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Can Learners Taught through Problem-Based Learning Strategy Demonstrate an Obligation to Conveying Positive Motivation towards Physics Enhanced Enrolment?

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Abstract: *The government of Kenya has invested enormous resources such infrastructure development, learning materials and professional development of teachers. Despite the efforts put in place to support access and quality education, enrolment and performance in physics in most Sub-County girls' secondary schools in Bungoma County at Form 3 remain relatively low and poor. The study aimed at investigating whether learners taught through Problem Based Learning Strategy demonstrate an obligation to conveying positive motivation towards Physics enrolment. The objective of the study was to establish the effect of problem-based learning strategy on girls' motivation towards "Fluid Flow" as compared to conventional teaching methods. The study adopted constructivist theories of learning. Quasi-Experimental design was used with 4 girls' schools targeted in Bungoma County. The study sampled Form two students because the topic of fluid flow is taught at form two. Simple random sampling was used to assign schools to experimental and control groups. The study used motivation questionnaire, physics Achievement Test (PAT) and Observation schedule. Two groups of each n=40 were either control or experimental were exposed to pretest and post-test. The reliability coefficient was calculated using KR-Fomulla-20 at 0.75. With the aid of SPSS 26.0, data was analysed using descriptive and inferential statistics and presented in form of tables. Results show statistically significant difference in the ability of Girls to derive the to perform better in the topic of Bernoulli's effects using PBLS and its effect on girls' motivation was relatively higher than use of conventional methods (ANOVA (F(4,155) = (Q2 = 459.886; Q16 = 462.375; Q24 = 831.272; Q26 =614.907 and Q28 = 406.743), p = .000). The study recommends the method should be strongly advocated by policy makers, the Government, Principals and teachers while teaching science subjects for effective skill development among the learners. The study is significant in bringing total reforms to CBC that call for the use of learner-centered instructional strategies to develop key competencies.*

Keywords: *Constructivists theory, Learner's Motivation, Problem-based learning strategy, Learner's Achievement*

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1. Introduction

In the 21st century, teaching and learning objectives are successfully achieved by enabling wholistic learner activities in schools. This is because learner characteristics are diverse and addressing such phenomenon in learning situation is critical. One aspect that drives learning process is by teachers facilitating good learning environment and motivation to individual learners (Borah, 2021). An interesting classroom environment is very important in ensuring successful and fruitful learning which requires creativity in designing teaching strategies. According to Borah (2021), teachers should use diverse motivational strategies to promote learners' learning process and develop their future life through academic performance.

One of the strategies often employed by teachers is the constructivists teaching strategies such as problem-based learning strategy (PBLS). Enquiries were made known that constructivists teaching strategies are of use not only in attainment but also help learners build their views about science and enlarge their thinking ability. Njoka (2020) portends that prior to the constructivist theory,

teaching methods include scientific inquiry. Most learners view science as a way of accepting facts about the world and promotion of conceptual change. Students should be given opportunities to alter concepts, prove laws, observe and draw conclusions (Angelle, Derrington & Oldham, 2021). Constructivists teaching take into account what students come in with initially at the beginning of instructions. This makes the learners practice and rebuild new experiences as they continue with the academic ladder. Therefore, learners are set for a chance to experiment their facts and their experiences with cognitive disagreement for them to connect and get solutions to their problems.

According to the constructivist school of thought, knowledge is not transmitted into the student, instead students build meaning from their interactions with one another (Otieno, 2019). Constructivists' theorist assent that individuals actively develop knowledge they possess. This development of knowledge is a lifelong process requiring significant mental engagement in the learner (Jurkova & Guo, 2021). Constructivists do center on the following: they support and act in varied viewpoints, they employ major source beside scheming, inductive and objective resources, give confidence to students in prior knowledge as they construct new meaning and they let students' reaction towards lessons as well as altering the teaching approaches used. Individual students learn through a continuous process of modifying and interpreting their own experiences.

In their point of view, the instructor provides learners with experience that let them calculate and control objects, they reconstruct meaning further from students' inquest and discussions. The science syllabus in high school needs to be moderated in a sense that strategies are rich in variables and conditions which can be designed into numerous teaching methods which would improve structural knowledge by a process (de Oliveira, et.al., 2021). This will be an ordinary aspect of constructivist learning, which creates opportunity for student's learning and understanding. Although different teaching approaches are being employed, students continue to hold wrong conceptions.

