The Development of Learning Activity through the KWDL Technique Combined with the Bar Model to Improve Problem-Solving Ability in Math for Secondary 1 (Grade 7) Students

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ABSTRACT
The research entitled The Development of Learning Activity through KWDL Technique Combined with BAR Model to improve problem-solving Ability in Math for Secondary 1 (Grade 7) Students made use of a quasi-experimental design wherein the experimental group was exposed to learning activities through the KWDL technique combined with BAR model while the control group learned through traditional. The sample used in this research was 38 Secondary 1 (Grade 7) students from Rizal National Science High School, Rizal Province, Philippines who studied in the second semester of the academic year 2022 by cluster sampling. The research instruments consisted of 1) learning management plans with learning activities through traditional; 2) learning management plans with learning activities through the KWDL technique combined with the BAR model; 3) problem-solving ability in a Math test. Data analysis included mean, standard deviation, and t-test. The results showed that: 1) the problem-solving ability in Math of Secondary 1 (Grade 7) students after studying learning activities through the KWDL technique combined with the BAR model was higher than before learning at a statistical significance level of .05 level; 2) the problem-solving ability in Math of Secondary 1 (Grade 7) students after studying learning activities through traditional was higher than before learning at a statistical significance level of .05; 3) the problem-solving ability in Math of Secondary 1 (Grade 7) students studying learning activities through KWDL technique combined with BAR model was higher than the learning activities through traditional at statistical significance level of .05.
KEYWORDS: KWDL technique, BAR model, Math problem-solving ability.

INTRODUCTION
Mathematics is a fundamental part of human thought and logic and integral in attempts at understanding the world and ourselves. It provides an effective way to build mental discipline and encourages logical reasoning and mental rigor. Also, mathematical knowledge plays a crucial role in understanding the contents of other subjects such as science, social studies, and even music and art. That is why mathematics should be treated as an important subject in the overall curriculum. It can be traced back to the medieval times when Greeks considered mathematics specifically geometry and algebra to be the two of the seven liberal arts courses. This historical role supported the notion that mathematics has provided the mental discipline required for other disciplines. In addition, mathematics is applied in various fields and disciplines such as science, engineering, economics, electronics, etc. The complexity of those problems often requires relatively sophisticated mathematical concepts and procedures. Mathematics provides foundational knowledge and skills for other subjects which is why in some curricula, mathematics is offered independently to support the study of other school subjects as an instrumental subject combining mathematics and other fields (ICMI, 2008).

Mathematics education usually concentrates on achievement in the cognitive domain. Despite recognizing the importance of mathematics, most of the students perceive the subject as difficult and boring and possess a belief that mathematics is not within their reach and that only people with high intelligence can learn mathematics. Most of the students follow surface learning strategies (Abdul Gafoor & Kurukkan, 2017). The lessons of science and mathematics using a learning management plan of phenomenon-based approach with e-learning media was at the most appropriate level with a total average of 4.77 while the ability to design science and math learning management plan was at a very good level and able to manage learning at a very good level (Samahito, 2020).

A study found that learners feel confident regarding mathematics learning. The majority of the participants expressed positive views regarding mathematics with most expressing that they feel happy to learn mathematics. Their optimism was slightly over-confident when they considered that mathematics rules can never be proven

