#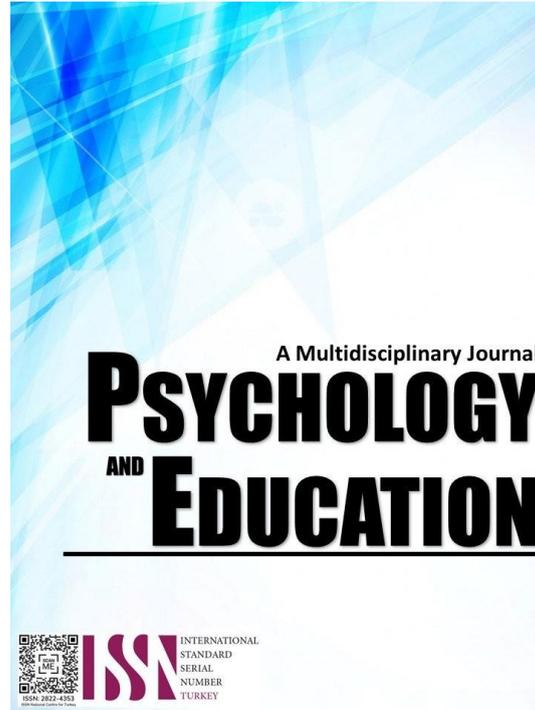 DEVELOPMENT AND VALIDATION OF SELF-DESIGNED E-LEARNING MODULE IN ADDING AND SUBTRACTING OF RATIONAL EXPRESSIONS IN MATHEMATICS 8

Development and Validation of Self-Designed E-Learning Module in Adding and Subtracting of Rational Expressions in Mathematics 8

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Abstract

The purpose of this study was to develop a self – designed e - learning module to enhance the skills in adding and subtracting rational expressions of the grade 8 students of Bagong Silangan High School. The design of this study is a combination of experimental and descriptive research design. In determining the total sample of the expert respondents, the study employed the cluster sampling technique. The respondents of the study were 110 grade 8 students and 32 experts. The self–designed e–learning module in adding and subtracting of rational expressions in Mathematics 8 featured introduction, adding and subtracting similar rational expression, adding, and subtracting dissimilar rational expression and enrichment. Based on the assessment of the panel of experts, the modules were found out to be accurate, well formatted, well presented, organized, accurate and relevant. Meanwhile, based on the students' assessment of the self – designed e – learning module in adding and subtracting of rational expressions in Mathematics 8, the modules are comprehensive, understandable, and suitable to their level. The performance of the students in adding and subtracting rational expressions in Grade 8 Mathematics in the control and experimental groups is significantly different based on comprehension, analyzing and evaluating areas.

Keywords: *e-learning module, development, validation, mathematics*

Introduction

Mathematics is a prerequisite in all aspects of human life. It is one of the most important things everyone must learn. Knowledge of algebra enables students to solve problems in mathematics with regards to numbers, age, mixture, distance and some business mathematics. The concept of geometry can also be used in real life such making computer programs, in robotics and architecture that deals with a lot of different shapes and forms. The use of statistics and probability in economics, medicines and in education. Also, mathematics is used for analyzing and communicating information and ideas to address a range of practical tasks and real-life problems (Gray and Tall, 1999).The basics of mathematics start in school, such counting and using the four fundamental operations. Mathematics is a significant course in school curriculum. Young age children must learn the basic foundations of the subject which is useful in functioning well in their everyday lives, Lebens, Graff & Mayer, (2011). It is in high school that students learn more complex about mathematics. This subject is a pre-requisite to college and all programs has this course.

Students' performance in international tests such as the Trends in International Mathematics and Science Study (TIMSS) provides reliable and timely data on the mathematics and science achievement of students in United States compared to that of students in other countries. TIMSS data have been collected from students at grades 4 and 8 since 1995 every 4 years, generally. In 2003, for 8th grade mathematics, Philippines ranked 34th out of 38 countries with the score of 378 compared to other Asian countries. This simply shows that the other country's educational system is far better than the Philippines'.

