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The Effectiveness of Know-Want-Learn (KWL) Strategy on Ghanaian Basic Five Pupils' Achievements in Mathematics

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Authors' contributions

This work was carried out in collaboration among all authors. All the authors designed the research and undertook the interventions. Authors PKB and SSYA marked the scripts, collected the data and wrote the first draft of the introduction, including the related literature review of the report. Author AO performed the data analysis, the tabular illustrations and the SPSS analyses. Authors PKB and RA interpreted the SPSS results, performed the discussion of the results/findings, made the various conclusions and wrote the abstract. Author RA edited the whole manuscript and formatted it according to the prescribed format of the Asian Research Journal of Mathematics (ARJM). All the authors did the prove-reading of the manuscript before submission was done. All authors read and approved the final manuscript.

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Abstract

The purpose of the study was to determine the effectiveness of Know-Want-Learn (KWL) strategy in basic five pupils' achievement in finding perimeter and area of plane figures. The study was conducted using a quasi-experimental design. The whole research was conducted at Sogasco Basic School in the South Tungu

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District in the Volta Region of Ghana, and it covered about four-week period. The participants of the study were 81 pupils, divided into two groups, ensuring gender balance: one an experimental group (n = 41) and the other a control group (n = 40). Two achievement tests (pre-test and post-test) were used to collect data for the study. The validity and reliability of the test results were established by using Conbrach Alpha method. SPSS was used to analyze the data. The findings revealed that, at five percent significant level, there were statistically significant differences between the mean scores of the pupils in the experimental and the control groups, in favor of the experimental group in terms of higher performances in the post-test; hence the KWL strategy used in the teaching of mathematics was very effective and had a great positive impact on the pupils' mathematics concept build-up and problem-solving abilities in the basic schools.

Keywords: Know-want-learn; basic school; mathematics; achievements; strategy.

1 Introduction

1.1 Background of the study

Today, many countries are revising their educational curriculum to meet the demand of 21^{st} century students at all levels, and Ghana is no exception. In 2019, the country adopted a standard-based curriculum in all pre-tertiary schools. The standard-based curriculum aims at making learning and teaching more effective to enhance pupils' achievement in various subjects, especially Mathematics. With this curriculum, every pupil is rich with opportunities to study mathematics or perform arithmetic.

The curriculum has emphasized the acquisition of skills in the 4Rs, which are Reading, wRiting, aRithmetic, and cReativity [1]. At every lesson, learners should be equipped with all these skills, especially in arithmetic.

According to Tezer and Cumhur, as in reference [2], Mathematics is a science whose reflection can easily be seen in our lives and can be used to gain meaning in our lives. Cohen, in reference [3], also refer to Mathematics as the 'queen' of the sciences because it gives ideas for extension in science. With all these assertions, one can conclude that Mathematics forms an integral part of our everyday lives, and every national development that is social, political, economical and physical is hanged on Mathematics, as in reference [1]. To easily achieve their goals, quality Mathematics education is paramount. It is a goal to strike in other subject areas. Certainly, one of the most powerful subjects in school curriculums is Mathematics.

According to Aseeri, [4], learning Mathematics requires a great deal of thinking and the use of higher other thinking skills. Also, in reference [3], Cohen opined that our idea of Mathematics depends on how much experience we have in such a subject. The general objective of learning Mathematics and learning at the primary school level in Ghana is to help pupils develop their ability to use mathematical knowledge to solve everyday problems [5]. However, this objective cannot be achieved unless teaching Mathematics at primary school is based on creative approaches through which the learners can be the originator of their knowledge. The term creative approach in teaching became popular in the first decade of the 21^{st} century. It has become a very useful approach in the development of countries' curricula. It is defined as stimulating learners' curiosity and imagination by using imaginative approaches to make learning more effective [6].

According to Owusu-Acheampong and Kwapong, reference [7], Mathematics is one of the most important subjects in Ghanaians' educational curriculum at all pre-tertiary levels of education. Despite its importance, the national assessment results consistently indicate that only a few of our basic school pupils possess the mathematical proficiency needed to access the opportunity that the 21^{st} century offers them. Their report highlighted that low performance depends largely on an educational system that focused on preparing students for passing examinations instead of assisting them to develop their core competencies. Most teachers turn to present concepts using the lecture method. This instructional method turns to ignore the varied uses of mathematics in solving real-life problems. Teachers, according to Abulhul [8], have incredible power through the use of creative instructional strategies to improve the level of students' academic achievement [8].