wrong. Moreover, it was found that the students are enthusiastic in their learning of mathematics. They found mathematics interesting and valuable. It is an interesting, useful, and analytical power-generating subject. Although very few found studying mathematics boring and tough (Akhter and Akhter, 2018). Meanwhile, the Philippines ranked 2nd from the bottom among the participating countries in the recent Programme for International Student Assessment (PISA) 2018. This alarming result revealed that Filipino students recorded a mean score of 353 points in Mathematics Literacy which is significantly lower than the OECD mean of 489 points. Data also showed that there was a decrease of 61 points in 2019 and even scored lowest among 58 countries in 2020. It was also reported that only 1 out of 5 Filipino students or approximately 19.7% attained at least the minimum proficiency level (Level 2) in Mathematics Literacy. However, the 2015 Review Report on the Philippine Education for All on National Achievement Test stated that while the Filipino learner's NAT Mean Percent Score (MPS) has increased over the eight years from 2005 to 2013, it has not yet reached 75 percent MPS target. Elementary level NAT is 6.12% points away from the target; while secondary level NAT is 23.59% points away from the target (Department of Education - National Report of the Philippines, 2019). In addition, the Philippines only scored 297 in mathematics and 249 in science, which are significantly lower than any other participating country. In mathematics, only 19% of Filipino students were on the Low benchmark, which means that they had "some basic mathematical knowledge," while 81% did not even reach this level. They can add, subtract, multiply, and divide one- and two-digit whole numbers. They can solve simple word problems. They have some knowledge of simple fractions and common geometric shapes. Students can read and complete simple bar graphs and tables (Magsimbol, 2020).

Mathematics teachers have a great role to play in the development and enhancement of the student's mathematical skills. After all, in the educative process, teachers are the most important factor contributing to student achievement. It is in this premise that teachers should be able to have mastered effective approaches and strategies in teaching mathematics that can help increase students' mathematical knowledge and skills which is key to improving mathematical outcomes (Ali et al, 2012). This premise is supported by a citation in an article when they said that as educators, teachers face an increasing list of demands and continue to be held accountable for the success of our students. Teachers get tethered down with thoughts of content coverage, state testing, and other accountability challenges. In a sea of responsibilities, teachers must remember why they started this journey because they wanted to make a difference in the lives of their students. The one factor that surfaced as the single most influential component of an effective school is the individual teachers within that school (Cleary, Morgan, Marzano, 2018). Moreover, great teachers can make up for the gaps and shortcomings if they anticipate them and make a plan for success throughout the school year. What teachers need to make the best impact are more training and more planning. Creating good teachers is a process that rarely occurs on their own. They work with good teams and create impactful plans based on data and experience. Not only are teachers not going anywhere anytime soon they are also the answer to getting students back on track with the time and skills they have missed out on (Fronk, 2020). Study after study shows teacher quality is the biggest contributor to academic achievement. The overwhelming factor in student achievement is the effectiveness and quality of the classroom teacher. They are the ones directly responsible for engaging the students in learning. They build a relationship with the student. Without that relationship, students cannot even create interest in coming to school, much less imagine engaging in learning. A quality teacher can make a decided difference in a student's educational career. Effective classroom teachers improve attendance, reduce discipline and solve problems between and among students (Ciurczak, 2018). Many students struggle in mathematics maybe because they find it dull and demotivated in understanding numbers and formulas. They see mathematics as an abstract thing and irrelevant figures that are difficult to comprehend. In this particular scenario should teachers get in and provide intervention so that students may think about mathematics the other way around? Students should be given activities that would help them see how mathematics relates to real-world scenarios to spark their interest in the subject (Akhter and Akhter, 2018). The use of pedagogical strategies that would help students effectively solve word problems and improve their ability should be introduced to them. The choice of the strategy would depend on the teachers. It should be able to elicit the optimum learning achievement desirable to meet the learning competencies designed for the subject (Akhter and Akhter, 2018).

The researchers were compelled to embark on introducing the development of learning activity through the KWDL technique combined with the BAR model as curriculum innovation with the hope that their mixture would help improve the problem-solving ability in mathematics among Secondary 1 (Grade 7) students.

LITERATURE REVIEW

It was found that the learning achievement in mathematics before and after being taught by the mathematics problem-solving packages based on KWDL Technique was statistically significant at the 0.05 level of significance. Also, the learning management in mathematics and problem-solving abilities before and after being taught by the mathematics problem-solving packages based on KWDL Technique were significantly different at the 0.05 level

of significance. The satisfaction of the third-grade students with the mathematics problem-solving skill packages based on the KWDL Technique was at the highest level (Meekhamthong, 2020).

The result of the research showed that the ability in solving mathematical problems of students who study by using collaborative learning along with the KWDL technique was higher than the students who received learning by using traditional method with statistical significance at the level of 0.05 while the collaborative learning skills of students who study by using collaborative learning along with KWDL techniques were higher than students who are learning by traditional method with statistical significance at the level of 0.05 (Suriyachote & Siharak, 2020).

