Effect of Personalisation of Instruction on Students' Motivation to learn Mathematics Word Problems in Nigeria

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Abstract: This study investigated the effect of personalisation of instruction on the motivation to learn mathematics word problems of 450 senior secondary students in Nigeria within the blueprint of quasi-experimental research of Solomon Four non-equivalent control group design. It also examined the influence of gender on motivation to learn mathematics word problems and personalisation was accomplished by incorporating selected information with students' personal preferences into their mathematics word problems. Motivation to learn mathematics word problems was measured by the mathematics word problems motivation questionnaire and data collected for the study were analysed using the independent samples t-test and one way ANOVA. The results showed significant main effect of personalization of instruction on students' motivation to learn mathematics word problems whereas no significant main effect of gender was found on the dependent measure.

Keywords: Personalisation of instruction, motivation, mathematics, gender

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1. Introduction

By 'word problem,' we mean those problems in which mathematical concepts and principles are expressed in everyday plain language, as distinct from purely formal mathematical symbols, signs or terminologies. Word problem is any mathematical exercise where significant background information on the problem is presented as text rather than in mathematical notation (Verschaffel, Greer & De Corte, 2000) and it could be delineated into three structures: the verbal formulation; the underlying mathematical relations and the symbolic mathematical expression. Word problem has its root in realistic mathematics education, a movement popularized in the seventies, when Freudenthal's ideas on mathematics education inspired educators to gradually change the mathematics curriculum (Verschaffel, Greer & De Corte, 2000). Freudenthal (1991) emphasized the idea of mathematics as a human activity, in contrast to the idea of mathematics as a closed system of formal rules, algorithms, and definitions. According to this view, students should be given the opportunity to develop all sorts of mathematical skills and insights independent of the teacher. The starting point for their discovery learning should be context problems in realistic settings, instead of formal rules (Harriet, Monique & Gerard, 2000).

Context in this setting depicts the verbal aspect of word problems, including numerals and does not refer to other modes of problem presentation, such as concrete or pictorial formats or the environment in which a problem is solved (for instance classroom climate) (Wiest, 2002). Mathematical word problems may serve several important functions in the classroom (Akinsola & Awofala 2009; Anzelmo-Skelton, 2006; Bates & Wiest, 2004): (i) It may be a means of bridging the gap between theoretical and abstract mathematics and

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practical ones (ii) Word problems may enhance rich mathematical thinking (iii) Because word problems are easily found, they may make mathematics more interesting and practical (iv) Word problems may give room for application of mathematics to real life situations (v) Word problems may be a common way to train and test understanding of underlying concepts within a descriptive problem, instead of solely testing the students' capability to perform algebraic manipulation or other "mechanical" skills (vi) Knowledge and effectiveness in word problems may be necessary for an individual to function in a literate society. As important as mathematical word problem is, students often find it difficult to learn. Several reasons have been adduced to this (Akinsola & Awofala 2009; Anzelmo-Skelton, 2006; Bates & Wiest, 2004): (i) lack of motivation to solve word problems (ii) students' poor reading and comprehension skills (iii) students' limited experiences in mathematical word problems (iv) students' inability to translate word problems into appropriate numeric format (v) the scarcity of practical options (vi) traditional thinking process which students are used to (vii) lack of linguistic clues that help students to select appropriate arithmetic operation (viii) verbalism, the abundance of sentences, and the length of the problem (ix) problems with extraneous information and (x) dilemmas posed by problem structure.

Numerous research studies have been conducted to investigate the difficulties students experience with mathematical word problems (Akinsola & Awofala, 2008; Akinsola & Awofala, 2009; Anzelmo-Skelton, 2006; Awofala, 2010; Awofala, Balogun & Olagunju, 2011; Bates & Wiest, 2004; Verschaffel, DeCorte & Vierstraete, 1999; Wiest, 2002). These studies have been conducted with students in both primary and secondary school classes and have reported a myriad of successful methods to checkmate mathematical word problem difficulties. Such methods include focusing on keywords in problems, identifying irrelevant information, concentrating on learning style differences and accommodating for these differences, providing direct instruction on specific strategies e.g. problem solving, and personalising mathematical word problems (Anzelmo-Skelton, 2006; Awofala, 2002).

The latter seems more manipulable and personalising mathematical word problem seems to be gaining ground presently. The term personalisation is loaded with many meanings and its use pervades every aspect of human life. In an educational sense, personalisation can be defined as infusing students' experience (both past and present) and interests into the educational content. Akinsola and Awofala (2009) defined personalisation of instruction as an instructional-design strategy in which the instructional context is made more meaningful by allowing learners to transform textual information to contain familiar referents. Awofala (2010) gave the following heuristics of personalisation strategy which differentiate it from the non-personalised one: (i) the personalisation strategy is interest oriented; (ii) use personal referent assessment; (iii) use individual prescription; (iv) allow student choice of problem context; (v) provide meaningful contextual information; and (iv) provide a stimulating study guide.

Many researches on personalisation have been centred on mathematical word problems (Awofala, Balogun & Olagunju, 2011; Akinsola & Awofala 2009; Akinsola & Awofala 2008; Bates & Wiest, 2004) because mathematical word problems are more amenable to personalisation strategy and these studies have revealed the positive effects of this strategy on five major variables in mathematics education: achievement, attitude, motivation, interest and self-efficacy. The effect of personalisation of instruction seems to depend on many factors which include mathematical talent, grade, background, type of problems, type of personalization, and mode of personalisation. While personalisation has been adequately researched into as a testing method in both general and special education classes (Anzelmo-Skelton, 2006; Bates & Wiest, 2004; Hart, 1996; Şimşek & Çakır, 2009), its effect as an instructional strategy in general education classes is not well pronounced (Akinsola & Awofala, 2009).