Constructivists state that the instructor needs to guide the learners to provide an environment conducive for students to construct meaning at individual and group level (Njoka, Julius & Julius, 2021). Knowledge is actively built by the students in collaboration with his/her world (Njoka, et.al., 2021). This brings about self-directed learning, which facilitates the construction of new knowledge. The use of problem-based learning strategy is linked to constructivist teaching because it involves activities that define the teacher as a facilitator and enables students to construct meaning that lead to scientific learning. Moreover, PBLS is a hands-on exploration that enhance the construction process, letting students discover by themselves thus making the students come to make sense of their experience gradually optimizing their interaction with the world. However, this view would require educators to vary motivation aspect of learners to achieve and sustain educational goals of the learning process.

Learners' motivation is an important element for the success of learners in the implementation of education curriculum although it is often ignored by teachers (Borah, 2021). Learning is not only supported but also enhanced through positive effective factors such as interests, motivation, attitude, belief, self-confidence and self-efficiency. According to Njoka (2020), motivation is defined as the efforts in which learners put into learning as a result of their need or desire to gain knowledge. However, Ng (2019) holds the view that motivation stimulate, directs and sustains education engagement of learners.

According to Nuraini, Asri and Fajri (2023), the use of appropriate teaching method(s) by science teachers should play a key role in helping students develop their ideas and process skills such as experimenting, observing, investigating, hypothesizing, predicting, integrating ICT during teaching and learning, drawing conclusions and communicating. PBLS leads to acquisition of problem-solving skills, enhance achievement and motivation in science-oriented subjects. However, a few teachers often incorporate PBLS as one of the constructivists teaching strategy in teaching physics as opposed to convention methods. Additionally, the ongoing curriculum reforms in Kenya with a shift to Competence Based Curriculum (CBC) call for the use of learner-centered instructional strategies. It is therefore important for the teachers to use learner focused instructional strategies so as to develop requisite competencies among learners to enable them fit in the 21st century society. However, it should be noted that teachers operate in a volatile and dynamic environment on implementation of the CBC.

With increasing stakeholders' current educational expectations, there is high demand for educators in their service delivery model to employ the constructivist learning strategy such as PBLS to promote learners' motivation for sustainable learning process. Both Njoka (2020) and Bett (2022) noted that all the teaching strategies practiced in Kenya schools are mostly expository and facts oriented, making students to be passive. Wafula (2017) argues that the curriculum and the syllabus remain boring if not converted into exciting and interesting episodes by the teacher using the right teaching methods. Many girls shy away from Physics because of the content approach which they believe makes the learning more abstract and difficult. As a result, there is need to improve the teaching of physics subject. Thus, the study aimed at determining whether learners taught through PBLS demonstrate an obligation to conveying positive motivation towards physics achievement. The study pursued the following objective:

To establish the effect of problem-based learning strategy on girls' motivation towards "Fluid Flow" as compared to conventional teaching methods.

2. Literature Review

The expression motivation to study is defined by as the state or measure of being meaningful. An interesting classroom environment is very important in ensuring successful and fruitful learning which requires creativity in designing teaching strategies. A student who is intrinsically motivated undertakes an activity for its own sake, for the enjoyment it provides, the learning it permits or the feeling of accomplishment it evokes (Devika, 2020; Ratcliffe & Tokarchuk, 2020). On the other hand, learners who are extrinsically motivated carry out assignments to get reward or avoid punishment from teachers (Meghesli & Ghania, 2021). These findings suggest that when the teachers capitalize on existing intrinsic motivation, there are several potential benefits that the teachers try to convince their students that learning rather than grades is the purpose of academic work. This can be done by emphasizing the interest value and practice of the material that the students are studying and by de-emphasizing grades and other rewards so that intrinsic motivation is emphasized.

Learning is not only supported but also enhanced through positive effective factors such as interests, motivation, attitude, belief, self-confidence and self-efficiency, leaners with a belief in their own abilities and value attribute their learning tasks as being significant predictors of their final success. A girl is more likely to desire to learn when she appreciates the value of the classroom activities and the believe that they will succeed if they apply reasonable efforts (Jiang, Chen & Wu, 2021). In addition, motivational belief can influence the process of learning and conceptual changes (Wong & Wong, 2021). This motivation is usually context specific and relies strongly on the classroom situation. Girls need to believe that they are capable of performing a task, that they have some control over the task and that the task is achievable. The beliefs that the teachers themselves have about teaching and learning and the nature of the expectations they hold for students also exert a powerful influence.