Research showed that (1) the students' reading skills were taught by using the K-W-L strategy in criteria as good. Shown by the mean of the post-test was 86.22, (2) the students' reading skills taught without using the K-W-L strategy in criteria as adequate, and (3) thus, the difference between the students' reading skills taught with and without using K-W-L strategy was significant. It means that the students taught by using the K-W-L strategy were better than the students taught without using the K-W-L strategy. In the same research above, the researcher suggested that to improve the students' reading skills by using the K-W-L strategy, the students have to read a lot of reading texts and try to comprehend the text. For the teacher, it would be better if the teacher can apply the strategies of teaching reading, especially for reading skills as a facilitator, motivator, and administrator (Kusumaningrum & Wahyu, 2018).

Another research findings revealed that after being taught the topic of differential equations via the KWDL technique learning management, over 60% of the participants satisfied the set criteria, at the statistically significant .05 level while the mean score of the satisfaction of the subjects regarding learning management was at a “high” overall level. Also, it was revealed that the students who learned using the KWDL technique showed higher mathematical word-problem-solving ability and higher mathematical retention skills than those who learned using the conventional approach at 0.01 level of significance (Rattanosot, et.al., 2018).

Furthermore, a study revealed that the fifth-grade students’ problem-solving abilities after applying the TGT technique with the bar model method were statistically significant at the level of 0.05 whereas the problem-solving abilities after applying the TGT technique with the bar model method were higher than the 75 % level. 2. The opinion of the fifth-grade student's towards taught TGT technique with the bar model method was at a high agreement level. On the aspects of the learning environment, learning usefulness and learning activities were perceived at a high agreement level respectively (Chaisongkram & Vanichwatanavorachai, 2018).

In another study, it was observed that the efficiency of problem-solving questions of addition, subtraction, multiplication, and division instructional package for fourth-grade students using KWDL and BAR-drawing technique was equivalent to 78.07/77.23, which was higher than the set criterion of 75/75 2. The achievement of the students was found that the scores of the posttest were higher than the pretest at the significant level of .01 3. The satisfaction of students on learning by using problem-solving questions of addition, subtraction, multiplication, and division instructional package for fourth-grade students using KWDL and BAR-drawing technique was ranked at a high level (Khuankawin, 2018).

In addition, it was found that the ability to solve mathematical problems of Primary 3 (Grade 3) students after learning management with the SSCS model together with drawing the BAR model was significantly higher than before learning management at 0.05 level; the ability to solve mathematical problems of Primary 3 (Grade 3) students after learning management by traditional methods was significantly higher than before learning management at 0.05 level, and the ability to solve mathematical problems of Primary 3 (Grade 3) students learning management with the SSCS model together with drawing the BAR model was significantly higher than another group of students learning management by traditional methods at 0.05 level (Piemsuk and Siharak, 2019).

Moreover, the objectives of the study included the student's satisfaction with the learning activities based on the STEM Education and KWDL Technique. The findings showed that the students made a mean score of 37.83 or 75.65% of the full marks on mathematics problem-solving ability, and 32 students or 80.00% of the group passed the prescribed criterion of 70% which is higher than the prescribed criterion while the students as a whole expressed the highest level of satisfaction with the learning activities basing on the STEM Education and KWDL Technique (Butriang and Tanunchaibutra, 2018).

A similar study whose objectives were to compare the learning achievements between students who learned based on the KWDL technique and traditional approach, and to compare the mathematical problem-solving abilities of students between the two groups, found that the efficiencies of learning activities; based on the KWDL technique was 80.78/80.14 and the traditional approach was 78.98/75.7. Also, the effectiveness index of the KWDL lesson plans was 0.5638 whereas the traditional lesson plans were 0.5014 and the students who learned based on KWDL lesson plans had higher post-learning achievements than their counterparts at a .05 level of significance ($p<.05$) (Summart and Viriyapong, 2021). In addition, a study found that the post-test scores of the respondents from the two groups improved in comparison to their pre-test scores. The mean pretest and mean posttest scores of both groups showed significant differences. The results showed that the use of virtual manipulatives in converting fractions to decimals had a significant difference compared with the use of the traditional method. Hence, the use of concrete manipulatives was highly effective (Parungao, 2021).