National Achievement Test (NAT) is a Philippine – made standardized test in different subject areas given by the Department of Education (DepEd) to the grade 7, 11 and 12 students of public and private schools yearly. NAT results in Quezon City schools in mathematics for the school year 2013 – 2014 has the Mean Percentage Score (MPS) of 54.76%, third to the lowest computed MPS next to Science and Critical Thinking Skills. In Bagong Silangan High School particularly, the computed MPS in NAT in mathematics was 44.68%. This means that, the students' comprehension in math is below average. However, the division of city schools are still looking for the intervention to elevate the MPS in math until this year.In the second quarter examination this school year on the said school. Among the grade levels, it was found out that grade 8 has the lowest computed mastery level (MPS) of 32.06% with verbal description of Low Mastery (LM). Grade 7 with 33.66% MPS, grade 10 has 48.08% and 33.23% for grade 9. One of the least mastered skills tallied was rational expression.

The coverage of rational numbers is wide. This is not just only a simple fraction, but the numerator and denominator are polynomials. Most students are

having a hard time to understand rational expressions as it requires the concepts and principle on prime numbers, factoring, and the four fundamental operations. To overcome the difficulties, teacher should have interventions like games, collaborative learning, and the use of computers and other electronic devices may function as well for students can easily comprehend rational expressions and its application.In this study, the students must be finished the four self-designed e-learning modules to fully understand adding and subtracting rational expressions and to achieve the learning objectives.

Research Questions

The purpose of this study was to develop a self – designed e - learning modules to enhance the skills in adding and subtracting rational expressions of the grade 8 students of Bagong Silangan High School. Specifically, the study sought to answer the following questions:

1. What are the features of the self–designed e–learning module in adding and subtracting of rational expression in Mathematics 8?
2. What is the feedback of the experts in the self–designed e–learning module in adding and subtracting of rational expressions in Mathematics 8 as to:
   2.1. Content;
   2.2. Format;
   2.3. Presentation and Organization; and
   2.4. Accuracy and up – to Datedness of Information?
3. What is the feedback of the students in the self – designed e–learning module in adding and subtracting of rational expressions in Mathematics 8 as to:
   3.1. Content;
   3.2. Format;
   3.3. Presentation and Organization; and
   3.4. Accuracy and up – to Datedness of Information?
4. How do the control and experimental groups perform after using the self–designed e–learning module in adding and subtracting of rational expressions in Mathematics 8?
5. Is there a significant difference between the post – tests of the control and experimental groups?

Literature Review

Today's technological integration has resulted in advancements and societal transformations that alter people's thinking, working, and living habits. The computer revolution is upon us, according to Etcuban et al. (2019). In the mathematics classroom, a computer is a tool that can be used in many ways. It could be a tool for making traditional practice more effective at teaching concepts, skills, and problem solving.

Innovation has impacted nearly every aspect of life today, according to Capuno et al. (2019), and training is no exception. Teachers have more resources in today's classroom to assist students learn mathematical ideas, and a mix of conventional and new teaching methods can benefit students of all abilities. Technology is critical in mathematics teaching and learning because it influences what is taught and improves students' learning. Mathematics is more than just a subject; it has applications in many aspects of human life. Its study equips students with fundamental life skills, procedures, and knowledge that will enable them to become useful members of society. The proper and coordinated use of innovation has an impact on all areas of mathematics education, including what is taught, how it is taught and learned, and how it is assessed.

According to Torrefranca (2017), if adequate self-instructional learning materials are offered, students can effectively promote their grasp of Rational Expressions and Variations. Particularly in the context of K-12 Mathematics curricula, where students are expected to develop critical thinking and problem-solving skills as they advance through the academic ladder. She claims that the use of modules in classroom education, as well as the instructor who creates the modules, has ramifications for both theory and practice.

According to Genç and Aydemir (2015), online puzzle exercises assist students better understand subjects and prepare for exams. Furthermore, these exercises benefit students by boosting their knowledge and retention of learnt terminology both in and out of class, resulting in beneficial learning experiences. It has been suggested that conducting online puzzle exercises in class as a course-end activity is more successful in terms of student learning than doing them outside of class.

Similarly, Conde (2015) stated that education is highly valued in Filipino culture. For the vast majority of Filipinos, education is the sole way for a youngster to achieve and secure a brighter future. They seek a more effective education system, therefore when e-Learning became available in the Philippines, educational officials quickly decided to incorporate it. Students benefit from e-learning in a variety of ways. They have complete freedom to access content whenever and whenever they want, using whatever system they like.

