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EXPLORATION OF THE ABILITY OF PRESERVICE MATHEMATICS TEACHERS USING KOLB'S EXPERIENTIAL LEARNING THEORY & LEARNING STYLES

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ABSTRACT

This study explores Kolb's four-phase experiential learning cycle in teaching and learning place value at the university level. The researchers applied a quasi-experimental pretest-posttest design. Forty-two preservice teachers who are currently undergoing education and training at the university were selected as samples. A total of 21 samples received the Kolb model treatment (experimental group), while 21 other samples received the traditional problem-solving treatment (control group). The researchers performed the analysis using the t-test and ANCOVA techniques. The analysis depicts that although Polya's traditional problem-solving and scientific models are widely recognized, Kolb's real-life principles of concrete experience, reflective observation, abstract conceptualization, and active experimentation force educational theories and practices into new directions by focusing on the many different roles. Content analysis on four preservice teachers assignments indicated that Kolb's learning experiences developed critical thinking and problem-solving skills, communication skills, modern technology usage, self-direction, and place value understanding. Thus, teachers are advised to implement Kolb's experiential problem-solving model while bridging the gap of traditional problem-solving strategies.

EKSPLORASI KEMAMPUAN CALON GURU MATEMATIKA MENGGUNAKAN KOLB'S EXPERIENTIAL LEARNING THEORY & LEARNING STYLES

Kata Kunci:

Instruksi pengalaman
Pembelajaran berdasarkan pengalaman
Model Kolb
Nilai tempat
Calon guru

ABSTRAK

Studi ini mengeksplorasi siklus pembelajaran eksperiensial empat fase Kolb dalam pengajaran dan pembelajaran nilai tempat di tingkat Universitas. Desain penelitian yang diterapkan adalah pretest-posttest eksperimen semu dengan sampel 42 calon guru yang sedang menjalani pendidikan dan pelatihan di Universitas. Sebanyak 21 orang menerima model pengalaman Kolb (kelompok eksperimen) sedangkan 21 orang lainnya menerima model pemecahan masalah tradisional (kelompok kontrol). Teknik analisis data yang digunakan adalah uji-t dan analisis ANCOVA. Hasilnya menunjukkan bahwa meskipun pemecahan masalah dan model ilmiah tradisional Polya diakui secara luas, prinsip-prinsip pengalaman nyata Kolb tentang pengalaman konkret, pengamatan reflektif, konseptualisasi abstrak, dan eksperimen aktif mendorong teori dan praktik pendidikan ke arah yang baru dan berfokus pada banyak peran yang dimainkan. Analisis isi dari empat sampel tugas calon guru menunjukkan bahwa pengalaman belajar Kolb mengembangkan berpikir kritis dan keterampilan pemecahan masalah, keterampilan komunikasi, penggunaan teknologi modern, pengarahan diri sendiri, dan pemahaman di masalah nilai tempat. Dengan demikian, disarankan agar guru dapat menggunakan teknik instruksional dengan model pemecahan masalah pengalaman Kolb sambil menjembatani kesenjangan dengan strategi pemecahan masalah tradisional.

1. INTRODUCTION

Explaining the basic concepts of the two approaches to traditional problem-solving adds value to the scientific and Kolb's models in this research. Problem-solving is a mathematical process, and the processes of mathematics are the ways of using the skills creatively in new situations [1] that entail engaging in a task for which the solution process is not identified beforehand [2]. Divides mathematical problems into story or word problems and process problems, where word problems can be solved immediately by selecting and applying one or more operations, whereas solving process problems requires more flexible thinking and better organizational skills [3]. Some of the mathematical processes are logic, reasoning, and communication, enabling us to use the skill in various situations [1]. New problem-solving approaches are emerging to boost and consolidate the original problem-solving model of Polya. One such modern paradigm is teaching for problem-solving, teaching about problem-solving, and teaching via problem-solving [4]. While there are many other problem-solving models, this paper will address Polya's (1945) four-stage and the scientific approach to compare with Kolb's experiential learning model.