Indeed, mathematics is a difficult subject because it requires learners an eclectic understanding of its concepts and dynamics. But since mathematics is essential in all curricular programs, students cannot get rid of it and it will continue to haunt them in any level of schooling they are in. That is why the teachers should have a great part in making mathematics education fun, interesting, and easy to motivate the learners to engage in it and in its activities specifically the word problem solving where most of the students fail to succeed.

Developing the learners' problem-solving ability is another issue. This requires the mathematics teachers themselves a wide range of knowledge and skills in the pedagogical field as well as their understanding of the mathematics curriculum and psychological processes and theories related to learning. Their adeptness in these necessary traits in education will enable them to select and use the methods and techniques that will eventually promote effective learning as was asserted by various researchers of the use of the KWDL technique and BAR Model Methods.

The richness of the literature and studies reviewed in this paper enabled the researcher to understand better his proposed research which is The Development of the Learning Activity of KWDL Technique Combined with the BAR Model to Improve Problem-Solving Ability in Math for Secondary 1 (Grade 7) Students.

METHODS

The study was anchored on Jean Piaget's Cognitive Developmental Theory which assumes that learners go through the same sequence of development at different rates. It also explains that a change in the reasoning level of a child happens when acquiring new ways to understand the world. Individuals construct their knowledge during interaction with the environment. The content of instruction needs to be consistent with the developmental level of the learners. Therefore, teachers must provide classroom activities and a variety of experiences for individuals and small groups rather than the total class group. Piaget also emphasizes that teachers should allow opportunities to classify group information to facilitate assimilating new information with prior knowledge to present problems that require logical understanding (Kendra, 2014).

Furthermore, this study also made use of progressivism and constructivism principles of education which both believed that education must be learner-centered. Learners learn best when pursuing their interests and satisfying their own needs. Learners construct knowledge rather than just take information passively. They build their representations and incorporate new information into their prior knowledge.

The development of learning activity through the KWDL technique combined with the BAR model allows the learners to make use of their pre-existing knowledge and use them in the mathematical problem-solving process. This also enables the learners to construct knowledge based on the given information using BAR modeling in presenting and solving the problems.

In addition, this research was undertaken at the Rizal Science National High School in the Province of Rizal, Philippines. The Rizal National Science High School, whose motto is the home of scholars, where excellence is a way of life, first opened in the school year 1998–1999. It was established to provide for a more intensive and advanced secondary education program with special reference to science and technology. The establishment of the Rizal National Science High School was conceived and proposed by Cong. Gilberto M. Duavit of the First District of Rizal envisioned Rizal to be "the knowledge center in Asia" in coordination with the Department of Education, Culture, and Sports (DECS) Division of Rizal.

At present, the Rizal National Science High School firmly stands at its permanent site Jose P. Rizal St., Dalig, Batingan, Binangonan, Rizal Philippines starting June 4, 1999 to continuously serve the community in providing quality education anchored to the Basic Education Curriculum of the Department of Education in the Philippines

and still operates applying their rigorous and competitive admission guidelines and grading system. In addition, the Rizal National Science High School is distinctly unique in its way of becoming the seat of contributing to Science, Technology, Mathematics, and Language Knowledge among its students (RA 8724, Congress of the Philippines).

In response to Rizal National Science High School's vision of creating innovation, this research determined the improved problem-solving ability in mathematics learning management using the KWDL Technique combined with the bar model among Secondary 1 (Grade 7) students of Rizal National Science High School in the Province of Rizal, Philippines. KWDL technique has been widely obsoletely used in Thailand and Asia but the researcher, with the able assistance of his competent research adviser, has thought of mixing the technique with Singapore's BAR model approach. The BAR model method will provide students with a powerful tool for solving word problems. The lasting power of bar modeling is that students can easily use bar model year after year once they have mastered the approach. The approach will lead students down the path toward mathematical articulacy and number sagacity. Moreover, the researcher, in his readings, has not seen nor read any research article or previous works using the KWDL technique combined with the BAR model specifically in the Philippines in Asia. The result of this research is hoped to bring in a new flavor to curriculum innovation not only in the locale where the study was conducted but around the globe.