This adaptability helps students to study in a method that suits them best.

The use of Modules in teaching Math, specifically word problem solving, is an effective teaching strategy, according to Lim (2016) in his study. Effective in the sense that it allowed the study's subjects to absorb mathematical ideas without having to cram to keep up with the teacher's pace. The usage of modules in the teaching of these specific Math concepts was extremely beneficial to the students in building their own learning study habits.As expressed by Agbirin and Obra (2019), the social media-based mathematics instructional module is valid and reliable, and it is acceptable as an instructional material; it meets the majority of the pre-delivery appropriateness criteria of the required learning competencies and skills of grade seven students in terms of lesson objectives, lesson content, language used, and evaluation activities.

Furthermore, With the development of Internet access and advancements in online technology, teaching methodologies have been rethought, resulting in potential alternatives to lecture-based instruction (Galway, 2014). The flipped classroom is founded on cognitive and social theories that encourage meaningful learning, which can only occur when students are actively engaged in learning activities (Long, 2016).Masullo (2017) suggested that instructional technology leaders should be able to collaborate with and identify classroom teachers who have the potential to become opinion leaders who can influence change in the school environment as part of their informal leadership.

Likewise, Students to who were exposed to self-learning modules performed better in the specified units of English grammar than those who were exposed to traditional methods of instruction and retained more of the stated units. Greager and Murray (2014) discovered that the Modules assisted students in learning and gave better opportunities for students to interact with the teacher by reducing the amount of time spent on routine instruction.Lastly, modular teaching, according to Sadia Sadiq (2014), is more effective in the teaching learning process than traditional teaching techniques. Because students can study at their own pace with this modular method. It is a free self-learning technique in which students are motivated and interested by rapid reinforcement and feedback on practice exercises.

Methodology

Experimental and descriptive research designs were used in this study. Experimental research is a powerful research method to establish cause-and-effect relationship (Borg, W.R., Gall, M.D.1989:639) involving two or more variables, the variable that becomes the cause (independent) and the variable that becomes the effect. This method is appropriate since the study wanted to find out whether the self – designed e–learning modules would cause a change in the performance of the students in adding and subtracting rational expression.

The goal of descriptive research is to create a detailed profile of the people, events, or situations being studied. Descriptive research involves gathering data that describe events and then organizes, tabulates, depicts, and describes the data collection (Glass & Hopkins, 1984).These methods of research were best fitted in the present research undertaking, because the study was to determine the difference in the students' performance before and after using the self - designed e – learning modules among the Grade 8 students during the second grading period, SY 2020 - 2021 at Bagong Silangan High School.

Participants of the Study

In determining the total sample of the expert respondents, the study employed the cluster sampling technique. Random sampling is frequently simpler to execute in schools, such as the public schools in District II, Quezon City. Out of the six (6) schools, sixty seven percent (67%) or four (4) out of the six (6) schools are randomly selected, and then all the experts in each school were selected as respondents.

A total of thirty - two (32) experts from the four randomly selected public schools in District II, Quezon City served as the respondents of the study. A total of 110 students from grade 8 section Agility and Benevolence from Bagong Silangan High School in both control and experimental groups also served as the subject respondents.

Instruments of the Study

The survey questionnaire used in this research was a standardized evaluation tool for learning material to satisfy the feedback of the students and experts in the self – designed e – learning module in adding and subtracting of rational expressions in Mathematics 8. The evaluation tool was composed of a series of questions that gathered the perception and assessment

of the expert and student respondents to the acceptability of the self – designed e – learning module in adding and subtracting of rational expressions in terms of its content, format, presentation and organization, and accuracy and up – to datedness of information. In this survey type, four choices were provided for every question or statement.The survey questionnaires together with the soft copy of the proposed learning material were sent to the respondents through google forms.In addition, A researcher - made test in mathematics was used to determine the performance of the subject respondents. This research instrument consists of a 50-item test on adding and subtracting rational expressions.

Procedure

An approval letter to conduct the study was sent by the researcher to the Schools Division Office of Quezon City. The researcher secured a letter to the principal of the selected schools in District II, Quezon City to conduct the survey for the evaluation of the proposed self-designed e-learning module in adding and subtracting of rational expressions in Mathematics 8.