Previous studies have indicated the positive effects of personalisation on achievement in word problems (Awofala, 2011; Awofala, Balogun & Olagunju, 2011; Akinsola & Awofala, 2009; Akinsola & Awofala 2008), attitudes toward word problem (Awofala, 2010; Awofala, 2014), interest (Awofala, Fatade, & Olaoluwa, 2013; Hart, 1996), motivation (Cordova & Lepper, 1996) and self-efficacy (Akinsola & Awofala, 2009), and other studies did not show any positive effects of personalisation on some of these variables (Bates & Wiest, 2004; Anzelmo-Skelton, 2006; Şimşek & Çakır, 2009).

In particular, Awofala, Balogun and Olagunju (2011) investigated the effects of modes of personalisation of instruction (group, individual, & self-referencing) and non-personalisation of instruction crossed with two levels each of verbal ability and cognitive style as moderator variables on the mathematical word problems achievement of 450 junior secondary Nigerian students of average age of 12 years. Personalisation was accomplished by incorporating selected information with students' personal preferences into their mathematics word problems content on either group basis, individual or self-referencing format. Findings showed that group personalisation; individual personalisation and self-referencing modes enhanced students' achievement in mathematical word problems than the non-personalisation strategy. Akinsola and Awofala (2009) investigated the effect of personalized print-based instruction on the achievement and self-efficacy regarding mathematics word problems of 320 senior secondary year two Nigerian students of average age of 16 years. The moderator effect of gender was also examined on independent variable (personalization) and dependent variables (mathematics word problem achievement and self-efficacy). The results showed that significant differences existed in the mathematics word problem achievement and self-efficacy beliefs of personalized and non-personalized groups in favour of personalised group, male and female personalized groups in favour of male group and male and female non-personalized groups in favour of male group.

In a study by Cordova and Lepper (1996), fourth- and fifth-grade students worked with educational computer activities designed to teach arithmetic and problem-solving skills. Results indicated that personalisation of the learning context produced increased in students' intrinsic motivation and their depth of engagement in learning than the non-personalisation strategy. Lopez and Sullivan (1992) demonstrated how personalisation of mathematics word problems could improve the mathematics (one- and two-step arithmetical operations) achievement and attitudes of 123, rural, Hispanic, seventh graders in Southern Arizona. Participants were blocked by pretest score and gender and assigned to one of three groups: (1) individualised personalisation, (2) group personalisation, and (3) non-personalised. Results showed that both the individualised and group personalisation treatments were significantly higher than the non-personalised version for the two-step mathematics performance and attitudes.

Awofala (2014) investigated the effect of a personalised print-based instruction versus a non-personalised print-based instruction on the attitudes toward mathematics word problems of 350 senior secondary school year one Nigerian students. The results of the data analyses showed that the personalised instruction students had higher levels of self-confidence, liking, usefulness, and motivation but recorded low level of anxiety regarding mathematics word problems compared with the non-personalised group students. While the personalised instruction students were more influenced by the context of the word problem than their non-personalised instruction counterparts, the personalised and non-personalised groups' students did differ on their attitudes toward mathematics word problem as a male domain. Ku and Sullivan (2002) researched the effects of personalisation on 136 fourth grade Taiwanese students and their teachers. The results of their study revealed that students in the personalised treatment made significantly greater pretest-to-post test gains than those in the non-personalised treatment. Both students and teachers using personalised problems showed better attitudes toward the programme than those using non-personalised word problems.

Bates and Wiest (2004) investigated the impact of personalizing mathematical word problems using individual student interests on 42 fourth-grade students' problem-solving performance in which two assessments were created using ten word problems selected randomly from a mathematics textbook. Both assessments contained problems exactly as they appeared in the textbook and problems that were personalized using student interests based on studentcompleted interest inventories. The scores generated were disaggregated to examine the impact of reading ability and problem type on the treatment outcomes. The results showed no significant increase in student achievement when the personalisation treatment was used regardless of student reading ability or word problem type.

Şimşek and Çakır (2009) investigated the effect of personalisation on 60 second-grade students' achievement and gender factor in mathematics education. Results showed that there were no significant differences between learners through personalized or non-personalized materials, and also there were no significant differences between gender through personalized and non-personalized problems. However, opinion of students was highly positive through the personalized problems. Davis-Dorsey, Ross and Morrison (1991) studied the effects of personalizing standard textbook word problems on 68 second-grade students and 59 fifth-grade students. Before the treatment condition, all of the students completed a biographical questionnaire that was used to develop the personalised problems. Findings revealed that personalisation proved to be highly beneficial to the fifth graders, but it did not positively impact the second-grade students' test scores.