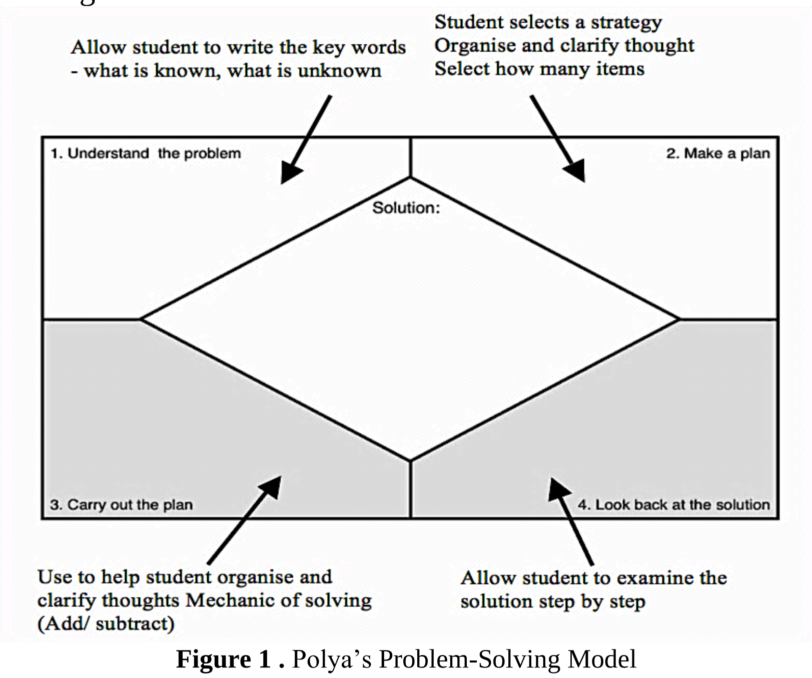

Figure 1 . Polya's Problem-Solving Model

This model was produced by Zollman's graphic organizer embedded with Pólya's Problem-solving Model in 2018, summarizing and dividing the various problem-solving principles into segments for easy understanding. The project was carried out in line with Polya's problem-solving model described in Figure 2. In understanding the problem, the preservice teachers were made to read and show an understanding of the problems in place value to think mathematically. In devising a plan, the preservice teachers set up alternative paths, diagrams, and charts they wished to apply to the problems [5]. In carrying out the plan, the preservice teachers implement their alternative paths or solution strategies on the problems [6]. In looking back at the solution, the preservice teachers check and interpret their solutions.

Even though the problem-solving approach by Polya was novel, one of the primary reasons people have trouble with it is that only some procedures work all the time, and each problem is slightly different. Also, problem-solving requires practical knowledge about the specific situation [7]. These two major impediments affected the smooth transfer of learning. It was therefore imperative to search for a hierarchical model. Even though instructional discoveries have been made, The Scientific Approach is proven to be one of such wonderful discoveries in experiential learning.

Another way of looking at the problem-solving process is called the scientific approach.

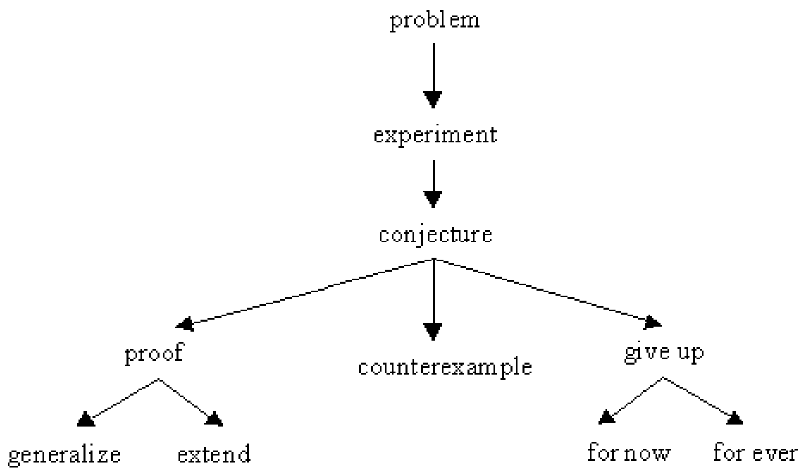

Figure 2. Scientific Problem-Solving Model [1]

This model was produced by the Ministry of Education of New Zealand to help learners begin a problem with an experiment so that when they get stuck, they conjecture for a while before proceeding with a plausible path of action [8]. In Figure 2, the problem is given, and initially, the idea is to experiment or explore to get a sense of how to proceed. Eventually, the solver should be encouraged to make a conjecture or guess the answer. If the conjecture is true it might be possible to prove or justify it. If the conjecture is wrong, it should be possible to give a counterexample to contradict the conjecture. However, if the problem is so hard, it is necessary to give up [1]. The major weakness of this model is that when the problem is too hard and cannot be solved, both the four-stage Polya's and the scientific methods become untenable and inapplicable. We, therefore, require a much more robust problem-solving model, and Kolb's experiential problem-solving model becomes the next best available option to consider.

In the experiential learning model, the conscience of experiential learning can be attributed to John Dewey. In 1938, John Dewy wrote his book Education and Experience to show the intimate and necessary relation between the process of experience and education. Students are believed to be more likely to be motivated and retain what they have learned when actively engaging in a learning experience [6]. Today, experiential learning includes service-based, inquiry-based, and problem-solving [9].