The population was composed of three (3) sections with 30 students per section divided into two clusters – the first cluster learned on site and the second cluster learned online. However, the researcher selected via simple random sampling technique only two sections which were randomly assigned to an experimental group and a control group. The sample of this research included thirty-eight (38) Secondary 1 (Grade 7) students from Rizal National Science High School in the Province of Rizal, Philippines studying in the education year 2022. The thirty-eight (38) students were divided into two groups who were randomly assigned to an experimental group and a control group with nineteen (19) students per group.

The research instruments consisted of 1) learning management plans with learning activities through traditional; 2) learning management plans with learning activities through the KWDL technique combined with the BAR model; 3) problem-solving ability in a Math test. The learning management plans with learning activities through the KWDL technique combined with the BAR model and the traditional and test questions which were used by the experts and subject specialists in evaluating its content. The Index of Item Objective Congruence (IOC) was at 0.67 indicating that the test questions used were consistent with the objectives and excellent with a Cronbach alpha coefficient of 0.96. The independent variables were the learning management plans with learning activities consisting of two methods such as the Traditional and the KWDL Technique combined with the BAR Model Approach specifically developed for Secondary 1 (Grade 7) students from Rizal National Science High School in the Province of Rizal, Philippines studying in the education year 2022. The thirty-eight (38) students drawn from the population of ninety (90) Secondary 1 (Grade 7) students were divided into two groups and were randomly assigned to an experimental group and a control group with nineteen (19) students per group. While the dependent variable was problem-solving ability in mathematics using the learning activity of the KWDL technique combined with the BAR model have been higher after-study achievement than the before-study KWDL technique combined with the BAR model with a statistical significance of 0.05. The data were analyzed using *Mean*, standard deviation, t-test for dependent samples, and t-test for independent samples as well as Effectiveness Index (EI).

FINDINGS

Table 1: Analysis Results to compare problem-solving ability in Math of the Secondary 1 (Grade 7) students between the before and after learning activities through the KWDL technique combined with the BAR model

Number Student	Before Study	After Study	Increase (D)
1	25	34	9
2	23	33	10
3	27	35	8
4	14	31	17
5	10	28	18
6	22	34	12
7	15	31	16
8	7	34	27
9	15	33	18
10	15	24	9
11	8	28	20
12	9	24	15
13	6	29	23
14	12	33	21
15	15	35	20
16	16	33	17
17	9	34	25
18	8	29	21
19	13	31	18
Mean ($\bar{x}$)	14.16	31.21	17.053
S	6.23	3.392	