Pambudi (2022) point out that to every large degree, students expect to learn if the teachers expect them to learn. That it is important for teachers to communicate positive expectations for their students, that they can learn the material presented to them. Some of the strategies and factors that may be employed to motivate girls and stimulate then to learn include; first teachers providing a supportive environment and establishing a trusting bond since motivation is natured by the teachers in every learning situation. Secondly, teachers should help girls recognize links between efforts and outcomes. Learning is a long-term plan of effort and investment. Thirdly, the teachers should breakdown learning steps into digestible pieces and minimize learner performance anxiety during learning activities.

Students' incentive affects significant Physics learning: specifically, if incentives are directly linked to higher level of thinking (Njoka, 2020). Most of research literature indicate notable relationships between learner's motivational viewpoints and their mental processes (Phan & Ngu, 2021). A range of factors have an effect on learners' intrinsic motivation such are those that involve them in classroom tasks considering their welfare, wants, goals and viewpoint regarding their potential and expectations that improve their self-worth (Larner, 2020).

According to Robinson (2019), learners' motivation depends on three factors; first is the feeling of worth, secondly, is the observation of efficiency and thirdly, is one's positive emotive reply to the information component. The conditions that must be satisfied for an activity to qualify to be intrinsically motivating, according to (Ng & Chu, 2021) are first, it has to have a suitable degree of confront, then have important and genuine tasks for learners; and have learners offer opportunity for educational criticism and recommendation; a task devoid of previous obstacles as well as constraints. Students perform in their own free will and point of reference in appraisal is not based on content, neither on comparison, but on individual evaluation in learning physics.

It is assumed that a stable classroom environment is necessary for intellectual growth and the introduction of the expression of investigation is alleged to improve learners' motivation for Physics learning. More student-centered strategies with many student discussions in experiments are needed to engage students in meaningful learning, (Aksela, 2019). Real-world problems motivate and help to encourage transfer of knowledge and skills, by encouraging students to apply their knowledge. This therefore encourages need to embark on PBLS to enhance problem solving, critical thinking and motivation towards physics learning.

Kanyesigye, Uwamahoro & Kemeza (2022) investigated the impact of problem-based learning strategy on learners' attitudes in learning physics in Uganda. They sampled 419 grade 12 learners undertaking physics in both public and private secondary schools. Using quasi-experimental approach with cross-sectional survey technique, two groups of students were exposed to learning for 12 weeks. The control group was subjected to conventional teaching method while the experimental group was treated with PBL method. Data was collected using 'Views About Science Survey tool' and analysed using both descriptive and inferential statistics. Results show that the experimental cohort acquired more positive attitude as compared to control cohort. The study resolved that PBLS was effective in the instruction of physics as a subject as compared to the conventional teaching methods with approximately 20% gain in

attitudes. Therefore, teachers were advised to use PBLS in relaying abstract terms and concepts in STEM in secondary schools.

Although Kanyesigye, et al., study find no statistical difference between gender with regard to students' attitudes in the achievement of physics, the current study attempts to examine the effect PBLS on Girls' motivation in achievement in illustrating Bernoulli's effects in nature through the PBL strategy. Other research find learners' attitude affecting their performances in science oriented subjects. For instance, Ibrahim (2019) observe negative perception in physics affects their performance negatively. According to Madsen, McKagan & Sayre (2020), it is imperative to improve learners' attitude for them to succeed in physics and develop critical skills. Teachers are advised to use teaching methods such as PBL to enhance learners' attitudes (Mbonyiryivuze, Yadav & Amadalo, 2021; Kanyesigye & Kemeza, 2021).

3. Methodology

3.1. Research Design

This paper critically examined whether the use of PBLS affect girls' motivation towards physics (Fluid Flow) as compared to other conventional teaching methods. The study was conducted in four girls' secondary schools in Bungoma County. The county was selected because of the performance in KCSE physics which has persistently recorded a low mean score in Girl's sub county schools over the years. All form two physics girls in the four sub-county girls' schools. were selected because the topic of Fluid Flow is taught at this level. The study adapted a nonequivalent Solomon Four Group Quasi-Experimental research design. Non-equivalent groups were used because classes in secondary schools once constituted existed as intact groups. The school authorities do not normally allow such classes to be broken up and reconstituted for research purposes. Thus, it was possible to assign class randomly as required in true experimental designs. The schools selected were however, assigned to the treatment and control conditions as intact groups. Four teachers from the 4 schools each with five years of teaching experience participated in the study. The quasi-experimental design is deemed appropriate for the study because it allowed for assessment of problem-based learning strategy.

