) Grade 7 learners. However, forty students undergo interviews via zoom and google meet due to the unavailability of the internet and gadgets. All the participants were enrolled in a modular distance learning modality. Purposive sampling was employed in this study since the participants were enrolled in digitally printed learning.

The study is limited to using educational manga as printed materials for modular distance learning concerning the performance of the learners. The response of the participants is limited to their evaluation of the printed materials and their effect on their academic performance. The proponent may be subjective in interpreting themes based on the participant’s responses.

### **Instrumentation**

The teacher-made evaluation tool was used to assess the relevant factors of printed materials, such as pedagogy, design, and interactivity effect. The reliability of the materials was determined and applied before it was distributed to the intended participants to ensure that the language and grammar were suitable to the type of participants included in the study. The replicability of the instruments was also considered in this study. This tool is made of a 4-point Likert Scale which contains criteria for effective printed materials. The evaluation mean was computed to identify what component of the materials required improvement. The participants will be given adequate time to assess the printed instructional materials, and the evaluation score will be collected for consolidation and analysis.

The effectiveness of the learning materials was based on the student's performance. Consolidated quarterly grades were analyzed and identified if there was an improvement in the number of proficient learners and learners who are longer active in school. The 1st and 2nd quarter grades were used as a baseline during the 3rd quarter as the implementation period. To validate the implication of the developed, printed materials on the learner's performance, a Focus Group Discussion (FGD) will be conducted composed of selected teachers and subject teachers. FGD will be administered through zoom or google meet.

### **Ethics Protocol**

The researcher requested permission from the Schools Division Superintendent and the School Head of E. Barretto Sr. National High School regarding the conduct of the study. Upon approval of the request, participants will be provided with a consent form that indicates that they voluntarily participate in the study. Adherence to DepEd's time-on-task policy shall be observed, ensuring that no disruption of classes will occur, and informed consent must be secured for all student participants before the conduct of the said activity. The survey shall be administered online in line with the safety health protocols amidst the COVID-19 pandemic. All the data gathered shall be used solely for research purposes in compliance with Data Privacy Act 2012. The developed, printed materials and evaluation tool were validated by experts and to be submitted to the Learning Resource Management Development System (LRMDS) for evaluation.

### **Data Gathering**

Materials used in the study were sent via group chat. A pre-test was administered to determine the prior knowledge of the respondents. A post-test was administered in the eighth week of the second quarter. The performance of the students during the second quarter was compared to their performance during the first quarter, where there were no Educational Mathematics Manga materials. After comparing their performance, they were instructed to attend the focus group discussion for the follow-up and to gather feedback based on the materials they had read. Semi-structured interviews were based on their perception and learning of the materials. Their challenges and problems were also asked to address their queries.



## Statistical Analysis

To determine the effect of the study, statistical treatment was used based on the results of the pre-test and post-test. A t-test for dependence was employed in the study. Focus Group Discussion was undergone after the full implementation of the study to determine the effect of the printed materials. Comparative analysis was undertaken using graphical presentations (e.g., pie charts). Other factors were added regarding the effectiveness of the materials and validated by the respondents during the focus group discussion. Data transcription was followed afterward.

## RESULTS AND DISCUSSION

To determine the teacher's and learner's evaluation of the educational manga materials in terms of content and pedagogy, textual and design, and pseudo-interactivity effect, a comparative table was shown below.

Table 1. The Comparative Analysis of the Teachers and Learner's Evaluation of the Materials Used during the Implementation

Criteria	Learners	Teachers
A. CONTENT AND PEDAGOGY	3.22	3.44
1. The instructions in the manga are clear.	3.18	3.40
2. The mathematical concepts included are accurate.	3.24	3.60
3. The lessons presented are understandable.	3.18	3.60
4. The language used in the materials is appropriate for the learners.	3.30	3.20
5. The material learning components were complete.	3.15	3.40
B. TEXTUAL AND DESIGN	3.31	3.56
1. The design leaves a good impression of the story.	3.30	3.60
2. The font used in the manga is readable.	3.36	3.60
3. The quality of the illustrations of the characters is good.	3.33	3.60
4. The flow of the story in the illustration slide is continuous.	3.27	3.40
5. The story and design are original.	3.27	3.60

C. PSEUDO-INTERACTIVE EFFECT	3.28	3.60
1. Learners grasp the meaning of the text better base on the illustration.	3.21	3.80
2. Learners' imaginations were inspired to join and be part of the story.	3.33	3.40
3. Learners could forget the stressful and frustrating reality.	3.36	3.40
4. Learners gain insight into the actual application of the concept.	3.15	3.80
5. Learners feel excited about the release of the next episode.	3.36	3.60