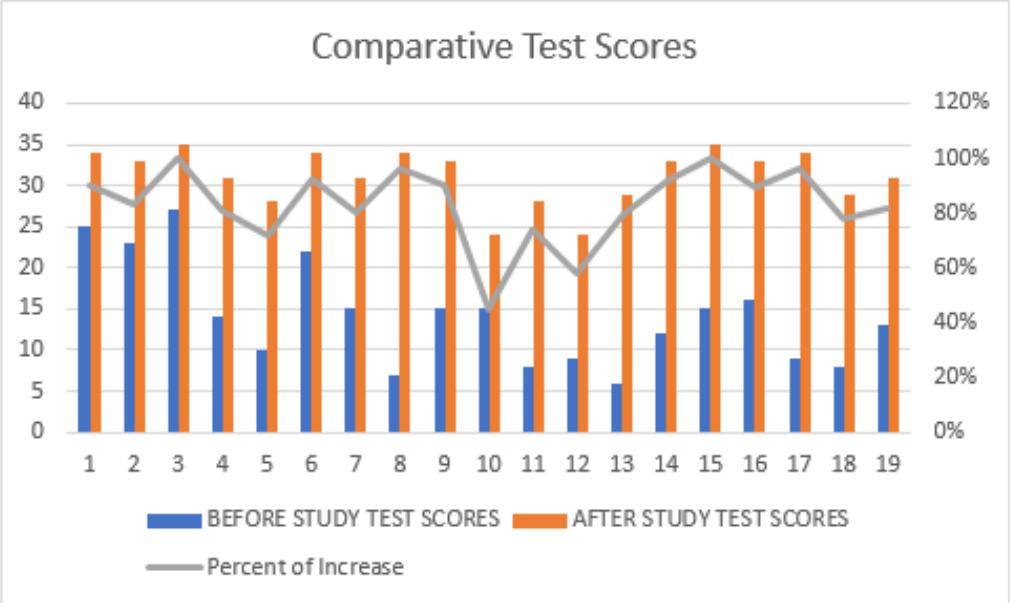

Figure 1 Comparison of the Problem-Solving Ability in Math of the Secondary 1 (Grade 7) Students between the Before and After Learning Activities through the KWDL Technique combined with the BAR Model

From Table 1 and Figure 1, the results revealed that after-study test scores of problem-solving ability in Math of Secondary 1 (Grade 7) students studying learning activities through the KWDL technique combined with the BAR model ($\bar{x}$ = 31.21, s = 3.392) were higher than their before-study test scores ($\bar{x}$ = 14.16, s = 6.23).

This implies that the students performed better in the after-study test as evidenced by a smaller standard deviation compared with the before-study test. In addition, the effectiveness index of 81.82% indicates that after the learning activities through the KWDL technique combined with the BAR model that the researcher has designed excellently, there was an increase of 81.82% in knowledge gained after the intervention. The result was in congruence with the studies conducted by Kusumaninggrum & Wahyu (2018) and Butriang & Tanuchaibutra (2018).

Table 2 Comparison of Problem-Solving Ability in Math Before-Study and After-Study Test Scores of Secondary 1 (Grade 7) Students studying learning activities through the KWDL Technique Combined with BAR Model

KWDL Combined with BAR Model Learning Management	(Number of Units) n	Mean ($\bar{x}$)	Standard Deviation (s)	Computed t-value (t)	Degrees of Freedom (df)	Sig. (p-value)
Before Study	19	14.16	6.230	13.559*	18	0.0000
After Study	19	31.21	3.392			

From Table 2, the results revealed that after-study test scores of problem-solving ability in Math of Secondary 1 (Grade 7) students studying learning activities through the KWDL Technique combined with BAR Model were ($\bar{x}$ = 31.21, s = 3.392) was higher than their before-study test scores ($\bar{x}$ = 14.16, s = 6.230).

Meanwhile, the p-value of 0.000 is less than the 0.05 level of significance which leads the researcher to reject the null hypothesis that the after-study test scores were significantly higher than the before-study test scores of Secondary 1 (Grade 7) Students who learned through KWDL Technique combined with BAR Model.

This only implies that the after-study test scores of problem-solving ability in mathematics of Secondary 1 (Grade 7) students who learned through the KWDL Technique combined with the BAR Model were significantly higher than the before-study test scores at 0.05 level of significance. The result was in congruence with the studies conducted by Chaisongkram & Vanichwatanavorachai (2018); Khuankawin (2018) and Meekhamthong (2020).

Table 3 Analysis Results to compare the before-study and the after-study problem-solving ability in Math of the Secondary 1 (Grade 7) students studying learning activities through traditional

Number Student	Before Study	After Study	Increase (D)
1	11	15	4
2	20	32	12
3	14	22	8
4	12	21	9
5	13	15	2
6	25	30	5
7	10	15	5
8	24	30	6
9	11	19	8
10	8	17	9
11	11	22	11
12	9	17	8
13	16	22	6
14	14	26	12
15	15	22	7
16	20	26	6
17	8	16	8
18	7	16	9
19	11	22	11
Mean ($\bar{x}$)	13.63	21.32	7.68
S	5.262	5.427	