1.2 Perimeter and area of a plane figure

The term "perimeter" refers to the entire length of a boundary surrounding a two-dimensional shape or plane figure. It represents the total length of the shape's sides. Depending on the unit of measurement used for the sides of the shape, the perimeter is typically expressed in centimeters, meters, or feet. The total amount of space or surface that a two-dimensional shape or plane figure encloses is measured by its area. Measured in square units like square centimeters, square meters, or square feet, it is the size of the area that the shape encloses [9].

Due to their widespread practical use in fields like building, engineering, and design, perimeter and area are both crucial ideas in geometry and mathematics. To measure and calculate the dimensions of various shapes and to design objects that fit into a specific space, it is essential to comprehend these concepts. They are also utilized in daily life for tasks like calculating the area of a garden to determine the amount of mulch or fertilizer needed or measuring the perimeter of a room to determine how much paint or flooring is needed. Areas are significant in many academic fields in addition to being important for practical applications. In mathematics, these concepts are fundamental for geometry, algebra, and calculus and are used to solve complex problems in these areas. For example, the area of a circle is a crucial concept in trigonometry and calculus, as it is used to calculate the volume and surface area of three-dimensional objects such as spheres and cylinders [10].

Applications of perimeter and area can be found in physics, biology, and other academic disciplines like economics. In physics, for example, the area of a shape is used to determine how much energy is needed to complete a task, while the perimeter of a shape can be used to determine how far an object travels in a given amount of time. In biology, area and perimeter are used to calculate the surface area of organs and the length of blood vessels and nerve fibers, respectively. Calculating the size of markets, the distance between competitors, and the number of resources required to produce a given amount of goods are just a few examples of how perimeter and area are used in economics. Understanding real estate and urban planning is also incredibly important because these ideas are used to calculate property sizes and boundaries as well as to create effective, environmentally friendly cities [11].

Along with many other disciplines, such as architecture, landscaping, and surveying, perimeter and area are crucial. For instance, architects need to know the size of rooms and buildings to estimate the amount of building materials needed, just as landscapers need to know the size of a lawn or garden to estimate the amount of fertilizer or mulch needed. To determine the size and shape of the land, surveyors use perimeter and area measurements. This information is crucial for establishing property lines and designing new structures or infrastructure [11,12].

In Ghana, fifth grade pupils' mathematics achievement has alarmed education stakeholders as the level performance of is consistently low. Many teaching strategies have been used to solve this problem, but the results are still not up to expectation [1]. As the KWL strategy has been effectively used in different educational settings worldwide with better results, its impact on the mathematics achievements in Ghanaian Basic education is yet to be thoroughly investigated.

It is in view of this problem that the researchers decided to use the Know-Want-Learn (KWL) strategy on Basic Level Five pupils in Ghana with the aim of enhancing pupils' learning of mathematics by activating their prior knowledge, stimulating their curiosity, and facilitating meaningful engagement with new concepts. This, on the broader perspective, would help in determining the effectiveness of the Know-Want-Learn (KWL) strategy on Ghanaian Basic Five pupils' achievements in mathematics. Hence, assessing whether implementing the KWL strategy would improve the pupils' mathematical concept build-up and problem-solving abilities than the conventional methods or not.

1.3 What is KWL strategy?

The KWL Approach is a metacognition approach designed by Donna Ogle in 1986. She first developed it as an instructional strategy to improve reading comprehension but due to its effectiveness, it was later adopted in all content areas of all subjects. The KWL strategy involves three stages: students identify what they know about a topic, express what they want to learn, and finally, reflect on what they have learned [13].

The new Standard-Based Curriculum (SBC) highlights the use of the KWL approach as the following phrases were used as content standard:

- What you should know already
- What will you learn?
- What skills will you develop?

The main creative approach that the study was based on is KWL Approach.

KWL is an acronym which stands for:
K – What do I know
W – What do I want to know
L – What I have learned.

The approach allows students/pupils to recall their previous knowledge on the topic. Ogle, in reference [13], opined that when students recall what is known, it prompts them to learn about the topic which motivates them. She explained that the main aim of the approach is using KWL charts to elicit students' previous knowledge of the topic. The KWL chart is divided into three main sections. The first column is titled "what do I know", the second column is titled "what I want know" and the last column is what "I have learned". This is as briefly illustrated in Table 1 below.

Table 1. Know-Want-Learn (KWL) chart designed by Donna Ogle in 1986.

	TOPIC:	NAME:
What I Know	**What I Want to Know**	**What I have Learned**

KWL charts can be applied in schools through the following steps:

1. Students brainstorm about what they already know about a topic and write their responses in the first column of the chart;
2. Students brainstorm about what they would like to know about the topic and write their responses in the second column of the chart; and
3. Learning activities and reading.