As indicated above personalisation can be seen from two angles: personalisation as a testing method (Bates & Wiest, 2004) and personalisation as an instructional strategy (Akinsola & Awofala, 2009). As a testing method, researchers have investigated word problem performance by alternating personalized and non-personalized items on the assessments in which students were made to solve these problems in a regularly schedule class. On the other hand personalisation as an instructional strategy entails creating two parallel instructional packages in which one is personalised to students' interest and preferences and the other is not personalised and contained non-meaningful contextual information thereby creating two different treatment conditions in which the experimental group is assigned the personalised treatment while the control group is assigned the non-personalised treatment in regularly schedule classes. In the personalised instructional strategy students engage in individual learning of the instructional programme on mathematics word problems while in the testing method students solve mathematics word problems either personalised or non-personalised. In addition, while personalisation as a testing method only compares personalised and non-personalised test items solved by students as indicated in the study of Bates and Wiest (2004), in this study students learned through the personalisation treatment and were assessed on motivation to learn mathematics word problems questionnaire to determine any possible positive effects.

The equivocal and inconclusive report about personalisation warrants further scrutiny and it is noted that there is a dearth of literature with respect to the effect of personalisation of instruction on the motivation to learn mathematics word problems. Motivation as an affect variable is considered important in this study for two reasons. Motivation is sometimes seen as indicative of learning outcomes and predictive of future success. Second, the characteristics of many mathematics classrooms appear to facilitate maladaptive patterns of motivation (Ryan & Patrick, 2001; Turner, Meyer, Cox, Logan, DiCintio, & Thomas, 1998) thus, some researchers have been interested in the role of motivation in mathematical problem solving, mathematical thinking or in learning of mathematics in general and in the social interactions in the classroom (Middleton & Spanias, 1999; Seegers & Boekaerts, 1993). Motivation refers to "a student's willingness, need, desire and compulsion to participate in, and be successful in the learning process" (Bomia et al, 1997, p.1). Ames (1992) viewed motivation as part of one's goal structure, one's beliefs about what is important and it determines whether or not one will engage in a given pursuit.

Research indicates that success in mathematics has a powerful influence on the motivation to achieve (Middleton & Spanias, 1999) and motivation contributes to the ability to solve problems (Md.Yunus & Ali, 2009). While student affects such as interest and motivation have been credited to be positively influenced by personalisation used as a testing method, the effect of personalisation as an instructional strategy on the latter variable is yet to be fully studied particularly in Nigeria. The first published work on personalisation in Nigeria is traceable to Akinsola and Awofala (2008). Using personalisation, Hart (1996) notes, "Most students are energized by these problems and are motivated to work on them" (p. 505). It is therefore important for teachers to use approaches that would facilitate students' positive attitudes toward mathematics and hence motivation to learn.

Without the needed motivation to learn mathematics and development of positive attitudes toward the learning of mathematics, students will be ill-prepared to acquire mathematical knowledge and skills needed to function meaningfully and contribute to societal debates with mathematical orientations. It is thus doubtful if such learners can make any substantial contribution to socio-economic growth and development. Students' motivation has implications for their own learning of the mathematics content (Barron, Harackiewicz, & Tauer, 2001; Urdan, Pajares & Lapin, 1997), and mastery of content knowledge affects their performance/achievement in this subject (Ball, Lubienski & Mewborn, 2001; Ma, 1999). This study therefore, investigated the (i) effect of personalization of instruction on students' motivation to learn mathematics word problems and (ii) effect of gender on motivation to learn mathematics word problems. Gender was included as a variable of interest in the present study because of its importance in mathematics education world-wide and more importantly differential findings of gender in previous researches on motivation exist (Anderman & Anderman, 1999, Anderman & Midgley, 1997; Eccles, Wigfield, Harold, & Blumenfeld, 1993; Jacobs, Lanza, Osgood, Eccles, & Wigfield , 2002; Seidman, Allen, Aber, Mitchell & Feinman, 1994; Watt, 2004; Wigfield, Eccles, Mac Iver, Reuman & Midgley, 1991). Boys may be more likely than girls to endorse personal ability goals (Anderman & Midgley, 1997). In terms of social goals, girls endorse relationship and responbility goals more than do boys (Ryan, Hicks & Midgley, 1997), whereas boys endorse status goals more than do girls (Ryan et al., 1997). Anderman and Aderman (1999) found that students' gender was not a significant predictor of their goal orientations in 6th grade. Eccles et al. (1993) found gender differences in self-competence beliefs and subjective task value in favour of boys.

The relation between personalisation and gender is fraught with mixed results. Davis-Dorsey et al (1991) in a study using a variation of the Ross personalisation paradigm found that fifth graders benefitted from personalisation and gender also yielded a significant main effect for fifth graders in favour of females. In an earlier study Lopez (1989) found no significant gender effect in his personalisation of mathematics word problem. This study is at variance to the one conducted by Murphy and Ross (1990) in their investigation whether gender may be a factor in student preferences and in solving mathematics story problems, using an integrated story line between story problems. They found that significant variations on the problem solving and attitude posttests significantly favoured the preferred-gender treatment over the mixed-protagonist group, but neither these groups significantly differed from the non-preferred gender group. Posttest results of problem-solving scores also revealed a gender effect in favour of girls, regardless of protagonist gender. Boys were significantly more likely to choose the masculine story.

In essence, the two null hypotheses formulated and tested in this study at α=.05 level of significance included:

a. There is no significant main effect of treatment on students' motivation to learn mathematics word problems and
b. There is no significant main effect of gender on students' motivation to learn mathematics word problems.

2. Method

This study adopted a Solomon Four Non-equivalent control group design within the blueprint of quasi-experimental research. The design was chosen partly because it was not possible to randomise students to the groups and partly because the unit of sampling a class had already been formed and, therefore, it was unprincipled to re-constitute one randomly. More so, secondary school classes occur as intact groups and school authorities do not normally allow the classes to be pulled to pieces and re-formed for research purposes (Gall, Borg & Gall, 1996). Specifically, the research design is symbolically represented in Figure 1 below.