Solomon Four control group Quasi-Experimental designs was deemed appropriate for this study because it was considered vigorous for both Experimental and Quasi-experimental studies (Mohajan, 2020). The design helped the research achieve four roles: to assess the effect of the experimental treatment relative to the control condition, to assess the interaction between pre-test relative to the post-test and to assess the homogeneity of the groups before administration of treatment.

Quasi-experimental research design procedure controlled all major threats to internal validity except those associated with interaction of selection and history, selection and maturation. To control for interaction between selection and maturation the schools were randomly assigned the control and treatment groups. The conditions under which the instruments were administered would also be kept as similar as much as possible across the schools to control for interaction between selection and instrument. The teachers who gave the intervention were trained on how to administer the treatment. They used schemes of work for four weeks then administered a post test. An instructional guideline for teachers in the study based on the Physics syllabus was constructed and used to train teachers on how to use the schemes of work and gave the treatment. A manual was used by the teachers in the experimental groups to ensure that there was uniformity in exposure of students in interventions. All the teachers involved in the study adopted a common scheme of work on the topic of Fluid Flow, which ensured that the intended content was covered uniformly for all the groups involved in the study.

3.2. The Participants

The study targeted about 6180 form 2 students and four teachers from the four selected girls' schools in the county. However, 160 students were used from the four schools with each school comprising of n =40 students.

3.3. Sample Size Determination

Two groups of each n=40 were either control or experimental were exposed to pretest and post-test.

3.4 Statistical Measures and Analysis

Data collection and analysis was done using a mixed methods approach, though qualitative and quantitative methods using questionnaire (Physics Achievement Test), interview schedule and observation schedule. The study Simple random sampling technique was used to group four schools to experimental and four others to control group. Where schools have more than one stream all participated but simple random sampling was done to select one stream for data analysis. To support practice and advance knowledge (Ngulube, 2019), validity and reliability of the tools were highly considered where the study carried out piloting using two secondary schools with the same characteristics as sampled schools in Busia County. However, stability was ensured by adopting the Kunder-Richardson (KR- Formula 20) estimates at 0.75 correlation coefficient for use.

3.5 The Procedure

A research permit was obtained from National Council of Science Technology and Innovation (NACOSTI) and also a letter from County Director of Education Officer-Bungoma County in order to conduct research in the sampled schools. The teachers were trained for one week on how to use PBLS. This empowered them to master the skills of using PBLS as a teacher's strategy. After this period a PAT pre-test was administered to experimental group 1 and control group 2. This was followed by the exposure of PBLS. At the treatment period, the researcher was assisted by the Physics teachers in the sampled schools to administer PAT post-test to all four groups. The study scored and coded the collected data for analysis. Data was analyzed using both descriptive and inferential statistics. Raw data was analyzed using means, standard deviation and percentages so as to meaningfully describe the distribution of the measurements from the SPSS 26.0. Reliability and sampling adequacy of the study instrument was determined tested for reliability while the sample was tested for adequacy to illustrate how dependable were the study tools for this research as shown in Table 1.

Table 1 Item-Total Statistics for K20 and Cronbach's Alpha Reliability Coefficients

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Objective	11.4750	11.538	.824	.925

Researcher's Experimental Data, (2023)

The KR20 was deployed to determine reliability of dualistic measurements and evaluate if items from the test attain the same right or wrong outcomes over a sampled girls of testing subjects. If KR-20 coefficient are < 0.75 and items with a Corrected Item-Total Correlation of < 0.30, those specific items are deleted and re-run the KR-20 analysis. From Table 1, the Cronbach's Alpha if item deleted column typically shows the KR-20 related with the question items. The KR-20 obtained for Q3= 0.925 and were more than the minimum threshold value of 0.75 hence the items were acceptable for analysis. Furthermore, the Item-Total Statistics column, in the Corrected Item-Total Correlation for Q3= 0.824 were more than the critical value of 0.30 hence no cause of alarm for items to be deleted. Therefore, the test to observe if data from the five questions met the assumption of reliability based on K20 show that the tools were highly reliable.