Before the lesson starts, the teacher introduces and guides pupils to write down what they know about the topic and what they want to know. Then as the lesson continues, pupils write down the new knowledge in the lesson and reflect on whether they have learned anything new.

Students return to the chart and fill in what they have learned in the third column of the chart, paying special attention to the information that is related to what they wanted to know [14].

According to Ogle, Hoffman and Beck, reference [15], KWL stimulates student thinking and reinforces questions. The KWL strategy is designed in such a way as to be suitable to be used by a teacher working together with all pupils in the classroom. It can also be easily transformed into a method for pupils' independent study [13].

1.4 Review of empirical literature

Aseeri, in reference [4], conducted a study on the topic "Effectiveness of Using KWL Strategy in Teaching Mathematics on the Achievement and Motivation of High School Students in Najran City, KSA". The sample consisted of (60) participants who were studying at Yarmouk Secondary School in Najran city, Saudi Arabia. They were all divided into two equal groups, control and experimental, where each group included (30) students. The experimental group was taught by the use of the KWL strategy while the control group was taught through the traditional way. Findings showed that there were statistically significant differences between the mean scores of students in the control and experimental groups in the post-test, and the motivation for achievement scale in favor of students in the experimental group. The differences in better performances favored the experiment group which had lessons using the KWL strategy.

In refefence [16], Usta and Yılmaz [16] conducted a study entitled "Impact of the KWL reading strategy on mathematical problem-solving achievement of primary school 4th graders." to investigate the possible impact of using the KWL reading strategy in teaching the topic "fractions and operations with fractions" to the 4^{th} grade students on problem-solving achievement. A quasi-experimental design with the pre-test-post-test control group (CG) was employed in the study. The study group consisted of 35 grade four students in Bartın, Turkey. The research used an experimental group (EG) and a control group (CG). There were 18 students in the experimental group (EG) and 17 students in the control group (CG). The test of equivalency (TE) and the Problem-Solving Achievement Test (PSAT) were used to gauge the effect of instruction with the KWL strategy. Reading texts were employed as data collection tools. The Wilcoxon Signed Rank Test and Mann-Whitney U Test were employed in the analysis of the data of the research. It was found from the research that the KWL strategy fostered the students' problem-solving achievement. However, there were no significant differences between the EG and CG in terms of the scores received in the step of implementing the plan.

In addition, Sawatpon [17], conducted a research entitled " The Use of the K-W-D-L Technique in the Development of Grade 10 Students' Mathematical Problem-Solving Abilities" with the aim of investigating the effectiveness of the K-W-D-L technique on grade 10 students' mathematical problem-solving abilities and to study the students' attitudes toward learning mathematics after participating in learning management designed, using the K-W-D-L technique. The participants were 40 grade 10 students in a selected public school in Thailand using a purposive sampling method. The instruments were learning management designed using the K-W-D-L technique to teach the fundamental concept of counting in mathematics class, a mathematic problem-solving test, and an attitude survey questionnaire. The data were analyzed using percentage, mean score, standard deviation, single sample t-test, and effectiveness index. The study's findings indicated that the K-W-D-L learning management was effective in developing Thai students' mathematical problem-solving abilities and that the students expressed satisfaction with the method [17].

Finally, Alsalhi [6], conducted a research entitled "The Effects of the Use of the Know-Want-Learn (KWL) Strategy on Fourth Grade Students' Achievement in Science at Primary Stage and Their Attitudes towards it". The study aimed at investigating the effects of KWL strategy in fourth grade students' achievement in science and their attitudes towards using it. He compared the results of different ways of teaching science topics and students' attitudes towards their use. The study was conducted using a quasi-experimental design case study. The sample size of the study was 62 students, divided into two groups, namely an experimental group and a control group, with each numbering 31 students. An achievement test and questionnaire were used to collect the data for the study, and the validity and reliability of the study confirmed as such. SPSS was used to analyze the data. The results revealed that there were statistically significant differences between the experimental and the control groups, in favor of the experimental group's performances. Also, experimental group's attitudes were more positive towards the using of KWL strategy [6].

From the above reviews, KWL is found to be very efficient in teaching mathematics and can be used effectively for students' learning of mathematics.

The improvement of teaching method and introduction of new strategies in teaching and learning activities can play the vital role to increase the average achievement of students in mathematics. It is based on this that the researchers were interested in investigating the effect of using the KWL approach in teaching measurement-perimeter and area of plane figures on basic five pupils of Sogasco Basic School.