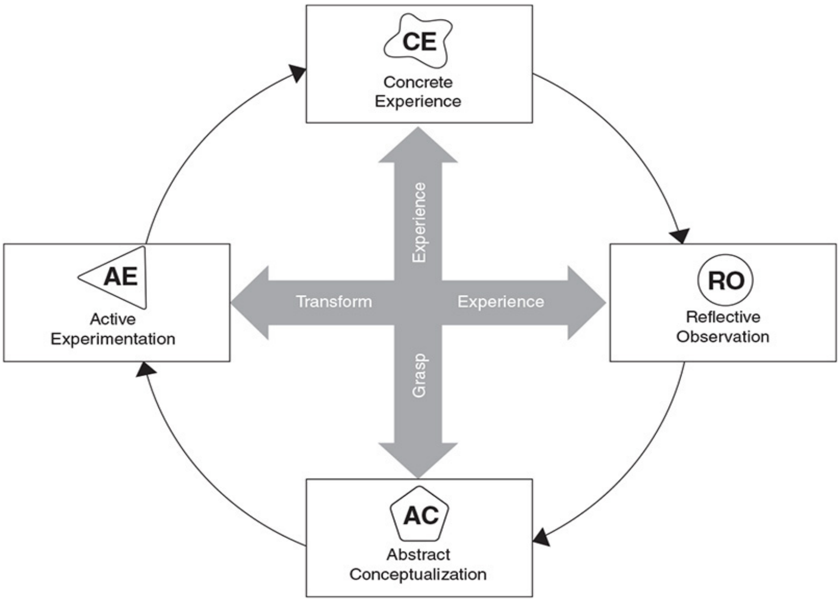

Figure 3. Experiential Learning Cycle [8]

This model was provided by McMullan and Cohoon (1979) to examine Kolb learning or problem-solving as a four-stage process beginning with concrete experiencing, then proceeding through reflective observation to abstract conceptualizing, and finally to active experimentation. This model helps four types of learners, divergers, assimilators, convergers, and accommodators, to take up tasks according to their learning type. From "Integrating Abstract Conceptualizing with Experiential Learning" [10]

In Figure 3, the Concrete experience concerns learning from feelings or reactions to experience, the Reflective observation concerns learning from watching and listening, the Active conceptualization concerns learning from thinking or analyzing problems in a systematic method, and the Active Experimentation concerns learning by doing or being results driven [11]. This paper conceptualized that at the concrete experience phase, the study used the meaning of place. At the reflective observation phase, the study geared activities toward brainstorming and problem-solving relevant to place value. At the abstract conceptualization phase of the study, the researcher presented topics under place value and ensured the relationship between theory and practice with the help of the learning management system. During the active experimentation phase, preservice students implemented their learned knowledge of place value into various experiments.

Experiential learning has many merits, such as developing critical thinking and problem-solving skills, improving effective communication skills, teaching about values and ethical standards, developing the ability to use modern technology, and creating the ability to become self-directed learners. Others are providing an awareness of and concern about the ethical implications of institutional policies and individual practices, giving an expanded awareness of their rights and responsibilities as citizens of a world community, and providing a scope to develop the ability to understand, communicate with respect and live harmoniously in a diverse society. The rest are igniting an understanding of their abilities, interests, and personalities and developing an awareness of the diverse forces that shape their world and themselves to keep pace with the changing society [12].

Opines that the benefits of Kolb‘s discoveries give students new experiences to develop strong observation/reflection skills to solve problems [9]. Research findings of [10] have shown that, in the given context, science teaching methodology is dominated by the acquisition of theoretical knowledge, lacking concrete experience activities and reflections on real-life experience, which are the hallmarks of Kolb's model. Kolb's model is even more useful in the initial teacher training for acquiring theoretical and practical knowledge. Also, in mathematics learning, [11] found out that Kolb's model gives mastery of concepts. Therefore, it was imperative to experiment with this model and compare it with other models in place value to validate its potency, effectiveness, and efficacy in temporary times.

Place value is the measure or worth of each digit in a number. For example, 5 in 350 represents 5 tens, or 50; 5 in 5,006 represents 5 thousand, or 5,000. It is, therefore, important that children understand that while a digit can be the same, its value depends on where it is in the number [13].

Ten Millions	Millions	Hundred Thousands	Ten Thousands	Thousands	Hundreds	Tens	Ones	Decimal point ▼	tenths	hundredths	thousandths
								.			

Figure 4. Place Value Chart

This figure was taken from Ellie Williams (2021) that sought to explain the concepts of place and the value of digits to KS2 children. Enumerates the essence for children to learn the base ten numeration and its importance to other mathematics concepts [13]. Children will likely be taught place value through the base ten numeration system. In the base ten numeration system, each position is occupied by Millions, Hundred Thousands, Ten Thousands, Thousands, Hundreds, Tens, Ones, Tenths, Hundredths, and so on. These are called place values. The place value is subdivided into whole and decimal places. The prefix 'th' denotes the decimal place values [14].