4. Results and Discussion

4.1 Effect of PBLS on Girls' Motivation towards "Fluid Flow"

The study sought to establish the effect of problem-based learning strategy on girls' motivation towards "Fluid Flow" as compared to conventional teaching methods. Five aspects of Motivation, namely, student, teacher, content, teaching method/process and environment were considered on MTPS scale of 1=SD, 2=D, 3=N 4=A 5=SD and results are shown in Table 2.

Table 2 Effect of PBLS on girls' Motivation towards "Fluid Flow"

PBLS Motivation Questions	N	Min	Max	Mean	Std. Dev.
Q2 (Physics lessons are very interesting	160	1.00	5.00	3.8500	1.21934
Q16 (I understand everything that my Physics teacher teaches	160	1.00	5.00	2.8500	1.21934
Q24 (the teaching methods used by Physics teacher are enjoyable	160	1.00	5.00	3.7875	1.33359
Q26 (I always participate in Physics lessons	160	1.00	5.00	3.7500	1.36902
Q28 (I cooperate with other students during Physics experiments	160	1.00	5.00	3.8500	1.39270
Valid N (listwise)	**160**				

Researcher's Experimental Data, (2023)

As shown in Table 2, results showed that all students were motivated with the Physics lessons and they attested that the lessons were interesting (M=3.85; SD=1.21934). The girls enjoyed the lessons, found physics terms abstract, and understood physics problems and calculations with ease through exposure to PBLS.

However, the students had varied opinion about everything taught by their physics teachers as this scored slightly lower (M=2.85; SD=1.21934). Therefore, the perception of learning physics differs significantly with the teacher handling these lessons. Perhaps some students find the lessons challenging due to the teacher characteristics which ultimately affects their performance in physics.

Furthermore, majority of the students agreed that the teaching methods used by the Physics teacher were enjoyable (M=3.7875; SD=1.33359). The use of PBLS incorporated diverse methods of discussion, demonstration and use of experiments/Practicals which enhanced student's curiosity and they were able to participate in the lessons by asking relevant questions and involvement in the tasks assigned. The analysis of observation schedules show that variation of the teaching methods made lessons well organized, and learners were able to connect the classroom environment with real life situations. Moreover, most learners always participated in Physics lessons (M=3.75; SD=1.36902), hence, physics content is practical in nature and the use of PBLS makes the learners more attentive to physics lessons unlike theory lessons. Consequently, majority of the learners were able to cooperate with other students during Physics experiments (M=3.55; SD=1.39270) as a result of the effect of PBLS. This also imply that the learning environment motivates learners when undertaking such lessons. Teachers should ensure that physics lessons resonate well with the environment in order to attain the overall objectives of the lessons. The current results are similar to those of Kanyesigye, Uwamahoro & Kemeza (2022) who investigated the impact of problem-based learning strategy on learners' attitudes in learning physics among 419 grade 12 learners in both public and private secondary schools in Uganda. They find that the experimental cohort acquired more positive attitude as compared to control cohort. The authors resolved that PBLS was effective in the instruction of physics as a subject as compared to the conventional teaching methods with approximately 20% gain in attitudes. Therefore, it is evident that the application of PBLS in relaying abstract terms and concepts in STEM subjects in secondary schools will enhance skill development among the learners.

4.2 Results of ANOVA on Effect of PBLS on Girls' Motivation towards "Fluid Flow"

The study further analysed students Motivation towards the topic 'Fluid Flow' using analysis of variance to test the hypothesis which states that; (Ho_1): There is no significant difference in the level of motivation towards Fluid Flow, a topic in physics between girl- students who are exposed to PBLS and those taught using conventional methods. The analysis of variance was used to compare the variability in test scores between the different schools and the variability within each school. ANOVA test use the sum of squares method and statistically allows investigators to test hypothesis to find the existence of statistical variance between means of groups. This was critical to determine the variability of PBLS in comparison to the Conventional method. Results are shown in Table 3

Table 3 Results of ANOVA on Effect of PBLS on Girls' Motivation towards "Fluid Flow"

		Sum of Squares	Df	Mean Square	F	Sig.
Q2	Between Groups	218.029	4	54.507	459.886	.000
	Within Groups	18.371	155	.119		
	Total	236.400	159			
Q16	Between Groups	218.120	4	54.530	462.375	.000
	Within Groups	18.280	155	.118		
	Total	236.400	159			
Q24	Between Groups	270.180	4	67.545	831.272	.000
	Within Groups	12.595	155	.081		
	Total	282.775	159			
Q26	Between Groups	280.334	4	70.084	614.907	.000
	Within Groups	17.666	155	.114		
	Total	298.000	159			
Q28	Between Groups	281.575	4	70.394	406.743	.000
	Within Groups	26.825	155	.173		
	Total	308.400	159			