A week before the actual survey, the researcher sent a letter of request to the expert respondents for their feedback on the proposed learning material. The survey was conducted through google forms. Item analysis for pilot testing of the performance test in adding and subtracting of rational expressions was made, and data for validity and reliability were obtained. The pre-test was administered during the first week of the second grading period school year 2020 - 2021. Experimentation happened where two groups were exposed to the same lessons. They differed only in the pedagogy to which they were subjected. The researcher administered a post-test after the utilization of the proposed self-designed e-learning module.A survey for the student respondents for their feedback of using self-designed e-learning module was taken place. The collected data was examined, evaluated, and interpreted by the researcher using statistical methods.

Ethical Considerations

The researcher himself explained and gave the informed consent to each participant before the conduct of the study. He ensured them that the information would be used with utmost confidentiality and within the purpose of the study only.

Results and Discussion

Features of the self–designed e-learning module in adding and subtracting of rational expressions in Mathematics 8

The self-designed e-learning module in adding and subtracting of rational expressions in Mathematics 8 is composed of four modules namely introduction, adding and subtracting similar rational expression, adding and subtracting dissimilar rational expression, and enrichment.

Module 1. It consists of the Introduction, a definition of the topic and a trivia which is related to the topic. The objectives were highlighted, these were the competencies to be acquired by the students for the lesson. Get-Up-and-Go is an activity before the lesson which intends to check what the learners already know about fractions by giving equivalent simplified form of each fraction. Preliminary is the activity that aims to diagnose the students understanding of the concept that Adding and Subtracting Rational Expressions has.

Module 2. It is about Adding and Subtracting Similar Rational Expressions. Skills Development provides a brief yet precise discussion of the lesson. This aims to help and give more ways to acquire new concepts and skills. It includes four examples for addition and three examples for subtraction with step-by-step procedure in performing the operation. There are two examples provided with steps for when the denominator is the opposite or the additive inverse of the other. Similar rational expressions are vividly explained for the students to fully understand the topic. Comprehension Check is a five-item task where students should perform each indicated operation. This is to assess the level of students' mastery of the topic.

Module 3. It is about Adding and Subtracting Dissimilar Rational Expressions. Skills Development composed of two activities that help students define the Common Multiple, Least Common Multiple (LCM) and Prime Factors. There are seven questions to be answered about the activities after accomplishing it. It also includes two examples each for addition and subtraction with step-by-step procedure in performing the operation. Comprehension Check which is a five-item task where students should solve the given dissimilar rational expressions. This is to examine the level of students' mastery of the topic.

Module 4. It is Enrichment. It consists of enrichment activity about the operation on rational expressions. It

follows by a skills' checklist that students acquire after answering the module. The final part of this module is the Assessment which concludes the whole module.

Feedback of the experts in the self–designed e–learning module in adding and subtracting of rational expressions in Mathematics 8

Table 1. *Feedback of the Experts as to Content*

Criteria	Weighted Mean	Verbal Interpretation
1. Content is suitable to the student's level of development.	3.78	Very Satisfactory
2. Material contributes to the achievement of specific objectives of the subject area and grade/year level for which it is intended.	3.81	Very Satisfactory
3. Material provides for the development of higher cognitive skills such as critical thinking, creativity, learning by doing, inquiry, problem solving, etc.	3.63	Very Satisfactory
4. Material is free of ideological, cultural, religious, racial, and gender biases and prejudices.	3.81	Very Satisfactory
5. Material has the potential to arouse interest of target reader.	3.63	Very Satisfactory
6. Adequate warning/cautionary notes are provided in topics and activities where safety and health are of concern.	3.69	Very Satisfactory
Overall Weighted Mean	3.72	Very Satisfactory

It can be seen that each of the criteria under content received ratings for experts as very satisfactory. The result shows that the experts found the contents of the self–designed e–learning modules were found out to be relevant, objective, have provisions for higher cognitive skills, socially acceptable, interesting and informative.

Based on the table 2, experts rated the self–designed e–learning module in adding and subtracting of rational expressions in Mathematics 8 very satisfactory with an overall weighted mean of 3.80 as to format. The result shows that the format of the self–designed e–learning modules have appropriate letter size and spacing, readability, simplicity, supplementary, realistic, attractive, culturally relevant, well -illustrated and accessible.