The new curriculum for the bachelor of education program in Ghana's place value is arguably one of the most important areas in the mathematics curriculum in basic education (upper primary option). This group of students is being trained to teach at the pretertiary levels of education in Ghana. The program is a four-year program; every year group has a set of objectives specifically focused on number and place value. The new education program is in its third year, but students have started experiencing low learning outcomes in mathematics, especially on the Number and Algebra strands [15].

As place value continues to exert its importance on number sense and operations of numbers, students at all levels of education require maximum competence to deal with the concepts [16]. Four in seven questions on the 2015 National Assessment of Education Progress relate to place value understandings, with only 40% of fourth-grade students performing at or above the proficient level. To consolidate its learning, research provides its applications in various arithmetic operations. Addition and subtraction are the two basic arithmetic operations allowing students to consolidate their knowledge of place value. To add or subtract, students must be able to regroup or rename. Regrouping is the process of making groups of tens, and renaming is the process of dissolving numbers into tens and ones. These two terms can be used interchangeably since the goal of regrouping, or renaming is to put numbers in their proper place values. This usually takes place in double-digit addition or subtraction. In addition, renaming occurs when the sum of any two addends is ten or more. In subtraction, renaming occurs when the minuend is smaller than the subtrahend (i.e., one has to subtract a bigger digit from a smaller digit) [17].

Similar research has been carried out on differences in problem-solving on place value between Kolb's model and then the traditional models for us to experiment and compare the two learner-centered approaches with place value not done [6], [12], [17] to which model best suits the learning of place value have not been answered in literature [6]. This study seeks to answer the following research questions: (1) What are the differences in problem-solving on place value between Kolb's and traditional models?, (2) To what extent does Kolb's four-step to problem-solving model have a place value?, and (3) How would Kolb's model solve problems in addition and subtraction of whole numbers with renaming?

2. METHOD

The researchers deployed a quasi-experimental pretest-posttest design to sample 42 preservice teachers. This is an experiment in which measurements are taken on individuals before and after they are involved in some treatment. Even though pretest-posttest design can be used in experimental and quasi-experimental research and may or may not include control groups, the researcher opted for quasi-experimental as the preservice teachers were already in their intact groups [18].

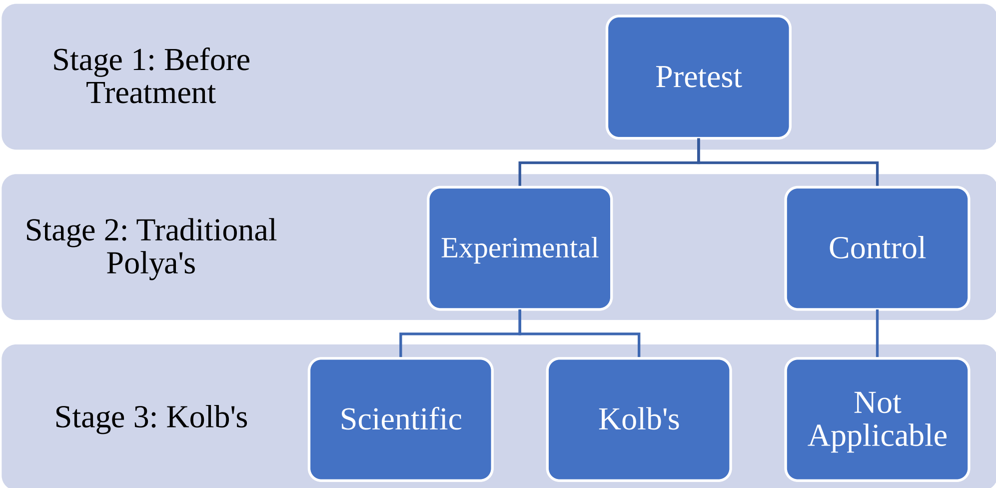

Figure 5. The Quasi-experimental Design

The research first administered a pretest on the traditional problem-solving methods to all 42 preservice teachers and collected the data. These traditional methods, namely Polya's and the scientific method, form part of the recommended topics in the curricula of all teacher education and training universities and colleges in Ghana. In the previous semester, examinations were conducted based on these two traditional models to serve as the pretest scores. After this stage, the researcher divided the class into two equal groups of 21 using students' index numbers. The experimental group received instruction on Kolb's experiential model, and the control group received instruction on traditional problem-solving models. (The division was to ensure that greater attention was paid to every preservice teacher.

In the control group, the researcher took preservice teachers through lessons on both the scientific and Polya models (see Figures 1 and 2). In each stage of the models, the researcher gave tasks on adding and subtracting whole numbers with renaming. Immediately after the demonstrations and tutorials, the researcher conducted a test. In the experimental group, the researcher took the preservice teachers through lessons on Kolb's model (see Figure 3). Again, data was collected from a test. The third stage of the process was to conduct an interview to allow the preservice teachers to talk about their own experiences with the models. This stage followed the same pattern as done for the traditional and Kolb models. The main aim of the interview was to corroborate the experiment's findings.