Group E_1	O_1	X	O_2

Group C_1	O_3	-	O_4
Group E_2		X	O_5

Group C_2		-	O_6

Figure 1. Solomon Four Non-Equivalent Control Group Research Design

In the sequel, O_1 and O_3 were pre-test; O_2, O_4, O_5, O_6 were the post-test; X was the treatment where students were exposed to the personalised programme. The dotted line implied participation of whole groups and the design involved an arbitrary allotment of intact classes to four different groups. Group E_1 was the experimental group and was given the pre-test, the treatment X and the post-test. Group C_1 was the control group which was given the pre-test, followed by the control condition and then the post-test. Group E_2 was given the treatment X and post-test but was not given the pre-test. Group C_2 was given the post-test only because it was a control group. Group C_1 and Group C_2 were given the control condition of non-personalised programme while Groups E_1 and E_2 were given the experimental condition. This design prevented all major threats to internal validity except those connected with interactions of selection and maturation, selection and instrumentation and history. No major event was observed in any of the sampled schools that would have warranted interaction between selection and history. To control for interaction between selection and maturation, the schools were allotted arbitrarily to the control and treatment groups. To control for interaction between selection and instrumentation, the conditions under which the instrument was administered were kept as similar as possible in all the schools (Gall, Borg & Gall, 1996; Shihusa & Keraro, 2009).

2.1. Sampling Procedure and Sample

The target population for this study consisted of all senior secondary school year two (SSS II) mathematics students in Ijebu-Ode and Odogbolu Local Government Areas of Ogun State, Nigeria. The Local Government Areas were selected because of its poor performance in mathematics at the senior secondary certificate examination and motivation of the students towards the learning of mathematics was considered as one possible factor contributing to this low performance. Thirty (30) schools were contacted for use for this study from among forty-two (42) senior secondary schools in the two local government areas. Twenty (20) schools were purposively selected and fifteen (15) of these schools were selected through a simple random sampling technique. Eight schools were randomly assigned as experimental group and seven schools as control group. In all, the sample consisted of 450 students. The average age of learners at this level was 16 years. These students were considered appropriate for this study because previous studies have shown that older children in elementary school benefited greatly from personalisation of mathematics word problem than younger children (Bates & Wiest, 2004; Davis-Dorsey, 1989). This is attributed to the fact that older children possess more developed schemata for processing information in a real-world context (Awofala, 2010). Table 1 below showed the distribution of the students in the four group of the design.

Table 1. Distribution of students in the four group of the design by gender

Treatment Group	**Gender**	**N**
Experimental group I	Male	55
	Female	56
	Total	111
Control group I	Male	56
	Female	57
	Total	113
Experimental group II	Male	57
	Female	57
	Total	114
Control group II	Male	56
	Female	56
	Total	112

2.2. Research Instruments

For the purpose of data collection, the following instruments were used for the study:

(i) Mathematics Word Problem Motivation Questionnaire (MWPMQ)
(ii) Students' Personal Interest Inventory (SPII)
(iii) Instructional Programme on Mathematics Word Problems (IPMWP)

2.2.1. Mathematics Word Problems Motivation Questionnaire (MWPMQ)

The MWPMQ was adapted from Glynn and Koballa's (2006) Science Motivation Questionnaire (SMQ) with some modifications to reflect motivation towards learning of mathematics word problems. It had a total of thirty items constructed on a five point Likert Scale. The elements in measuring motivation were intrinsic motivation, extrinsic motivation, relevance, self-determination, self-efficacy, and assessment anxiety. Each of the elements of MWPMQ contained five items. The maximum score of the MWPMQ was 150 and the minimum 30. The questionnaire was validated by two experienced mathematics teachers and two mathematics educators. The MWPMQ was pilot tested in one secondary school in Odogbolu Local Government Area of Ogun State, Nigeria with 40 students. The Cronbach's Alpha analysis showed that the reliability for the MWPMQ was high (r = 0.88). A brief description of items which make up each of the six specific components of motivation is described in the sequel (Table 2).

Table 2. Components of motivation

Component of Motivation	Sample Item
Intrinsic motivation	The mathematics word problem I learn is more important to me than the grade I receive.
Extrinsic motivation	I like to do better than the other students on the mathematics word problem tests.
Relevance	I think about how I will use the mathematics word problem I learn.
Self-determination	I put enough effort into learning the mathematics word problem.
Self-efficacy	I am confident I will do well on the mathematics word problem tests.
Anxiety	I am nervous about how I will do on the mathematics word problem tests.

2.2.2. Students' Personal Interest Inventory (SPII)

This instrument was designed to determine the personal background and preferences of the participants. The inventory items included student's name, something to shop for, favourite food, names of friend, name of a game, favourite type of vehicle, sports and so forth. The 18-item survey was in open-ended form so that students wrote in their answer for each item and this was used to personalise the original word problems based on the most common interests and preferences of all subjects in the treatment rather than for each individual based on that individual's interest and preferences. The frequency choice on any of the items was calculated and the percentage found. Table 3 below showed the sample analysis of participants' response to personal interest inventory by frequency count and percentage.