It was hoped that by the end of this research, the following questions would be answered.

- How would KWL strategy be employed as a novel method in teaching mathematics?
- Would KWL strategy improve pupils' capacity to relate previously taught material to new information?
- Would KWL strategy highlight teaching methods for mathematics teachers, as required by the standard based curriculum?
- How would the findings of this research help mathematics teachers in their professional practice?
- What recommendations should be made for the corresponding stakeholders?

2 Materials and Methods

2.1 Research design

The study was conducted using quasi-experimental research designs to assess the effectiveness of the KWL approach on pupils' achievement at Sogasco Basic School.

Quasi-experimental research methods are research designs that aim to identify the impact of a particular intervention, program or event (a “treatment”) by comparing treated units (households, groups, villages, schools, firms, etc) to control units. Quasi-experimental research methods are useful for estimating the impact of a program or event for which it is not ethically or logistically feasible to randomize. (Dimewiki-The World Bank, 12 February 2020) [18]. Quasi-experimental research designs test causal hypotheses. Quasi-experimental designs identify a comparison group (control group) that is similar as possible to the treatment group (experimental group) in terms of baseline (pre-intervention) characteristics. The comparison group captures what would have been the outcomes if the program/policy had not been implemented (i.e. counterfactual). Hence, the program/policy could be said to have caused any difference in outcomes between the treatment and comparison groups [19].

In the study, the participants were grouped into two, experimental and control groups.

2.2 Population and sample

The target population was all Ghanaian basic five pupils which was limited to all basic five pupils in the South Tongu District in the Volta Region of Ghana for convenient sake. Also, the pupils of Sogakope Basic School in the South Tongu District were purposely selected for the study for closeness of the school to the corresponding researcher.

The sample size was ninety-four (94) basic five pupils in Sogakope Basic School in the Volta Region of Ghana. The sample was then divided into control group and experimental group with each group consisting forty-seven (47) pupils, ensuring gender balance. However, for lack of puntuality among some pupils, the number of pupils in the control group was reduced to forty (40) and that in the experimental group was also reduced forty-one (41).

2.3 Using the KWL strategy to teach perimeter and area of plane figures

The KWL method was particularly useful during the teaching of plane figures (perimeter and area). This is how the lesson went on:

1. What the pupils knew: The teacher asked the pupils what they already knew about area and perimeter. Examples of plane figures as well as simple definitions, formulas and examples were included. This process enabled the teacher to comprehend each pupils, starting point and spot any misunderstandings or knowledge gaps that required correction.
2. What pupils wanted to learn: The teacher then asked the class what they wanted to learn about area and perimeter. This covered particular subjects, queries they have, or areas where they felt they needed more assistance. Due to their ability to specify their learning objectives, pupils who completed this step felt more engaged and invested in their education.
3. What pupils had learned: The teacher asked the class to briefly review their knowledge of area and perimeter at this stage. This involved brand-new formulas, definitions, or methods for resolving issues. The pupils could review what they had learned and solidified it in this step by reflecting on their learning.

2.4 Instrumentation

Test (pre-test and post-test) was the main data collection instrument used. To ascertain the homogeneity of the participant of control group and experimental group, the pre–tests was conducted on the two groups. The pre-test was administered under strict invigilation for both the control and the experimental groups simultaneously and in correspondence with the Standard-Based Curriculum guidelines, for the purpose of determining whether the achievements of both groups were equal or not. The scripts were then collected and marked using a standardized prepared marking scheme. Each correct answer for each question was awarded 1 mark, making a total of 25 marks. This was then followed by the intervention stage whereby the pupils were taught measurement- perimeter and area of plane figures using the KWL strategy for the experimental group and the conventional method for the control group. A period was 35 minutes and each lesson took two periods per day from Monday to Thursday for two weeks. The post-test was then administered for both groups and the scripts collected and marked under similar conditions as in the case of the pre-test. The whole research work took period of four weeks.

The questions in both achievement tests (pre-test and post-test) were selected from Ministry of Education (MOE)-approved Mathematics textbooks and resource packs. In all, there were 25 multiple choice questions in each achievement test. Through an interview, some colleague teachers were asked to express their opinions about the validity of the test tools. The reliability of the tool was tested for by Cronbach Alpha Method. In reference [20], Tavakol and Dennick stated that a Cronbach Alpha value of 0.80 or greater is good.

2.5 Data collection and analysis

The pupils' pre-test and post-test scores were used as the data for the study. The raw scores were tabulated for each group and compared. The data sets under the pre-test and the post-test were further analyzed numerically using the mean score and standard deviation.