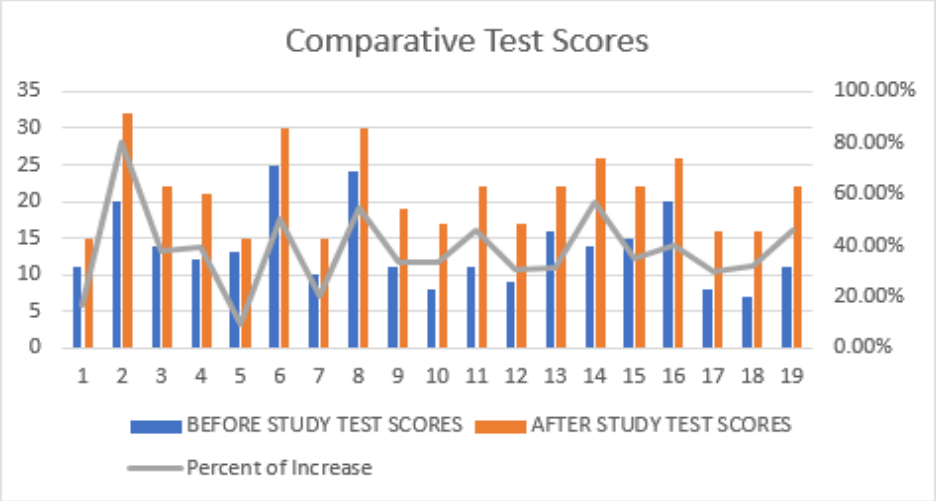

Figure 2 Comparison of the Before-Study and the After-Study Problem Solving Ability in Math of the Secondary 1 (Grade 7) students studying learning activities Traditional

From Table 3 and Figure 2, the results revealed that after-study test scores of problem-solving ability in Math of Secondary 1 (Grade 7) students studying learning activities through traditional ($\bar{x}$ = 21.32, s = 5.427) were higher than their before-study test scores ($\bar{x}$ = 13.63, s = 5.262).

This implies that the students performed better in the after-study test as evidenced by a slightly smaller standard deviation compared with the before-study test. In addition, the effectiveness index of 41.83% indicates that after the learning activities through traditional, there was an increase of 41.83% in knowledge gained.

Table 4 Comparison of Problem-Solving Ability in Math Before-Study and After-Study Test Scores of Secondary 1 (Grade 7) Students studying learning activities traditional

Traditional Learning Management	(Number of Units) n	Mean ($\bar{x}$)	Standard Deviation (s)	Computed t-value (t)	Degrees of Freedom (df)	Sig. (p-value)
Before Study	19	13.63	5.262	12.271*	18	0.000
After Study	19	21.32	5.427			

From Table 4, the results revealed that after-study test scores of problem-solving ability in Math of Secondary 1 (Grade 7) students studying learning activities through traditional were ($\bar{x}$ = 21.32, s = 5.427) higher than their before-study test scores ($\bar{x}$ = 13.63, s = 5.262).

Meanwhile, the p-value of 0.000 is less than the 0.05 level of significance which leads the researcher to reject the null hypothesis that the after-study test scores were significantly higher than the before-study test scores of Secondary 1 (Grade 7) Students studying learning activities through traditional. This only implies that the after-study test scores of problem-solving ability in Math of Secondary 1 (Grade 7) students who received learning by using traditional were significantly higher than the before-study test scores at 0.05 level of significance. The result of this study is in congruence with the findings of Piemsuk and Siharak (2019) who found that the after-learning management was significantly higher than before-learning management among students who learned using the traditional method at 0.05 level of significance.