Table 3. Sample analysis of participants' response to personal interest inventory by frequency count and percentage

Item category	Choice of item	Frequency count	Percentage
Food and drink	Maltina	380	84.4
	Fried Rice	409	88.9
	Chicken pie	356	79.1
	Milo	390	86.7
	Meat pie	426	94.7
Music, game and sport	Fuji	420	93.3
	Football	436	96.9
	Boxing	420	93.3
House material, Vehicle and profession	Television	420	93.3
	Nokia phone	386	85.8
	Mazda 626	386	85.8
	Lawyer	356	79.1
Name of place, friend and institution	Ijebu Ode	300	66.7
	Zenith Bank	319	70.9
	Mr Biggs	319	70.9
	Ade	318	70.7
	TASUED	420	93.3

2.2.3. Instructional programme on Mathematics Word Problems (IPMWP)

Two parallel versions of an instructional programme on arithmetic and algebraic word problems were developed in print form in English. One example each of arithmetic word problem and algebraic word problem follow:

Example 1 (arithmetic). Find the rate of simple interest in per cent per annum at which ₦142 will amount to ₦295.36 in 12 years.

Example 2 (algebraic). Segun sold a Nokia phone for ₦1200 and made 20% profit. How much should Segun sell the phone to make a profit of 25%?

The two versions of the instructional programme used in this study were in a similar format to those enacted in the Awofala (2010) study covering the same instructional objectives. The problems were tailored along the senior secondary year two mathematics textbooks used by the participants. Both versions were paper-based because, as in the case generally in Nigeria, not enough computers were available at the school at the time to deliver the instruction by computer. Also, both versions required the same computational skills and numbers but the problem context differed. The non-personalised version was written first and provided only minimal, non-meaningful contextual information as obtained in the students' mathematics textbooks. The personalised version provided familiar, relevant problem contexts and was written by incorporating the most popular referents (places, foods, sports, etc) from the students' personal interest inventory. One example each of word problem in their personalised context and non-personalised context forms follow:

Example 1
Personalised context: TASUED deposited a certain sum of money in Ijebu-Ode branch of Zenith Bank on two different occasions, each time equal amount. TASUED withdrew ₦500.00 from the deposit and still had ₦1825 left. How much did TASUED deposit in Zenith Bank?

Example 2
Non-personalized context: A certain sum of money is deposited in a bank on two different occasions, each time equal amount. After taking ₦500.00 out of the deposit, I still have ₦1825 left. How much was deposited in the bank?

A major distinction between examples 1 and 2 is that in example 1, the context of the word problem is derived from the students' repertoire of familiar experiences and preferences while in the example 2, the context of the word problem is non-familiar because none of the students chose the preferences used in the formulation of the word problem. It is noted that problem context is relative and as used here refers to the familiarity/non-familiarity of the word problem to students' experience and interest (Awofala, 2014).

It should be noted that the PII in itself is only one aspect of creating motivating tasks. For example, very often, the curiosity for the mystery of something unknown could be source of motivation in a problem. The personalised instructional programme was based on the Instructional Development Model (Gustafson, 1995) which has three phases: Define, Develop, and Evaluate in its development and implementation. The personalised version followed the heuristics given by Awofala (2010) which are (i) interest oriented; (ii) use personal referent assessment; (iii) use individual prescription; (iv) allow student choice of problem context; (v) provide meaningful contextual information; and (iv) provide a stimulating study guide. The instructional programme also covered procedures for solving word problems. A Polya's (1945/1973) four-part strategy was incorporated into the instructional programme for both personalised and non-personalised treatments.

(a) Understanding the Problem
(b) Devising a Plan
(c) Carrying out the Plan
(d) Looking Back

Understanding involved asking questions and identifying what needed to be found or learned and what information was available. Planning required reflecting about alternative methods for tackling the problem at hand, while carrying out the plan involved the appropriate selection and implementation of one or more of the alternatives considered. Looking back emphasised reflection in the form of ways to check and validate answers and methods, and verifying whether or not the solution tackles the problem.

Sample personalised version of the instructional programme

Problem 1. A Mazda 626 filled with Milo travels 132km from Ijebu Ode in 1¼ hours. Calculate the speed of the car.

Solution

1. Understanding the Problem: In this step the learner is encouraged to find the unknown, gather the data and separate the data into parts.The learner is encouraged to answer the following questions:

(i) What is the distance traveled by the car?
(ii) For how many hours did the car travel?
(iii) What is the speed of the car?

2. Devising a Plan

(i) The car travels 132km and uses 1¼ hours

(ii) $\text{Speed} = \dfrac{\text{distance traveled}}{\text{time taken}}$ i.e., S= D/T

Solve for S.

3. Carrying out the Plan: In the 'solve' step, the students will perform the mathematical computations necessary to determine an answer.

Speed = D/T

= 132km / 1¼

$= \dfrac{132\text{km} \times 4}{5\text{h}}$

Speed =105.6 km/h. Thus, the speed of the car is 105.6km/h

4. Looking Back: Examine the solution obtained: In this step, the students are encouraged to check the result, think of other methods to solve the same problem and decide if the strategy could be used for other problems.

Distance traveled= speed × time taken

=105.6km/h× 1¼ h

=105."6km/h × 5/4 h

=132km.

Sample non-personalised version of the instructional programme
Problem 2. A car travels 132km in 1¼. Calculate the speed of the car.

Solution

1. Understanding the Problem: In this step the learner is encouraged to find the unknown, gather the data and separate the data into parts.The learner is encouraged to answer the following questions:

(i) What is the distance traveled by the car?
(ii) For how many hours did the car travel?
(iii) What is the speed of the car?