Table 2. *Feedback of the Experts as to Format*

Criteria	Weighted Mean	Verbal Interpretation
1. Size of letters is appropriate to the intended user.	3.88	Very Satisfactory
2. Spaces between letters and words facilitate reading.	3.81	Very Satisfactory
3. Font is easy to read.	3.88	Very Satisfactory
4. Printing is of good quality (i.e., no broken letters, even density, correct alignment, properly placed screen registration).	3.84	Very Satisfactory
5. Simple and easily recognizable.	3.88	Very Satisfactory
6. Clarify and supplement the text.	3.84	Very Satisfactory
7. Properly labelled or captioned.	3.88	Very Satisfactory
8. Realistic / appropriate colors.	3.84	Very Satisfactory
9. Attractive and appealing.	3.69	Very Satisfactory
10. Culturally relevant.	3.53	Very Satisfactory
11. Attractive and pleasing to look at.	3.75	Very Satisfactory
12. Simple (i.e., does not distract the attention of the reader).	3.78	Very Satisfactory
13. Adequate illustration in relation to text.	3.81	Very Satisfactory
14. Harmonious blending of elements (e.g., illustrations and text).	3.81	Very Satisfactory
15. Used contributes to easy reading.	3.81	Very Satisfactory
16. Easy to access.	3.78	Very Satisfactory
Overall Weighted Mean	3.80	Very Satisfactory

Table 3. *Feedback of the Experts as to Presentation and Organization*

Criteria	Weighted Mean	Verbal Interpretation
1. Presentation is engaging, interesting, and understandable.	3.78	Very Satisfactory
2. There is logical and smooth flow of ideas.	3.81	Very Satisfactory
3. Vocabulary level is adapted to target reader's likely experience and level of understanding.	3.81	Very Satisfactory
4. Length of sentences is suited to the comprehension level of the target reader.	3.81	Very Satisfactory
5. Sentences and paragraph structures are varied and interesting to the target reader.	3.72	Very Satisfactory
Overall Weighted Mean	3.79	Very Satisfactory

It can be gleaned from the data that experts rated all the criteria in terms presentation and organization as very satisfactory and with an overall weighted mean of 3.79. The result shows that the modules are well presented, logical, suitable for the target readers and well structured.

Table 4. *Feedback of the Experts as to Accuracy and Up-to-datedness of Information*

Criteria	Weighted Mean	Verbal Interpretation
1. Conceptual errors.	3.75	Not Present
2. Factual errors.	3.81	Not Present
3. Grammatical errors.	3.72	Not Present
4. Computational errors.	3.88	Not Present
5. Obsolete information.	3.78	Not Present
Overall Weighted Mean	3.77	Not Present

As manifested in the table, all the expert respondents concurred those conceptual errors; factual errors; grammatical errors; computational errors; obsolete information with their weighted means of 3.75, 3.81, 3.72, 3.88, and 3.78, respectively and have the verbal interpretation of not present in the self – designed e – learning module in adding and subtracting of rational expressions in Mathematics 8. The learning material is accurate and updated as experts rated the learning material with an overall weighted mean of 3.77.

Feedback of the students in the self–designed e–learning module in adding and subtracting of rational expressions in Mathematics 8

Table 5. *Feedback of the Students as to Content*

Criteria	Weighted Mean	Verbal Interpretation
1. Content is suitable to the student's level of development.	3.88	Very Satisfactory
2. Material contributes to the achievement of specific objectives of the subject area and grade/year level for which it is intended.	3.86	Very Satisfactory
3. Material provides for the development of higher cognitive skills such as critical thinking, creativity, learning by doing, inquiry, problem solving, etc.	3.90	Very Satisfactory
4. Material is free of ideological, cultural, religious, racial, and gender biases and prejudices.	3.84	Very Satisfactory
5. Material has the potential to arouse interest of target reader.	3.88	Very Satisfactory
6. Adequate warning/cautionary notes are provided in topics and activities where safety and health are of concern.	3.93	Very Satisfactory
Overall Weighted Mean	3.88	Very Satisfactory

With all the criteria used in obtaining the evaluation of students as to content, an overall weighted mean of 3.8822 was attained with a verbal interpretation of very satisfactory. The result shows that the contents of the modules were found out to be suitable for the learners.