In the first stage of analyzing the models of Tables 1 and 2, the performance of the preservice teachers in the experimental and control groups was compared using robust statistical t-test and ANCOVA tools. The researcher observed the differences in scores between the traditional models and Kolb's model and the differences in Kolb's four-step model. After the difference tests, the researcher analyzed the interview transcripts with excerpts of students' transcripts. The interview transcripts corroborated the statistical significance in more confirmatory ways.

Several factors could affect internal validity in a pretest-posttest design experiment, including history, maturity, attrition, regression to the mean, and selection bias. However, the main use aim of the pretest and random selection of participants into the two groups minimized many threats, especially history, maturation, statistical regression, and selection and selection bias. All 21 participants in the experimental group stayed in the experiment though [18]. It was observed that random assignment was not possible since the participants were in their intact groups.

There were a number of ethical issues the researcher had to address before, during, and after the research. Before carrying out the study, the researcher obtained permission from the department and the assurance of no conflict of interest in the findings. After this permission, the researcher obtained informed consent from the participants because the research necessitated obtaining the consent and cooperation of the preservice teachers who were the subjects of the experiments. Initially, the researcher ensured acceptance by the preservice teachers before embarking on the task and guaranteed confidentiality. Confidentiality of the information supplied by the participants demanded that the researcher assured participants never to disclose the outcomes of their test performance to anybody [19].

Secondly, the anonymity of the participants required me to use secret identifiers that would not reveal the true identity of each participant in the study. In addition, the researcher ensured privacy by ensuring participants were not disrupted or disturbed during classes or leisure time. In the experiments, the researcher protected participants against harm by ensuring the study would not pose any risks [20].

More importantly, the researcher ensured that the study was essential and would benefit the participants and the larger research community. The quality, integrity, and distribution of the findings have demonstrated this. There is also the aim for responsible publication not just to get promotion but to advance research and scholarship in this learning area. This publication could serve as a mentoring platform to help educate, advise, and mentor students, teacher trainees, and early careers in education research [20].

3. RESULTS AND DISCUSSION

3.1 What are the Differences in Problem-Solving on Place Value Between Kolb's and Traditional Models?

In this research question, the pretest, the posttest scores, and the mean gains on both Kolb's and the traditional models would be used to analyze the results. The mean gains describe the differences in means between the pretest and the posttest scores. In this context, we would interpret any positive mean gain as posttest scores being better than pretest scores and negative mean gains as posttest scores NOT being better than pretest in both Kolb's and traditional models.

Table 1. Preservice Teachers' Performance in Kolb's and Traditional Models

Treatment	Mean score	Pretest score	Posttest score	Mean gain
Kolb's model	Mean	11.56	32.40	20.84
	N	21	21	
	Standard deviation	7.662	8.305	
Traditional models	Mean	10.32	11.30	0.98
	N	21	21	
	Standard deviation	5.738	7.871	

Table 1 presented the mean scores of students exposed to Kolb's model and traditional models. The pretest mean score of the experimental groups is 11.56, and the standard deviation is 7.662. The pretest mean score of the control group is 10.32, and the standard deviation is 5.738. The posttest mean score of the experimental groups is 32.40, and the standard deviation is 8.305. The posttest mean score of the control group is 11.30, and the standard deviation is 7.871. The difference between the mean gain score of students exposed to Kolb's model and traditional models is 19.86.

In Table 1, the results show that Kolb's model had better mean gains than the traditional models in both the pretest and posttest scores. Right so, as the qualities of experiential learning as espoused by [12] far outweigh the qualities of Polya's and Scientific problem-solving methods. The new experiences that students gain in observing and reflecting on experiential learning processes are ample evidence to help students propel themselves to higher heights [19]. Particularly important is the utility of Kolb's model of Science and Technology [12], which is dominated by interconnected theoretical knowledge. Kolb's model is even found to be more useful in the initial teacher training of teachers [16]. The skills it offers to trainees to master found concepts and derive knowledge from real everyday life give credence to its very discovery.

The increases in means from the pretest to the posttest could be attributed to the student's knowledge of place value. There is no gain in re-echoing the fact that the base ten numerations are essential [21]. Even though place value is divided into whole and decimal parts, it aids in learning numbers and their values [14]. This is why many countries, including Ghana, have adopted place value as one of the major areas of education and training to equip their teachers under training so that they can competently handle all other aligned topics to place value. Therefore, it is important to research on time to maintain the new educational reform.