2. Devising a Plan

(i) The car travels 132km and uses 1¼ hours
(ii) Speed = $\frac{\text{distance traveled}}{\text{time taken}}$ i.e., S= D/T

Solve for S.

3. Carrying out the Plan: In the 'solve' step, the students will perform the mathematical computations necessary to determine an answer.

Speed = D/T
= 132km / 1¼
$= \frac{132\text{km} \times 4}{5\text{h}}$
=105.6 km/h

The speed of the car is 105.6km/h

4. Looking Back: Examine the solution obtained: In this step, the students are encouraged to check the result, think of other methods to solve the same problem and decide if the strategy could be used for other problems.

Distance traveled= speed × time taken
=105.6km/h× 1¼ h
=105.6km/h × 5/4 h
=132km.

Instruction on the strategy for solving the word problems contained the rule and its application with appropriate examples and practice problems were provided. Answers to all problems were provided at the end of the instructional programme to enable self-checking. A review was provided after the completion of the practice problems by the students. The review contained a summary of the procedures for solving the problems. The two versions of the instructional programme were given to three English Educators and four Mathematics Educators in Tertiary Institutions for assessment in terms of:

(a) Language clarity to target population
(b) Content coverage
(c) Relevance to stated objectives.

Some changes connected to grammatical errors (e.g. 'was' changed to 'were') in the personalised version were made by the English Educators while the Mathematics Educators made changes in connection to typographical errors in the solutions of the word problems in both versions of the instructional programme. Thus, all the experts' opinions were incorporated into the final versions of the instructional programme before its implementation in the classrooms.

2.3. Procedure

The study was carried out in four weeks and it involved fifteen classrooms with a teacher and a research assistant in each class. So, a total of 15 mathematics teachers and 15 research assistants were recruited for the study. During the first week, students responded to two instruments i.e. Personal Interest Inventory (PII) and Mathematics Word Problems Motivation Questionnaire (MWPMQ) as pretest, second week was utilized to develop the personalized versions of the instructional programme on mathematics word problems using the students' Personal Interest Inventory. In the first day of third week, schools were arbitrarily allotted to one of two treatment conditions: personalisation and non-personalisation and participants were given lectures on the study's purpose, procedures and lesson materials. In the second day the treatment started and participants in each intact class were given their corresponding version materials for studying independently for four consecutive days during a single 40-minutes class period. The option of a longer treatment was not considered because the authors were of the opinion that the content areas for the study could be learnt within the small treatment period. The participants were involved in individualised learning of the instructional programme. During the lesson, teachers and research assistants acted as a medium for management and control. So no teaching was carried out in any of the fifteen classes because the participants were to learn the instructional programme on their own. The teachers and the research assistants helped in the administration of the two versions of the instructional programme to the respective participants. They also helped in the administration of MWPMQ as pretest and posttest. The last week was used for administration of MWPMQ as posttest. All the participants that studied the personalised version and received pre-test and post-test were classified as Experimental group I (n =111), those that studied the non-personalised version and received pre-test and post-test, Control group I (n =113) while those participants that studied the personalised version and received only post-test were regarded as Experimental group II (n =114). The Control group II (n =112) studied the non- personalised version and received only post-test.

2.4. Data Analysis

In this study, the multiple Likert statement responses to the mathematics word problems motivation questionnaire were summed together and this allowed the use of parametric tests in that all items used the same Likert scale, a defendable approximation to an interval scale (i.e. coding indicates, magnitude of difference between items, but there is no absolute zero point), and all items measured a single latent variable (i.e. a variable that is not directly observed, but rather inferred from other variables that are observed and directly measured). The results of the histogram display normal curve conducted indicated that the dependent measure was normally distributed across treatment conditions. Also, the non-significant F test from Levene's statistic was the sign of homogeneity of variance ($p>0.05$). The normality of the data showed that parametric statistic could be adopted. The descriptive statistics of mean and standard deviation were employed as precursors to adopting the inferential statistics of one-way Analysis of Variance (ANOVA), paired samples t-test and independent samples t-test. ANOVA was used to determine if the four groups differed significantly among themselves on experimental variable. An independent samples t-test was used to test differences in the pre-treatment (post-treatment) mean scores on the dependent measure between the experimental and control groups (male and female participants) because of its superior quality in detecting differences between two groups. A paired samples t-test was used to test differences in the pre-treatment and post-treatment mean scores for E_1 and C_1 separately.

3. Findings

In this section, findings are presented based on the null hypotheses formulated for the study. At the beginning of this study the assumption was that the two groups to be used in the study were homogenous. The author therefore sought the homogeneity of the groups in terms of their responses to the pre-treatment questionnaire and not regards to groups' achievement levels or mathematical talent or grades before the application of the treatment procedure (Wiersma & Jurs, 2005). A pre-treatment questionnaire on mathematics word problems motivation was administered on two groups. The groups were experimental group (E_1) and the control group (C_1). Table 4 below showed that the mean for group E_1 was 84.12 while that of group C_1 was 83.79. Thus, the level of motivation between groups $E_1$and C_1 was not significantly different [$t (222) = 0.75$, $p>.05$]. Hence, the groups used in this study showed similar features and were therefore found to be relevant for the study.