The following null hypotheses (H_0) and alternate hypotheses (H_1) were set and tested for in the study at 5% (0.05) significant level:

i. H_0: There is no significant difference between the mean score of the control group (μ_{1a}) and that of the experimental group (μ_{2a}) in the pre-test.

H_1: There is significant difference between the mean score of the control group (μ_{1a}) and that of the experimental group (μ_{2a}) in the pre-test.

Mathematically, H_0: $\mu_{1a} = \mu_{2a}$;
H_1: $\mu_{1a} \neq \mu_{2a}$.

ii. H_0: The mean score of the control group (μ_{1b}) would be significantly greater than or equal to that of the experimental group (μ_{2b}) in the post-test.

H_1: The mean score of the control group (μ_{1b}) would be significantly less than that of the experimental group (μ_{2b}) in the post-test.

Mathematically, H_0: $\mu_{1b} \geq \mu_{2b}$;
H_1: $\mu_{1b} < \mu_{2b}$.

iii. H_0: There is no significant difference between the mean scores of the pre-test (μ_{1c}) and that of the post-test (μ_{2c}) for the experimental group.

H_1: There is significant difference between the mean scores of the pre-test (μ_{1c}) and that of the post-test (μ_{2c}) for the experimental group.

Mathematically, H_0: $\mu_{1c} = \mu_{2c}$;
H_1: $\mu_{1c} \neq \mu_{2c}$.

The data on the pupils' pre-test scores and post-test scores were analyzed by using t-test from Statistical Package for Social Science (S.P.S.S) to test the hypotheses above. The hypothesis i. would be tested using a two-tailed t-test, hypothesis ii. would be tested using a one-tailed t-test and hypothesis iii. would be tested using a paired t-test. The scores were collated and the corresponding t-values were used to compare the means of the two groups, which would lead to the rejection of the corresponding null hypotheses (H_0) or not, as against the corresponding alternate hypotheses (H_1).

3 Results

From the results of the interview, the validity of the test tools was established by the opinions of some of the colleague teachers. Also, the test on the reliability of the test tool by the Cronbach Alpha Method revealed that the Cronbach Alpha value was 0.821 which is greater than 0.80.

During the conduct of the pre-test, it was observed that the pupils in both groups were found fidgeting as some were trying all possible means to copy from their fellows while some were sitting idle not knowing what to do. Even during the marking, it was revealed that those who were seen doing something were using trial-and-error or any possible means to get the answers.

However, during the conduct of the post-test, it was observed that there was still some kind of fidgeting among the pupils in the control group though not as serious as during the conduct of the pre-test. On the part of the experimental group, every pupil was serious seen writing something. Also, during the marking, it was observe that the pupils in the experimental group presentations were more orderly and accurate than those in the control group.

Table 2. Pre-test and post-test scores for the pupils in the control group

Code	Pre-Test Scores	Post-Test Scores
01	12	8
02	9	7
03	7	7
04	9	8
05	5	9
06	6	7
07	4	8
08	9	9
09	5	7
10	11	15
11	5	6
12	6	9
13	9	10
14	9	10
15	9	9
16	8	4
17	10	8
18	3	6
19	9	13
20	9	7
21	4	9
22	12	6
23	12	14
24	7	8
25	5	9
26	7	9
28	8	9
29	5	8
30	8	8
31	3	9
32	4	3
33	7	13
34	8	12
35	3	6
36	4	8
37	8	13
38	11	14
39	6	8
40	8	4

The pupils' pre-test and post-test scores for control group and experimental group are as shown in Table 2 and Table 3 respectively below. There are three columns in both tables: the first columns are headed by code, which deals with the serial numbers of the pupils; the second columns are headed by pre-test scores and the third columns are headed by post-test scores.

The scores of the pupils in the control group (Table 2) shows the lowest mark in the pre-test was 3, scored by three pupils with codes 18, 31 and 35 while the highest mark was 12, obtained by three pupils with codes 01, 22 and 23. Also, the lowest mark in the post-test was 3, scored by one pupil with code 32 while the highest mark was 15, scored by one pupil with code 10. Moreover, all the forty pupils in the control group scored marks less than 50% (12.5) of the total marks in the pre-test while six pupils (out of forty) scored marks greater than 50% (12.5) of the total marks in the post-test.