Table 6. *Feedback of the Students as to Format*

Criteria	Weighted Mean	Verbal Interpretation
1. Size of letters is appropriate to the intended user.	3.86	Very Satisfactory
2. Spaces between letters and words facilitate reading.	3.97	Very Satisfactory
3. Font is easy to read.	3.90	Very Satisfactory
4. Printing is of good quality (i.e., no broken letters, even density, correct alignment, properly placed screen registration).	3.88	Very Satisfactory
5. Simple and easily recognizable.	3.98	Very Satisfactory
6. Clarify and supplement the text.	3.95	Very Satisfactory
7. Properly labelled or captioned.	3.91	Very Satisfactory
8. Realistic / appropriate colors.	3.91	Very Satisfactory
9. Attractive and appealing.	3.86	Very Satisfactory
10. Culturally relevant.	3.79	Very Satisfactory
11. Attractive and pleasing to look at.	3.90	Very Satisfactory
12. Simple (i.e., does not distract the attention of the reader).	4.00	Very Satisfactory
13. Adequate illustration in relation to text.	3.95	Very Satisfactory
14. Harmonious blending of elements (e.g., illustrations and text).	3.95	Very Satisfactory
15. Used contributes to easy reading.	3.97	Very Satisfactory
16. Easy to access.	3.84	Very Satisfactory
Ove1rall Weighted Mean	3.91	Very Satisfactory

It can be seen from the table that the students evaluated the learning material with an overall weighted mean of 3.91 and verbal interpretation of very satisfactory. The result shows that the format including the fonts and illustrations of the self-designed e-learning modules were easily recognizable by the students.

Table 7. *Feedback of the Students as to Presentation and Organization*

Criteria	Weighted Mean	Verbal Interpretation
1. Presentation is engaging, interesting, and understandable.	3.90	Very Satisfactory
2. There is logical and smooth flow of ideas.	3.88	Very Satisfactory
3. Vocabulary level is adapted to target reader's likely experience and level of understanding.	3.91	Very Satisfactory
4. Length of sentences is suited to the comprehension level of the target reader.	3.93	Very Satisfactory
5. Sentences and paragraph structures are varied and interesting to the target reader.	3.95	Very Satisfactory
Overall Weighted Mean	3.91	Very Satisfactory

The table shows that the students evaluated the learning material as very satisfactory in terms of presentation and organization with an overall weighted mean 3.91. the result show that the presentation and organization of the modules are comprehensive, understandable and suitable to their level.

Table 8. *Feedback of the Students as to Accuracy and Up-to-datedness of Information*

Criteria	Weighted Mean	Verbal Interpretation
1. Conceptual errors.	3.91	Not Present
2. Factual errors.	3.90	Not Present
3. Grammatical errors.	3.88	Not Present
4. Computational errors.	3.78	Not Present
5. Obsolete information.	3.88	Not Present
Overall Weighted Mean	3.87	Not Present

Students found that the grammatical errors and obsolete information are not present in the self – designed learning material with weighted mean of 3.88 each; as well as the conceptual errors; factual errors; computational errors with their weighted means of 3.91, 3.90, and 3.78, respectively. It can be gleaned from the data that the students agreed that the self – designed learning material is accurate and updated with an overall weighted mean of 3.87.

Performance of control and experimental groups after using the e – learning module in in adding and subtracting of rational expressions in Mathematics 8

Table 9. *Post-Test Mean Percentage Scores of the Control and Experimental Groups*

Group	Comprehension		Analyzing		Evaluating		Total	
	MPS	VI	MPS	VI	MPS	VI	MPS	VI
Control Group	48.33	AM	49.28	AM	50.59	AM	49.44	AM
Experimental Group	65.93	MTM	64.67	AM	66.59	MTM	65.72	MTM

When taken as a whole, the control group garnered an MPS of 49.44 which is interpreted as Average Mastery while the experimental group have an MPS of 65.72 which is interpreted as Moving Towards Mastery. The experimental group have higher MPS by 16.28 compared to the control group. It is implied that the experimental group performed better in all areas compared to the control group as shown in the increase

of MPS. The use of Self – Designed E – learning Module in Adding and Subtracting of Rational Expressions in Mathematics 8 is deemed to be effective in increasing the students Mean Percentage Scores.