Table 4. Independent samples t-test results of the pre-treatment scores on MWPMQ by pre-treatment groups

Group	N	Mean	SD	Df	t-value	p-value
E_1	111	84.12	4.72	222	0.75	.30
C_1	113	83.79	4.22			

The results in Table 5 below showed that the mean score for male students was 85.29 while that of their female counterparts was 84.69. The t-value was 1.27 and this showed that a statistically non-significant difference existed in mathematics word problems motivation between the male and female participants. The non-significant difference in mean scores for both the pre-treatment groups and gender necessitated the use of ANOVA to analyze the difference among the four groups on the post-treatment score on MWPMQ.

Table 5. Independent samples t-test results of the pre-treatment scores on MWPMQ by gender

Gender	N	Mean	SD	Df	t-value	p-value
Male	111	85.29	5.01	222	1.27	.15
Female	113	84.69	4.94			

The MWPMQ mean scores of students from the four groups were compared using one way ANOVA. As contained in Table 6 below, the post-treatment mean scores on MWPMQ for the four groups were not the same. Groups E_1 and E_2 had mean scores of 94.61 and 93.79 in that order while Groups C_1 and C_2 had mean scores of 84.89 and 85.68 respectively.

Table 6. Post-treatment mean scores on MWPMQ of students in the four groups

Group	N	Mean	SD
E_1	111	94.61	5.71
C_1	113	84.89	4.82
E_2	114	93.79	5.21
C_2	112	85.68	4.31
Total	450	89.74	5.01

One way ANOVA was carried out in order to find out whether these means were significantly not the same. The results are shown in Table 7 below.

Table 7. ANOVA results of the post-treatment scores on MWPMQ in the four groups

Source of variance	Sum of Square	Df	Mean Square	F	Sig.
Between groups	2435.01	3	811.67	247.76	0.00*
Within groups	1461.09	446	3.28		
Total	3896.10	449			

*Significant at p<.05 level

Table 7 showed that the difference in the mean scores among the four groups were significant [$F_{(3,446)} = 247.76$, $p<.05$]. After establishing that there was a significant difference between students on personalised instruction and those on non-personalised instruction, it was pertinent to confirm further the direction of the difference. This was accomplished via post hoc tests of multiple comparisons using Tukey's Honesty Significance Difference (HSD) test (Montgomery, 2013). This test was considered suitable in this study because there are a large number of groups being compared and that the test helps in reducing the chances of a Type I error occurring by detecting differences between groups. The results indicated that the differences in the mean scores of groups E_1 and C_1 groups E_1 and C_2, groups E_2 and C_1 and groups E_2 and C_2 were statistically significant ($p<.05$).

A paired samples t-test was conducted between pre-E_1 and post-E_1 in order to determine its significance. Table 8 below showed that the pre-treatment mean score for group E_1 was 84.12 and the post-treatment mean score for group E_1 was 94.61. Thus, the difference in mean score of (10.49) between the post-treatment and pre-treatment mean scores for E_1 was statistically significant [t (110) = 14.92, $p<.05$].

Table 8. Paired samples t-test results between the pre-treatment scores and post-treatment scores on MWPMQ by experimental group I

Group	N	Mean	SD	Df	t-value	p-value
Pre-E_1	111	84.12	4.72	110	14.92	0.00*
Post-E_1	111	94.61	5.71			

*Significant at p<.05 level

In addition, a paired samples t-test was conducted between pre-C_1 and post-C_1 in order to determine its significance. Table 9 below showed that the pre-treatment mean score for group C_1 was 83.79 and the post-treatment mean score for group C_1 was 84.89. Thus, the difference in mean score of (1.10) between the post-treatment and pre-treatment mean scores for E_1 was statistically not significant [t (112) = 1.83, $p>.05$].

Table 9. Paired samples t-test results between the pre-treatment scores and post-treatment scores on MWPMQ by control group I

Group	N	Mean	SD	Df	t-value	p-value
Pre-C_1	113	83.79	4.22	112	1.83	.34
Post-C_1	113	84.89	4.82			

The results in Table 10 below showed that the difference in the post-treatment mean scores on MWPMQ between the male and female participants was statistically not significant [t (448) = 1.85, $p>.05$]. This showed that gender had no variant effect on students' motivation to learn mathematics word problems.

Table 10. Independent samples t-test results of the post-treatment scores on MWPMQ by gender

Gender	N	Mean	SD	Df	t-value	p-value
Male	224	90.78	5.92	448	1.85	.36
Female	226	89.82	4.98			

4. Discussion

The findings of this study have shown that the group personalisation strategy enhanced learners' motivation to learn mathematics word problems than the non-personalised instruction which Awofala (2010) claimed differed significantly from the personalised strategy. This result showed the more facilitative potential of personalised strategy to enhance motivation in mathematics word problems over the non-personalised instruction thereby supporting the advocates of personalisation strategy (Ku & Sullivan, 2002). The significant main effect of treatment is consistent with several results on personalisation studies (Awofala, 2014; Awofala, 2011; Awofala, Balogun & Olagunju, 2011; Awofala, 2010; Akinsola & Awofala, 2009; Akinsola & Awofala, 2008; Anand & Ross, 1987; Murphy & Ross, 1990, Lopez & Sullivan, 1992). However, this significant effect in favour of personalisation is inconsistent with some results obtained as well (Choi & Hannafin, 1997; Ku & Sullivan, 2000; Bates & Wiest, 2004). One factor that could be responsible for the inconsistency in results might be the age of the participants in the study. Studies that found non significant effect of personalisation on learning outcomes used small samples from elementary school children whereas studies that found significant effect of personalisation on learning outcomes used large samples from higher grade levels. Thus, age may be a determining factor in the choice of technique(s) to stimulate students' interest in mathematics word problem solving. While higher grade levels are noted for increasingly difficult mathematics problems, the complexity of these problems may enhance personalisation strategy to influence student word problem achievement (Awofala, 2010) and in the present study motivation to learn mathematics word problem. Thus, the inconsistency in results could also be explained by the differences in sample used for the study. In addition, inconsistency in results could be explained by the differences in usage of personalisation of instruction. Most studies that rely on personalisation as a testing method showed non-significant effect (Anzelmo-Skelton, 2006; Bates & Wiest, 2004; Şimşek & Çakır, 2009) while those studies that employed personalisation as an instructional strategy exhibited significant effect (Akinsola & Awofala, 2008; Akinsola & Awofala, 2009; Awofala, Balogun & Olagunju, 2011). The presence of a personalisation effect on word problem motivation was probably as a result of many factors.