Based on Table 1, Engagement in SLM comics can encourage self-directed instructions. Independent learning can produce better acquisition of better and improve oneself. Manga Comic is effective to increasing the students' literal reading comprehension of the main idea; it was improved by the mean score of literal comprehension before and after giving treatment with the t-test value main idea comprehension is greater than t-table (Putri et al., 2021). That is why for the content and pedagogy, as perceived by students, it was evident that using SLM manga comics helps them to understand better and engage themselves in learning without the aid of anyone. Being responsible and self-directed learners can be attained if learners can be exposed to the provided reading materials to improve themselves in Mathematics. Teachers believed that it would lessen their workload since face-to-face learning was shifted to remote learning. For Textual and Design, students were motivated to read since it was presented in a brief and concise manner. Teachers found it easy to understand since the wordings were very limited.

For Pseudo Interactivity Effect, students were amazed by the illustration vis-a-vis the story conceptualized in the Manga Series. They were excited to read the next episode. As teachers, it was very evident that printed materials helped the students to grasp and relate the topic to a real scenario. As Wendt (2020) said, real-life problems are almost always socially complex, even when we are by ourselves. Psychological problem-solving research must therefore integrate complexity as a domain of investigation.

To identify the effective printed learning materials to be attributed to learning performance, quarterly analysis performance was then compared. (*See table 2*).

Table 2. Comparative Analysis of the Quarterly Performance of Learners

Grading Period	Outstanding 90% - 100%	Very Satisfactory 85% - 89%	Satisfactory 80% - 84%	Fairly Satisfactory 75% - 79%	Not Meet Expectations Below 75%	No Longer Active in School
1st Quarter	4	2	9	23	2	16
2nd Quarter	5	7	13	15	0	10
3rd Quarter	7	7	19	7	0	4

Based on the above table, the comparative analysis of the quarterly performance of learners showed that during the first quarter, nine (9%) of them got a satisfactory rating on their report card, 2% of them did not meet the expectation, while 16% showed no interest/no longer active in school. On the other hand, the second quarter showed that 13% of them got a satisfactory rating on their report card, none of them did meet the expectation, and 10% were no longer active in school. After the implementation of the study, using educational manga series, the third quarter showed in the table that 19% of them got a satisfactory rating on their report card, none of them met the expectation, and only 4% were no longer active in the school. Mangas have been successful in transcending cultural barriers and making an important and lasting impression on audiences around the globe. At first, this success was limited, but now the imagination of readers has been captured everywhere, spawning a fan base that has been increasing day by day (Mahaseth, 2017).

To analyze how pseudo-interactive effects relate to learning performance, a focus group discussion was undergone, and challenges were gathered based on their responses. It was then transcribed to come up with the themes that emerged in the study. Table 3, 4, and 5 shows the responses and themes based on the necessary data.

Table 3. Themes on the Challenges That Learners Experience in Modular Distance Learning

Participant	Direct Quotation	Initial Code	Theme
Learner A	“Mahirap minsan yung module , lalo na pagka walang nakalagay na discussion”	The learners experience difficulty understanding the lesson.	Printed materials alone are not enough to help learners in learning.
Learner B	“Sometimes I get stressed because it’s hard, sometimes it’s easy, sometimes it’s really hard to understand.”		
Learner C	“Mahirap kasi walang nagtuturo, lalo na pag mahirap na yong topic at walang pag tanungan”	The learners required assistance to fully understand the activity.	
Learner D	“Hindi nakikita ang tiser para ipaliwanag ang gagawin”		

Table 3 shows how learners appreciate the modular distance learning modality. They were aware that this modality was developed considering the current situation and capability of most of the learners. They believe that through modules, they would gain a chance to continue learning despite the pandemic. The use of manga to foster reading comprehension can be effectively accomplished by planning lessons and activities in the order of the learning content corresponding to each level of text comprehension (Okubo et al., 2019).

Table 4. Themes on the Challenges That Learners Experience in Modular Distance Learning

Participant	Direct Quotation	Initial Code	Theme
Learner A	“Maganda at maayos dahil kahit module lang tinuturuan parin kami ng mga guro kung paano ito gawin”	Learners accept modular distance learning based on their understanding of the current situation.	The learners positively respond to the use of modules in distance learning.
Learner D	“Para maiwasan ang pag dikit dikit ng mga tao kaya,wala munang face to face classes at modules muna”		
Learner E	“Good, because many children are still learning at home.”	Flexibility is an important characteristic of the open learning process.	
Learner F	“Self-learning modules are designed where the learner is free to choose what to learn, how to learn when to learn, and where to learn.”		