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Table 5 Compare problem-solving ability in Math of the Secondary 1 (Grade 7) students after learning activities through traditional and KWDL techniques combined with the BAR model

Learning Management	(Number of Units) n	Mean ($\bar{x}$)	Standard Deviation (s)	Computed t-value (t)	Degrees of Freedom (df)	Sig. (p-value)
Traditional	19	21.32	5.427	-6.739*	36	0.000
KWDL Technique Combined with BAR Model	19	31.21	3.392			

From Table 5, the results revealed that after-study test scores of problem-solving ability in Math of Secondary 1 (Grade 7) students studying learning activities through the KWDL Technique combined with BAR Model were ($\bar{x}$ = 31.21, s = 3.392) was higher than the after-study test scores of problem-solving ability in Math of Secondary 1 (Grade 7) students studying learning activities through traditional ($\bar{x}$ = 21.32, s = 5.427).

Meanwhile, the p-value of 0.000 is less than the 0.05 level of significance which leads the researcher to reject the null hypothesis that the after-study test scores of problem-solving ability in Math of Secondary 1 (Grade 7) students studying learning activities through KWDL technique combined with BAR Model were significantly higher than the after-study test scores of problem-solving ability in Math of Secondary 1 (Grade 7) students studying learning activities through traditional.

This only implies that the after-study test scores of problem-solving ability in Math of Secondary 1 (Grade 7) students who learned through the KWDL Technique combined with the BAR Model were significantly higher than the after-study test scores of problem-solving ability in Math of Secondary 1 (Grade 7) students who learned through traditional at 0.05 level of significance. This finding is in accordance with the research results of Summart and Viriyapong (2021); Piemsuk and Siharak (2019); Rattanosot et.al. (2018); Suriyachote & Siharak (2020) and Parungao (2021).

CONCLUSIONS AND EVALUATION

The homogeneity of the experimental units used in the study cannot be denied because in the first place, all share the same characteristics, to name a few, in terms of age, grade level, and academic achievement since they are all honor graduates in their elementary education. However, the samples were divided into two groups – the experimental and the control groups. Both were administered with the same before-study test but were exposed to different techniques or methods using the learning activity designed for each group by the researcher. Hence, there was a randomization procedure that took place and the researcher can now make statistical inferences about the population from which the samples were taken.

The results of the study showed that the intervention using learning activities through the KWDL technique combined with the BAR model had an effectiveness index (EI) of 81.82% indicating an increase in knowledge gained after the intervention. It was revealed also that the two groups performed better in the after-study test as evidenced by the means, standard deviation, and the results of the t-test for two independent samples. Furthermore, it revealed that the after-study test scores of problem-solving ability in Math of Secondary 1 (Grade 7) students studying learning activities through the KWDL technique combined with the BAR Model were significantly higher than the after-study test scores of problem-solving ability in Math of Secondary 1 (Grade 7) students studying learning activities through traditional as evidenced by the p-value of 0.000 statistically tested at 0.05 level of significance. This implies that the use of the KWDL technique combined with the BAR model brings effectiveness and was helpful among Secondary 1 (Grade 7) students.

This is in accordance with the Secondary 1 (Grade 7) students specifically those who learned through KWDL technique combined with the BAR model found enjoyment and were enthusiastically solving problems in mathematics which was observed by the experimenter as well as the appreciation shown by the students on the importance of the subject matter in real life situations. Moreover, students found the use of the KWDL chart and BAR model as an innovation in learning as well as the math teachers. The use of the KWDL chart helped them become conscientious by looking closely into the information details in the given problems while the bar modeling has helped them analyze the problems better giving them visual representations of the details in the word problem to come up with the correct and precise solutions. The same attitude was very apparent on the part of the mathematics teacher who served as the experimenter. She found the learning activity to be a mathematical problem-solving ability-enhancing technique. The novelty that it conveys is sufficient enough to attain the curriculum standards. Both stakeholders became more organized which helped the students learn independently and the teacher teaches diligently. Mutual exchange of knowledge seemingly allowed students to develop new ideas and new concepts and encouraged the teachers to become more innovative and more skillful in the delivery of the subject matter. This finding is in accordance with the research results of Kusumaninggrum & Wahyu (2018) and Butriang & Tanuchaibutra (2018) in their separate studies.

This may mean that the mixture of learning activities like the KWDL and the BAR modeling may probably increase independent learning and motivation to enhance problem-solving ability that will eventually elicit desirable learning outcomes.

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