Researcher's Experimental Data, (2023)

The ANOVA test was used to examine causes of variability in data observation in terms of variability between groups and variation within the groups and variance in total observations. The choice of ANOVA test to this hypothesis was much preferred than other test like Multiple t-tests in this study because ANOVA minimizes the type I errors (errors due to chance) unlike the t-test statistic (Gray, et. al., 2017). The p-value in the test gives useful direction on whether we can reject or retain null hypothesis (Ho) in the test. A significance level of 0.05 is used to validate the claim of the hypothesis in satisfying ANOVA assumptions. However, according to (Polit & Beck, 2018), variability within groups is compared to variability between groups using the F-ratio (F-statistic). If the observations are true with null hypothesis, then no statistically difference shown between groups whereby F-statistic is closer to 1. Moreover, a larger F value illustrate that the difference between groups with independent construct(s) is genuine (Mishra, et. al., 2023). A significance p-value of < 0.05 implies that the means of the groups vary from one other by large amount for the difference to be statistically significant.

As shown in Table 3, the effect of PBLS on Girls' motivation towards "Fluid Flow" for the five questions had significant positive regression weights, showing teachers use of PBLS improved Girl's motivation in learning physics as a science subject. A one-way ANOVA as presented in Table 3 indicate that the significance value was 0.000 (i.e., $p = .001$) for all the questions, which is below the set value of 0.05. Therefore, there is a statistically significant difference in the mean performance of physics in the topic 'Fluid Flow' between the different groups of students (control and experiment).

Similarly, the F ratios calculated were large indicating that there is more variability between the groups (cause by the independent construct) than there is within each group (error term). The ANOVA F statistic tests (Q2 = 459.886; Q16 = 462.375; Q24 = 831.272; Q26 =614.907 and Q28 = 406.743) respectively in the model as a whole was significant as the critical F-value calculated was higher than the critical table value of 2.422 ($F_{calculated} > F_{table}$ value). These results show that there was statistically significant difference between variables of Girls' motivation to learn physics as determined by one-way ANOVA ($F(4,155)$ = (Q2 = 459.886; Q16 = 462.375; Q24 = 831.272; Q26 =614.907 and Q28 = 406.743), p = .000).

Since the F-statistics were greater than the critical value (2.422), the study rejects the null hypothesis in favour of the alternate hypothesis and deduce that there is significant difference in the level of motivation towards Fluid Flow, a topic in physics between girl- students who were exposed to PBLS and those taught using conventional methods. Similarly, other research find learners' attitude affecting their performances in science oriented subjects. For instance, Ibrahim (2019) observed negative perception in physics affects their performance negatively. In the same vein, Madsen, et. al., (2020) argue that it is imperative to improve learners' attitude for them to succeed in physics and develop critical skills through the appropriate teaching method. Teachers are advised to use teaching methods such as PBL to enhance learners' attitudes (Mbonyiryivuze, et. al., 2021; Kanyesigye & Kemeza, 2021). This observation was witnessed in both public and secondary schools in Uganda among students undertaking physics while the current study was undertaken among public secondary schools in Bungoma county, Kenya. Aksela (2019) argue that meaningful learning requires more student-centered strategies with many student discussions in experiments. Real-world problems motivate and encourage transfer of knowledge and skills, by encouraging students to apply their knowledge. This therefore encourages need to embark on PBLS to enhance problem solving, critical thinking and motivation towards physics learning.

4.3 Model Summary for Effect of PBLS on Girls' Motivation towards "Fluid Flow"

Further analysis of regression was performed and results are as illustrated in Table 4.

Table 4 Model Summary for Effect of PBLS on Girls' Motivation towards "Fluid Flow"

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.983[a]	.967	.966	.25230

a. Predictors: (Constant), Q28, Q16, Q2, Q24, Q26

Researcher's Experimental Data, (2023)

In determining the variable contribution of learners' motivation towards Fluid Flow in Physics, findings in Table 4 demonstrate the model summary statistics and the results reveal that the model could predict 96.6% of the performance of physics when exposed to PBLS. The R value was 0.983 shows that the correlation coefficient between the groups and test score performance. Furthermore, the model shows the outcome size of the analysis which was a huge magnitude (Alamer & Al Khateeb, 2023). Its square value was .967 and its adjusted square was .966. This signifies that 96.6% of the variation in the test score performance at the study schools could be explained by taking learner characteristics and their differences, teacher's

characteristics and their tactical use of PBLS, learning environment, content and method of delivery into account, perhaps are the motivating factors that determine student's performance in general.