Generally, personalisation stimulates inherent interest and enhances personal meaning of new content. This was accomplished in this study by implanting dominant and interesting learner's personal referents into the problem context, thereby situating the complexity of the environment of the learner's everyday life in the context. Essentially, learners imagined being in the problem context and this degree of relationship might have assisted them in housing new information with existing knowledge configurations. In this way, learners may have attended to the personal meaning and relevance of the context to their everyday life experience (Akinsola & Awofala, 2009).

Another reason for the presence of significant personalisation effect on motivation to learn mathematics word problem may be associated with the vicarious feelings and intellectual representations entrenched in the learning tasks. By transmuting written information to contain familiar referents, learners can gain significant personal information about their competences with respect to the strategies enacted to engage the problems and this is often considered a source of motivation to learn. In this study, students were able to picture personal referents in the problem and this experience may have motivated them to gain efficacy in the usage of the strategies for solving the problems. Increased motivation and student excitement were visibly noticed when students saw personal referents included in a problem. This was evident in the comments made by them while studying the personalised programme. Comments such as “Hey, this includes my name,” or “These problems are interesting” and the smiles that followed were taken as signs of increased student interest. This corroborates Bates and Wiest’s (2004) submission to personalisation as an instructional strategy “to break the monotony of word problems containing unknown people, dealing with unfamiliar situations, asking uninspiring questions” (p. 24).

In essence, the personalised treatment enacted in this study may have adequately addressed the lack of motivation to solve mathematical word problems (Hart, 1996) and irrelevance of word problems to students’ lives (Ensign, 1997) often cited as major clogs on the path of students’ understanding of word problems. The significant effect of treatment on students’ motivation to learn mathematics word problems recorded in this study may not be unconnected to the ability of students exposed to the personalised programme to find more personal attachment and deeper meaning in their learning than the non-personalised group. The personalised programme contributed to the lessening of the problem of lack of motivation of students towards mathematics word problems. This finding can be described in that the personalised programme which is interest-based allows students’ choice of problem context and provides meaningful contextual information and this could have enhanced intrinsic motivation and satisfaction of psychological and social needs of the personalised group. This meaningful problem context may serve as a catalyst for students’ motivation and interest when learning how to solve word problems in mathematics and this may result in increased students’ comprehension of the material (Awofala, 2014).

The non-significant difference established in motivation to learn mathematics word problem between male and female participants showed that gender had no effect on students’ motivation to learn mathematics word problems. This contradicts findings of earlier study conducted by Md.Yunus and Ali (2009) that established significance difference in overall motivation scores between the female and male respondents, favouring the females but in support of the findings by Seidman, Allen, Aber, Mitchell, and Feinman

(1994). Watts (2004) reported that gender differences favoured boys in motivation to learn mathematics during the secondary school years. However, the pattern is against the popular finding in Nigeria where boys outperformed girls in achievement in mathematics word problem and mathematics is often considered a masculine domain. The non-significant effect of gender on students' motivation to learn mathematics word problems could be as a result of the interaction pattern that prevailed in the classrooms which did not favour one gender above the other. Eccles and Midgley (1989) maintain that students are maximally motivated to learn when classroom situations fit well with their needs, interests, and skill levels. This might have been the lot of both male and female participants in this study because equal opportunities were given to both male and female participants to learn the instructional programme. In addition, activities and learning materials in mathematics word problems provided might have been better aligned with the learning interests and preferences of both males and females in this study. Thus, this might have shortened out gender difference in motivation to learn mathematics word problems in the study.

5. Conclusion and Suggestions

The present results were obtained by implementing group personalisation strategy in a low-technology driven environment that characterises schools in Nigeria and in many other countries of the world. The use of personalisation or interest-based instruction (Awofala, 2010; Ku & Sullivan, 2002), in such environments has implications for teachers to make a conscious and deliberate effort to learn their students' interests/preferences and to incorporate them regularly into their mathematics instruction. Teachers can complement their prior knowledge of student interests/preferences by using an interest survey, as clearly enacted in the present study, or by engaging their students in occasional discussions about current topics and events within and outside their domains that may be popular with them.

However, two major limitations of this study are that attempts were not made to investigate (i) the interaction effect of personalisation and gender on students' motivation to learn mathematics word problems and (ii) the main effects of personalisation and gender on the individual subscale of motivation to learn mathematics word problems. These limitations notwithstanding, present themselves as implications for further research. In conclusion, it may be reasonable to carry out a longitudinal research on the effect of personalisation of instruction on motivation to learn mathematics word problems for possible generalization of the results of this study.

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