In addition, when it comes to place value, many a student performed abysmally. Students at all levels need help to grasp the concepts of regrouping or renaming. Admittedly, this problem was also revealed in the findings of [17]. That notwithstanding, it is clear that Kolb's model rained higher than the traditional models and must be considered in the teaching and learning of place value. Addition and subtraction with renaming continue to threaten the successful training of teachers competent enough to handle such areas of learning at the pretertiary levels. Research works of [3] and [22] found that students must gain the knowledge and skills to tackle examination problems on place values. Many students needed to group numbers according to the places they occupied. Worst still, many students could regroup the digits in abstract terms but needed to comprehend the concepts when presented with teaching and learning materials. When the pretest was confounded, the results are shown in Table 2.

3.2 Research Question Two: to What Extent does Kolb's Four-Step to the Problem Solving Model have a Place Value?

This research question seeks to delve deep into the potency and effectiveness of Kolb's model by constraining the pretest scores as covariates. Taking the significance level as 5%, the results will be interpreted by p-values. If any p-value is less than 5%, then the model is statistically significant, and Kolb's model is adjudged effective. The closer the significant values are to 0, the more effective the model is.

Table 2. Performance in Kolb's Four-Step Model in Place Value

Source	Type III sums of squares	df	Mean squares	F	Sig.
Corrected model	989.0257a	2	494.512	13.163	.000
Intercept	436.390	1	436.390	11.616	.000
Pretest	949.933	1	949.933	25.286	.000
Treatment	.048	1	.048	.0013	.001
Error	713.774	18	39.654		
Total	24,014.000	21			
Corrected total	1,702.8000	20			

Table 2 showed significant differences in the performance of preservice teachers exposed to Kolb's experiential model in place value. The significant differences in experiential learning were much deeper and more revealing. The student's oral interviews showed that experiential learning was more effective, enjoyable, and fun, as supported by the following transcriptions.

3.3 Research Question Three: How Would Kolb's Model Solve Problems in Addition and Subtraction of Whole Numbers with Renaming?

3.3.1 Sample Transcripts of Kolb's Experiential Model in Place Value

Student 'A': Sample Transcript using Expanded Form

Step 1: Abstract Conceptualization

Using the concept of expanded form to subtract 289 from 764, you first rewrite both numbers using the expanded form. Make sure you line up the numbers correctly by their place value.

Step 2: Active Experimentation

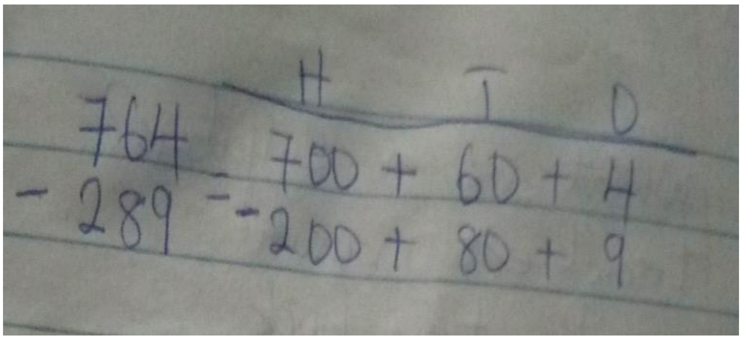

Figure 6. Step 2: Active Experimentation

We are subtracting 289 from 764, So 764 will come first, followed by 289. You then subtract the numbers in each column. First, subtract the numbers in the one's column (4-9). Since 9 cannot be subtracted from 4, you borrow one (1) from the 6 under the tens column. Making the one (1) 10 and making the 60 become 50. You then add the 10 to the 4 making it 14. You now have this.

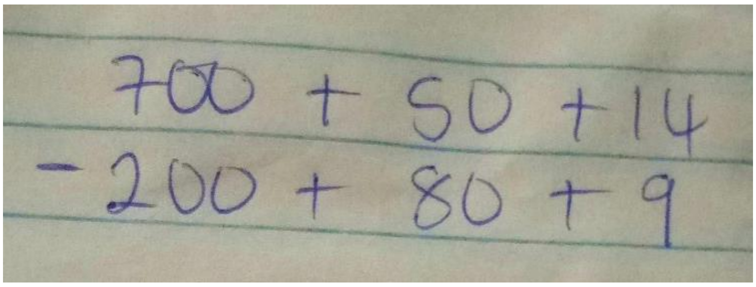

Figure 7. Step 2: Active Experimentation

Step 3: Concrete Experience
You then subtract the 9 from the 14, giving you 5.
You continue subtracting the number in the next column, the tens column. Since 80 cannot be subtracted from 50, you borrow 1 from the 7, which is under the hundred columns making the (1) 100 and reducing the 700 to become 600. You then add the 100 to the 50 in the tens column making it 150. You now have this:

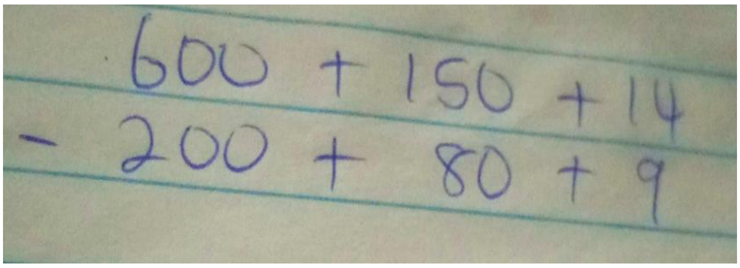

Figure 8. Step 3: Concrete Experience

Step 4: Reflective Observation

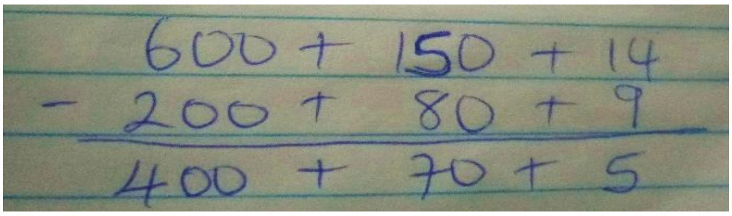

Figure 9. Step 4: Reflective Observation

You subtract the 80 from the 150 in the tens column. Your answer will be 70.
You continue subtracting the numbers in the next column (hundreds column). Which is 600 – 200, which will give you 400. You now have this:

Student 'B': Sample Transcript using Abacus
Step One: Abstract Conceptualization
Many students will understand that subtraction means "takeaway ."Hence using Abacus as a resource material will make students understand the concept of subtraction. The 764 is expanded as 700 + 60 + 4 whiles 289 is expanded as 200 + 80 + 9.

Step Two: Active Experimentation
The students will be briefed on the concept of place value: ones, tens, hundreds, and so on.
In subtraction with expanded form, we will start with "ones" to "tens" and then to hundreds.

To begin with, let's introduce the figures in their expanded form or expanded notation.
764 =700 + 60 + 4 and 289 = 200 + 80 + 9
Step Three: Concrete Experience
Take away 7 ones from 4 ones, which is impossible, so we take 1 ten from 6 tens, which leaves 5 tens. One ten is equal to 10 ones + 4 ones are equal to 14 ones. 14 one’s takeaway 9 ones = 5 ones

	H		T		O
764	= 700	+	50	+	4
289	= 200	+	80	+	9

Step Four: Reflective Observation
Takeaway 8 tens from 5 tens are impossible; therefore, taking 1 hundred from 7 hundreds leaves 6 hundred. That is 100 tens + 50 tens = 150 tens and 150 tens take away 80 tens = 70 tens.
Takeaway 2 hundreds from 6 hundred leaves four hundred, takeaway 8 tens from 15 tens, leave 7 tens, and take away 9 ones from 14 ones leaves 5 ones as shown below:

600	+	150	+	14
- 200	+	-80	+	-9
400	+	70	+	5

Which is Four Hundred and Seventy-Five (475).
Expanded form = 400 + 70 + 5
Therefore, when we use the concept of expanded form to subtract 289 from 764, we will get 475

700	+ 60	+	4
- 200	+ 80	+	9
400	+ 70	+	5

3.3.2 Sample Transcripts of Traditional Models in Place Value

Student ‘C’: Sample Transcript using Expanded Form
Step One: Understand the problem
Guide students to rewrite both numbers using the expanded form. Make sure you line up the number correctly by place value: 700+60+4 and 200+80+9.

Step Two: Devise a plan
Guide students to draw lines to divide the hundreds, tens, and ones: 700|60|4 and 200|80|9

Step Three: Carry out the plan
Guide students to draw the equal sign and operation symbol: 700|60|4 minus 200|80|9
Guide students to subtract each column, regrouping them when necessary: 700|60|4 - (200|80|9)

Step Four: Look back
Guide students to recognize that the answer is in expanded form, so they should rewrite it in standard form: 400+70+5=475

Student ‘D’: Sample Transcript using Expanded Form
Step One: Understand the problem

The expanded form is writing a number to show the place value of each digit. It is shown as the sum of each digit multiplied by its place value (ones, tens, hundreds, and the like).

Step Two: Devise a plan
To teach expanded form to the student, the student should understand the concept of place value because expanded forms use the place value of digits.For example, 764 in expanded form is = 7 x 100 + 6 x 10 + 4 x 1 =700 + 60 + 4.

Step Three: Carry out the Plan
The standard subtraction algorithm is based on our base-ten positional numeration system. When subtracting numbers, place value must be acknowledged. Consider the example of subtracting 21 from 74. The first digit is in the tens place. The second digit is in the one's place. In expanded form, 74 means 7 tens 4 ones, or 70 + 4. So, 74 − 21 can be written in the following ways:

74 = 70 + 4
− 21 = − (20 + 1)
53 = 50 + 3 = 53

The subtraction algorithm consists of subtracting first the ones, then the tens, then the hundreds, and so on, regrouping when necessary. The reason the subtraction algorithm works can be illustrated using the expanded form of the numbers.
Have children consider 52 − 38.