The R2 = 0.967 indicates that 96.7% of the association in dependent construct can simply be attributed by the effect of the independent construct. However, only 3.3% cannot be explained. In an adjusted R2 = 0.966 roughly points out the model in general. The difference in the two gives 0.967 - 0.966 = 0.001 which implies that when model is ultimately extracted from targeted population other than the sampled units, it may result in approximately 0.1% less in variance of the result. The 0.1% variance also less than the proposed error of 5% in all the reported answers. In line to Alamer & Al Khateeb (2023) with reference to the quantity of the adjusted R square, it can be inferred that student motivation could justify 96.6% variance of the performance of physics to a greater extent by the moderating effect of PBLS on motivation. This motivation is usually context specific and relies strongly on the classroom situation. Therefore, girls need to believe that they are capable of performing a task, that they have some control over the task and that the task is achievable. However, many teachers point out that low achievement in Physics is as a result of negative attitudes by the learners as well as omitted linkage between primary and secondary science syllabus. Therefore, the current results indicate that the effect of PBLS on learners' motivation significantly influence performance of science related subjects.

Motivational belief can influence the process of learning and conceptual changes. In order for our learners to achieve the process skills, teachers need to adapt pedagogies that enhance students' ability to 'learn to think and think to learn. Girls who are critically thoughtful and positively embrace problem solving throughout their learning as they develop deeper engagement and understanding. Teachers can create conditions that encourage students to actively engage in learning through critical inquiry. Thus, learners develop a repertoire of thinking tools that they learn to use independently. This leads to learners who have stronger competence with scientific inquiry skills.

Furthermore, the study analysed the qualitative data and findings are as follows from the interviews:

One of the questions that was asked during the interviews in the four schools was*, "Can learners taught through Problem Based Learning Strategy demonstrate a commitment to conveying positive motivation towards physics achievement?".* According to participants, PBLS creates a cultivating environment for learners to build competencies, autonomy, interest, relatedness and resilience towards learning. This is important role in stimulating broad-based and individual-directed learning among the students. Most of the teachers observed that that developing positive attitudes require determined pedagogies and solid advocacy by the teachers and the experience is key. So, with use of constructivists strategies such as PBLS overtime, learners would have had resilient practice that transition at any period. This should encompass proper teacher facilitation of the method and appropriate approach to the teaching objectives and promoting constructivism thinking and champions of PBLS as knowledge includes misconceptions, the result may be distorted or rejected of the new learning (Njoka, et al., 2021).

Q24 = 831.272; Q26 =614.907 and Q28 = 406.743), p = .000), R^2 = 0.967.

5. Conclusions and Recommendations

5.1 Conclusions

The evidence presented in this paper show that PBLS has a significant moderating effect of learners' motivation and capacity for physics achievement as experimented with the topic of 'Fluid Flow' at the study area. However, poor performance among the girls at study area could be rather weak, lack of authority and autonomy as teachers are formally there but might lack appropriate experience in the use of constructivists teaching strategies. This research urgently calls for adequate policy framework in the midst of the implementation of CBC/CBET in our education systems in Kenya. However, the linear regression model summary revealed that schools/learners that have credible constructivists strategies and taught through Problem Based Learning Strategy also demonstrate an obligation to conveying positive motivation towards Physics achievement where 96.6% of all the variables were statistically and significantly predict the achievement of the physics at the study area, $F(4, 269)$ = (Q2 = 459.886; Q16 = 462.375;

5.2 Recommendations

The study recommends that:

1. In line with these findings, the Governments and educators should adequately support the use of constructivists strategies, including PBLS for promotion of skill development among the learners.
2. The school Principals and management should be strategic and champion to promote the likely utilization of PBLS to inform decisions and improve learners' performance of our schools especially in science oriented subjects hence the Constructivism theory supported.
3. The government should promote the development policy on PBLS and regulatory ecosystem to support and bear useful and reliable learning processes and practices; and also strengthen constructivism framework, and institutional capacity.

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