Table 4 emphasizes the challenges that the learners encounter while implementing a modular distance learning modality. The idea that the modules would be enough for them to learn was not attained. This is due to difficulty in understanding the instruction and insufficient discussion. Aquino et al. (2018) stated in their research that the students were gauged to have “Low Level” performance in literal, interpretive, critical, and application reading comprehension. On the merits of the findings, the study offers several recommendations, including the actual use of the developed learning material for instructional intervention purposes.

Table 5. Themes on the Learners' Perspectives on Educational Manga

Participant	Direct Quotation	Initial Code	Theme
Learner A	"Nakakapanabik ang mga nangyayari at maganda din ang istorya nito"	The learners enjoy reading and learning illustrated learning materials.	Manga modules show factors that the learners were looking for in printed learning materials.
Learner C	"Nakakapbigay ng ispirasyon at maraming aral na makukuha"		
Learner D	"Maayos kasi mas maganda yun dahil may mga lawaran kang titingnan para mas mabilis matukoy ang babasahin mo"	The illustrated learning materials provide a better understanding to learners of printed modular.	
Learner F	"I can understand the lesson easily, and it will be more exciting and entertaining to study when your module is a manga or comics series."		

Table 5 shows descriptions of the educational manga, as illustrated learning materials provided. All the learners describe the illustrated learning materials as an intervention that provides better learning. Some factors that separate the illustrated learning materials from the available self-learning materials enhance motivation since the manga has a sequential story and provides clear instruction supported by illustration. As presented by Murakami and Bryce (2009), manga either overtly or covertly informs readers with valuable real-world information while entertaining them with engaging stories and characters. By combining visual and verbal texts with stories, manga is able to make difficult topics easy to understand. To integrate mathematical concepts into illustrated learning materials such as educational manga series, the learner's experiences were laid down, as shown in Table 6.

Table 6. Themes on the Learners’ Experience in Using Educational Manga

Participant	Direct Quotation	Initial Code	Theme
Learner B	“sa pamamagitan ng paglalarawan ng lessons mas maiintindihan kung ano ang dapat gawin”	Illustrated printed materials provide better instruction.	Printed learning materials must provide instructions through an interesting method.
Learner C	“Nakatulong ito sa paraan ng pag papakita ng eksplenasyon”		
Learner D	“Mas mabilis maintindihan ang topic dahil may real life application sya”	The learning can be grasped easily and maintain the interest of learners.	
Learner F	“I understood the lesson better, and I feel like I want to study more if we have this kind of learning material.”		

Table 6 describes the learners’ experience in using educational manga. Their response stresses the integration of better instruction and discussion through illustration. Also, the learning materials show an authentic application of theories based on real-life activity, as shown in the manga. This factor makes the materials more interesting. To strengthen the claim of the result, Murakami and Bryce (2009) concluded that manga is essentially more educational media than mere entertainment. These manga works are often based on accurate information derived from careful research, providing high literary value and intellectual stimuli to readers.

### CONCLUSIONS

Using printed modules, sequential learning provides continuous learning and ignites excitement in learners. Illustrated instructions can clarify the directions of learning and enhance distance participation. It also allows real-life applications where students/learners practically understand the value and importance of learning.

## RECOMMENDATIONS

Educational intervention using printed EDUCATIONAL MANGA SERIES significantly increased teachers' beliefs in increasing students' performance. The findings also indicated that Educational Manga positively affects students' mastery of the subject matter. Therefore, the usually printed module was still effective and relevant to be always used as a learning resource during the pandemic, and it is also applicable as remediation and intervention strategies. It is best to conclude that (a) Illustrated instructional materials are highly recommended for experimental activity such as but not limited to science laboratory activity and technical vocation hands-on activity, (b) The design of developing manga as instructional materials can be utilized in programs on Flexible Learning Option (FLOs), and (c) Gradual adjustment of printed learning materials from pure textual to illustrated design.

## TRANSLATIONAL RESEARCH

The findings of this study may be best translated through benchmarking and implementing best practices from the other successful school in Calamba City, Laguna. Printer materials will also be shared as reference materials that will be used to increase the performance of the students in Mathematics. These materials will also help develop the reading habits of the students since this is aligned with the comics, which nowadays our young generations will be more interested in.

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