52 5 tens 2 ones 4 tens 12 ones
− 38 → − (3 tens 8 ones) → − (3 tens 8 ones)
→ 1 ten 4 ones = 14

When 52 and 38 are written in expanded form, it can be seen that there are not enough ones in the minuend to subtract the ones in the subtrahend. Therefore, one ten is removed from the tens and added to the ones to create 12. It is now possible to subtract the ones, resulting in 4 ones, and then subtract the tens, resulting in 1 ten. Examining these steps in expanded form makes it easier for children to understand the standard algorithm.
After students are through with subtraction of two digits (in expanded form), task them to find the place values of huge numbers like 17504, 6577, 26779, and the like.
When they are through, the researcher will ask them to subtract 289 from 764 using their knowledge of subtracting two digits.

Step Four: Look Back
After some time, the researcher will allow students to justify or give reasons for their answers. After that, we will solve it together for those who get it to make corrections.
The solution will be in a form like this;764 – 289
Change the digits to expanded form

764 = 7 x 100 + 6 x 10 + 4 x 1 minus 289 or - (2x 100 + 8 x 10 + 9 x 1)
= 700 + 60 + 4 -(200 + 80 + 90)

Now we will regroup the numbers according to their place values like this:
(700 – 200) + (60 – 80) + (4 – 9) = (500) + (-20) + (-5)
We then add the results to get our answer: 500 – 20 – 5
We tackle the negatives: 500 – 25
= 475 → 4 x 100 + 7 x 10 + 5 x 1
→ 400 + 70 + 5

3.3.3 The scientific approach

Identifying the problem

Using expanded form to subtract 289 from 764, a person using the scientific method must first identify the problem is subtraction. It is not just subtraction but subtraction of two three-digit numbers with renaming.

Formulating an experiment

After a problem has been identified within the scientific method, an experiment is carried out. The experiment for this subtraction problem uses the Abacus or the algorithms. The only concern here is to be able to subtract. It does not matter the suitability or appropriateness of the method.

Conjecture

The solution would be to dissolve 289 into 200 + 80 + 9 and 764 into 700 + 60 + 4 to subtract ones, tens, and hundreds. Now it is observed that 9 cannot be subtracted from 4. So, they add one of the 6 tens to 4 ones to get '14' ones. That difference would be whether or not they really understand the concept of place value.

They now subtract 9 from 14 ones to get 5 ones. Another problem is created at tens of 764, and that is 5 tens have been left. They go for one of the hundreds, dissolve it into tens, and obtain '15' tens to subtract. Last, they subtract 6 hundred from two hundred to obtain four hundred. Each of the 4 randomly preservice teachers did the work. The work was collected and analyzed.

Proof, counterexample, and give up

Out of the four, three gave up, and one had proof. The researcher went ahead to analyze the proof. However, it was abundantly clear that the preservice teacher struggled to prove the answer.

Why was it called ‘14’ ones and not one ten, four ones?

Why was it ‘15’ tens and not one hundred, five fives?

These issues still need to be answered! It was therefore clear that using the two traditional models to solve problems in mathematics remains a daunting task for preservice teachers.

4. CONCLUSION

The results in Table 1 show that Kolb's model had better mean gains than the traditional models in both the pretest and posttest scores. Also, the results in Table 2 show significant differences in the performance of preservice teachers exposed to Kolb's experiential model in place value. The four student-teacher interactions with the researcher show that Kolb’s experimental model provides better and more strategic pathways to problem-solving than the normal Polya’s model. Therefore, preservice teachers' experiences in experiential teaching and learning of problem-solving models yielded better and more effective learning outcomes as they adequately developed and transformed the teachers' social, practical, and instructional needs. However, Kolb's experiential model enhanced better performance of preservice teachers exposed to place value than traditional methods. It was also confirmed that the model enhanced better performance of students irrespective of their differences in gender, region, and levels.

To fortify experiential pedagogies, it was generally recommended that mathematics educators refocus and tailor their instructional skills, techniques, strategies, and methods to the experiential problem-solving model while bridging the gaps with the traditional problem-solving strategies. The following recommendations were advanced;

1. The use of Kolb's model should be encouraged during teaching and learning of place value since it enhances the better performance of students irrespective of their gender.
2. Preservice teachers should be exposed to Kolb's problem-solving model during their education and training. Efforts should be made to organize training and re-training programs on Kolb’s model for practicing mathematics teachers.
3. Text-Book authors should endeavor to incorporate Kolb's models of teaching and learning mathematics while writing new editions. This would encourage the use of the models by both teachers and students in teacher education and training institutions.
4. The online learning platforms should be exposed to Kolb's problem-solving model too. Efforts should be made to organize online training and re-training programs on Kolb’s model for practicing mathematics.

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