In Table 3 (scores of the pupils in the experimental group), the lowest mark in the pre-test was 2, scored by one pupil with code 21 while the highest mark was 14, obtained by a pupil with code 2. Also, the lowest mark in the post-test was 12, scored by one pupil with code 17 while the highest mark was 25, scored by two pupils with codes 02 and 04. Moreover, one out of the forty-one pupils in the experimental group scored a mark greater than 50% (12.5) of the total marks (25) in the pre-test while forty pupils (out of forty-one) scored marks greater than 50% (12.5) of the total marks in the post-test.

Table 3. Pre-test and post-test scores for the pupils in the experimental group

Code	**Pre-Test Scores**	**Post-Test Scores**
01	9	23
02	14	25
03	5	22
04	11	25
05	10	20
06	7	17
07	7	22
08	11	19
09	9	20
10	6	18
11	8	18
12	10	21
13	11	19
14	5	19
15	9	19
16	3	16
17	7	12
18	8	19
19	6	19
20	12	23
21	2	20
22	9	20
23	8	21
24	11	22
25	5	15
26	3	16
28	6	20
29	12	24
30	10	24
31	12	23
32	10	24
33	10	20
34	6	17
35	6	18
36	6	20
37	8	21
38	8	22
39	6	16
40	7	20
41	8	16

The SPSS output for the test of hypotheses i., ii. and iii. are as shown in Table 4, Table 5 and Table 6 below. In Table 4 and Table 5, the control group and the experimental group were coded 1 and 2 respectively under the column headed by group. Table 6 shows the paired t-test results of the pre-test and the post-test scores for the pupils in the experimental group.

From Table 4, the mean scores of the control and the experimental groups were 7.33 and 7.98 respectively. Also, the standard deviations of the control group and the experimental group were 2.586 and 2.706 respectively. This means that the pupils in the control group scores are slightly less dispersed about the mean score than that of the experimental group in the pre-test.

Moreover, the SPSS two-tailed t-test results, shown in Table 4, revealed that the calculated t-value was 1.06, which is less than the table value of 1.9904 at 5% (i.e P=.05) significant level. Hence, we fail to reject the null hypothesis, meaning there is no significant difference between the mean score of the control group (μ_{1a}) and that of the experimental group (μ_{2a}) in the pre-test.

Table 4. SPSS two-tailed t-test output for the pupils' pre-test scores in the control group (1) and the experimental group (2)

SN	Group	No of Sample	Mean	Std. Deviation	t-value calculated	Tabulated t-value
	1	40	7.33	2.586	1.06	1.9904
	2	41	7.98	2.706		

From Table 5 below, the mean scores of the control and the experimental groups were 8.78 and 19.93 respectively. Also, the standard deviations of the control group and the experimental group were 2.757 and 2.902 respectively. This means that the pupils in the control group scores are slightly less dispersed about the mean score than that of the experimental group in the pre-test.

Furthermore, from the one-tailed t-test, the calculated t-value was found to be 17.844, which is greater than the table value of 1.9904 at 5% (0.05) significant level. Hence, we reject the null hypothesis with the implication that there was statistical evidence that the mean score of the control group (μ_{1b}) was less than that of the experimental group (μ_{2b}) in the post-test.

Table 5. SPSS one-tailed t-test output for the pupils' post-test scores in the control group (1) and the experimental group (2)

SN	Group	No of Sample	Mean	Std. Deviation	t-value Calculated	Tabulated t-value
	1	40	8.78	2.757	17.844	1.9904
	2	41	19.93	2.902		

In Table 6 below, the difference between the mean scores of the pupils' pre-tests scores and post-test scores was 11.95, which is positive, meaning the mean score of the pupils' post-test scores was far greater than that of the pupils' pre-test scores . Also, the calculated t-value, which was 30.137, is greater than the table value of 2.0211 at 5% (0.05) significant level. With this, we reject the null hypothesis with the statistical implication that there was a significant difference between the mean of the pre-test scores and that of the post-test scores of the pupils in the experimental group.

Table 6. The paired t-test results of the pre-test and the post-test scores for the pupils in the experimental group

SN	Group	No of Sample	Mean	Std. Deviation	t-value calculated	Tabulated t-value
	Pre-test-post-test	41	11.95	2.539	30.137	2.0211

4 Discussion

The purpose of the study was to investigate the effect of the KWL approach as an instructional strategy to improve pupils' achievement in mathematics, using the topic: Measurement-Perimeter and Area of Plane Figures.

First of all, since the test items in both the pre-test and post-test were set by the standard-based curriculum criteria and from the pupils' textbook, it means the test items are content representive, involve mathematical reasoning, reading comprehension, creativity, etc, as confirmed by some colleague teachers, the validity of the test tools established is accurate. Also, the reliability of the test tools (pre-test and post-test) were established with Cronbach Alpha value of 0.821 is accurate, as this is in line with Tavakol and Dennick (2011) idea that any Cronbach Alpha value of 0.80 or greater is good.