Significant difference between the post – tests of the experimental and control group

Table 10. *Test of Difference on the Performance of the Control and Experimental Groups*

Test	Group	Mean	SD	p–value	Decision	Interpretation
Comprehension	Control	7.25	2.79	0.000	Reject *Ho*	S
	Experimental	9.89	3.91			
Analyzing	Control	8.87	3.30	0.000	Reject *Ho*	S
	Experimental	11.64	4.43			
Evaluating	Control	8.60	3.32	0.000	Reject *Ho*	S
	Experimental	11.32	4.24			
Total Score	Control	24.72	8.24	0.000	Reject *Ho*	S
	Experimental	32.86	11.81			

Based on the computations, the p-value of 0.000 was generated which is significantly lower than the 0.05 level of significance. Therefore, the null hypothesis is rejected, and the alternative hypothesis is accepted. This means that there is a significant difference on the performances of the control and experimental groups in terms of comprehension, analyzing and evaluating domains. It is implied that the performance of the students in the experimental group with the use of Self – Designed E – learning Module in Adding and Subtracting of Rational Expressions in Mathematics 8 is better compared to the control group.

Conclusion

Based on the findings of the study, the following conclusions were drawn: (1) The self–designed e–learning module in adding and subtracting of rational expressions in Mathematics 8 featured introduction, adding and subtracting similar rational expression, adding, and subtracting dissimilar rational expression and enrichment. (2) Based on the assessment of the panel of experts, the content, format, presentation, organization, accuracy, and up-to datedness of information of the self– designed e – learning modules derived a very satisfactory rating in all criteria set. The modules were found out to be accurate, well formatted, well presented, organized, accurate and relevant. (3) Based on the students' assessment of the self – designed e – learning module in adding and subtracting of rational expressions in Mathematics 8, as to the content, format, presentation, organization, accuracy, and up-to datedness of

information garnered a very satisfactory rating as perceived by the students. It is implied that the modules are comprehensive, understandable, and suitable to their level. (4) The performance of experimental group after using the self – designed e – learning module in adding and subtracting of rational expressions in Mathematics 8 produced an increase in the mean scores of the tests in terms of comprehension, analyzing and evaluating compared to control group exposed in traditional approach. The Mean Percentage Scores of the control group is Average Mastery (AM) while Moving Towards Mastery (MTM) is recorded in the experimental group after using the self – designed e – learning module. (5) The performance of students in the control and experimental groups differs significantly on the implementation of the self-designed e-learning module in adding and subtracting of rational expressions in Mathematics 8. This implies that the use of self-designed e-learning module improves the performance of the students. The performance of the students in adding and subtracting rational expressions in Grade 8 Mathematics in the control and experimental groups is significantly different based on comprehension, analyzing and evaluating areas. The use of self-designed e-learning modules in teaching the competency of adding and subtracting rational expressions in Grade 8 Mathematics is deemed to be effective.

Based on the findings of the study and the foregoing conclusions, the following recommendations are set forth: (1) The features of the self-designed e learning modules were relevant and responsive to needs of the learners. It is then recommended that the school administrators may help in the replication of the intervention with other departments of the school and the district as well. (2) The self-designed e-learning modules have high ratings based on the assessment of the experts and students. Therefore, the production and operation of the said modules is recommended to enhance further the student's interest and insights towards the subject. Furthermore, quality assurance with the Divisions Learning Resource and Management Section may be undertaken for the material to be published in the Learning Resource Portal for wide utilization. (3) The level of students' performance is differed with the use of self-designed e learning module. It is then recommended that principals may set targets in order to ensure that the teachers have adequate instructional media and internet connectivity so as to further improve the performance of students amidst distance learning modalities. (4) The students should motivate

themselves and learn how to adjust to the teaching approaches of the teachers towards learning mathematics for them to have a better academic performance. They may should be adept with the proper usage of the different learning modalities to improve learning. Responsible use of internet and other social media platforms may also be embodied by them to avoid abuse and misinformation. (5) That the future researchers would continue to conduct research pertaining to the performance and approaches in the field of Mathematics. The results of research and investigation will cater information and data for the school administrators, curriculum planners and resource managers and teachers in planning and developing programs that will be beneficial in the different learning institutions and its clienteles especially in unprecedented situations.

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