The fact that all the pupils in both the control and the experimental groups were seen fidgeting in different manner during the conduct of the pre-test shows that the pupils lacked the basic knowledge in the solution of measurement (perimeter and area of plane figures) problems. However the reduction in the level of fidgeting among the pupils in the control group and no fidgeting among the pupils in the experimental group, during the conduct of the post-test, shows that the convention method used to teach the pupils in the control group was not effective as the KWL strategy used on the pupils in the experimental group. This assertion was affirmed by the fact that the pupils in the experimental group presentation of work were more orderly than that of those in the control group. This indicate that the usage of KWL strategy had a great positive impact on the pupils' mathematics problem-solving abilities and that the pupils were more cognizant and satisfied with it than that of the conventional method, which is in line with Sawatpon [17] findings, as in reference [17].

Even though the SPSS output for pupils' pre-test scores, as shown in Table 4, indicated that the pupils' mean score for the control group (7.33) was slightly less than that for the experimental group (7.98) by a difference of 0.65, it does not necessarily mean the experimental group performed better than the control group in the pre-test. The same thing applies to the difference in the standard deviation values for the two groups. This is because these are all descriptive statistics and as such it would not be laudable to draw conclusions to cover the target population, as Gordor and Howard [21] asserted in reference [21]. There was the need therefore to consider inferential statistics aspect, the t-test, whereby the calculated t-value = 1.06 was compared with the tabular t-value = 1.9904 at 5% significant level, which showed that there was no significant difference between the mean score of the control group (μ_{1a}) and that of the experimental group (μ_{2a}) in the pre-test despite the difference in values of the mean scores for both groups. This means that, statistically, there was no difference in performances between pupils in the control group and those in the experimental group in the solution of perimeter and area of plane figures problems prior to the introduction of the KWL strategy to the experimental group.

Also, in Table 5, the difference in the mean scores (8.78 and 19.93) of the pupils' post-test scores for the control group and the experimental group respectively was very wide such that the mean score of the pupils' post-test scores for the experimental group was more than twice that of the control group. The standard deviations of the two groups indicated that the pupils in the experiment group post-test scores were more dispersed than those of the control group. However, due to the descriptive nature of these results, conclusion could not be drawn to cover the target population. Hence, considering the t-test, there was statistical evidence that there was the mean score of the control group (μ_{1b}) was significantly less than that of the experimental group (μ_{2b}) in the post-test, meaning that the performances of the pupils in the experimental group, after the introduction of the KWL strategy, was better than that of those in the control group in the post-test, just as in the case of Aseeri (2020) findings in reference [4].

With the paired t-test results (in Table 6), the significant difference of value 11.95 between the mean scores of the pupils' pre-test scores and post-test scores for the experimental group clearly shows that the pupils' performance in solving problems associated with perimeter and area of plane figures increased tremendously after they were taught by using the KWL strategy. It was also observed during the conduct of the post-test that the pupils' fidgeting level had reduced to the barest minimum, unlike the case during the conduct of the pre-test. This is in line with Usta and Yılmaz [16], Sawatpon [17] and Alsalhi [6] findings that the KWL strategy usage contributed to learners' positive attitude towards mathematics problem-solving abilities, as in references [16,17 and 6].

5 Conclusions

It is always important to adapt teaching method that helps to explain material to individual student to learn. KWL is used as an additional approach to teaching mathematics which would have an impact on students' mathematics learning and would help to increase teachers' effectiveness in mathematics classroom.

Since the validity and reliability of the test tools and the results were respectively established, the data collected for the study were adequate and accurate for the analysis; hence the various findings from the research were accurate.

Generally, the data analyses revealed that the KWL strategy was very effective and had a positive impact on the pupils' mathematics concept build-up and problem-solving abilities.

Furthermore, using the KWL strategy helps in increasing the confidence level of the pupils in their mathematics problem-solving abilities at any point in time. The pupils in the experimental group demonstrated gains in achievement and conceptual development of measurement (perimeter and area) of plane figures during the use of the KWL strategy. They also developed more positive attitude towards mathematics in general.

In actual sense, mathematics concept build-up and problem-solving requires ability to reason analytically. With this, the learner must understand and develop a relationship between what is known and to be known, identify the new facts, understand what is required, outline what has been given and needed to analyze the problem in order to arrive at the solution. The use of KWL strategy helps in achieving all these in the process of mathematics concept build-up and problem-solving because during the instructional period using the KWL strategy, the pupils in the experimental group were much enthusiastic in understanding what was going on. Also, during the conduct of the post-test, the pupils showed no fidgeting attitude. However this was not the case on the part of the pupils in the control group. This also indicates that teachers can use the KWL teaching method in their classes to help pupils develop their thinking processes, particularly when solving mathematical problems. Hence, the KWL strategy is very effective in the teaching of mathematics.

Finally, since the KWL strategy is about information processing, planning, execution and revision, it can be used to study other mathematics topics effectively.

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Competing Interests

Authors have declared that no competing interests exist.

References

[1] Ministry of Education (MOE). Annual Report on Education. National Council for Curriculum and Assessment (NaCCA); 2019.
Available:www,nacca,gov.gh

[2] Tezer M, Cumhur M. Mathematics through the 5E instructional model and mathematical modelling: The geometrical objects. EURASIA Journal of Mathematics Science and Technology Education. 2017;13(8): 1305-8223.
DOI: 10.12973/eurasia.2017.00965a

[3] Cohen H. Mathematics today-sprucing up the old queen. Communications of the ACM. 1983;26(12): 1037-1038.

[4] Aseeri MMY. Effectiveness of using KWL strategy in teaching mathematics on the achievement and motivation of high school students in Najran City, KSA. IOSR Journal of Research & Method in Education. 2020;10(3):2320–1959.

[5] Davis EK. Mathematics classroom discourse in typical Ghanaian public school: How does it look like? The Oguaa Educator. 2018;12(2): 1-27.

[6] Alsalhi NR. The effects of the use of the Know-Want-Learn Strategy (KWL) on fourth grade students' achievement in science at primary stage and their attitudes towards it. EURASIA Journal of Mathematics, Science and Technology Education. 2020;16(4):em1833.

[7] Owusu-Acheampong E, Kwapong OATF. Promoting Assessment for learning to ensure access, equity, and improvement in educational outcomes in Ghana. Journal of Interdisciplinary Studies in Education Special Issue: Schooling & Education in Ghana. 2021;2166-2681.
Available:https://ojed.org/jis

[8] Abulhul Z. Teaching strategies for enhancing student's learning. Journal of Practical Studies in Education. 2021; 2(3):1-4.
DOI: https://doi.org/10.46809/jpse.v23.22

[9] Winarti DW, Amin SM, Lukito A, Van Gallen F. Learning the concept of area and perimeter by exploring their relation. Journal on Mathematics Education. 2012;3(1):41-54.

[10] Cass M, Cates D, Smith M, Jackson C. Effects of manipulative instruction on solving area and perimeter problems by students with learning disabilities. Learning disabilities research & practice. 2003;18(2):112-120.

[11] Yeo JKK. Exploring the use of calculators in the Singapore's Primary Mathematics Curriculum. Electronic Journal of Mathematics and Technology. 2008;2(1):73-83.

[12] Milikić MP, Maričić SM, Vulović NR. The GeoGebra software application in the perimeter concept formation in lower grades of elementary school. Zbornik radova Pedagoškog fakulteta, Užice. 2022;24(3):127-140.

[13] Ogle DM. KWL: A teaching model that develops active reading of the expository text. The reading teacher. 1986;39(6):564-570.

[14] Zouhor Z, Bogdanović L, Segedinac M. Effects of the know-want-learn strategy on primary school students' metacognition and physics achievement. Journal of Subject Didactics, 2016;1(1):39-49.
DOI: 10.5281/zenodo.55473

[15] Ogle D, Hoffman J, Beck I. Creating contexts for inquiry: From KWL to PRC2. Knowledge Quest. 2009;38(1):57-74.

[16] Usta N, Yılmaz M. Impact of the KWL reading strategy on mathematical problem-solving achievement of primary school 4th graders. The Journal of Educational Research. 2020;113(5):343-363.
Available:https://doi.org/10.1080/00220671.2020.1830017

[17] Sawatpon N. The use of the K-W-D-L technique in the development of grade 10 students' mathematical problem-solving abilities. Journal of Educational Issues. 2022;8(1):2377-2263.

[18] Available:dimewiki.wordbank.org

[19] White H, Sabarwal S. Quasi-experimental design and methods, methodological briefs: Impact evaluation 8. Florence. UNICEF Office of Research; 2014.

[20] Tavakol M, Dennick R. Making sense of cronbach's alpha. International Journal of Medical Education. 2011;2:53.

[21] Gordor BK, Howard NK. Elements of statistical analysis. Accra, Ghana. The City Printers; 2000.

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