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Problem Based Learning Resources and Exposure in higher Education: Evidence from the Kwame Nkrumah University of Science and Technology, Kumasi - Ghana.

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Abstract

The limited literature on problem based learning (PBL) in the context of Ghana instigates the doubt as to whether universities in the country apply this educational strategy. To clear this doubt, the present study is conducted to outline the experiences and review the resources that are inclined to the environments of PBL, using survey data from the Kwame Nkrumah University of Science and Technology (KNUST). Survey participants were educational managers, teachers and students of the university. In the results, the researchers identified experiences among teachers and students that agree with the principles of PBL. The participants largely admitted that the university has insufficient support for PBL in terms of human and infrastructural resources. Content expert teachers constitute the only human resource, yet they lack the requisite training for facilitating PBL. Considerably more attention is needed regarding infrastructure, training on the science of facilitation and platforms for industrial and other real-life situational exposure.

Keywords: experience, education, facilitator, problem based learning, resource, library, university

Introduction

Driven by integrating school learning with real-life situations, problem based learning (PBL) is recognized as an approach to instructional delivery in education. According to Wilkerson and Gijselaers, (1996), this instructional strategy is characterized by student-centered approach, where teachers act as "facilitators rather than disseminators," and "ill-structured" problems serve as the initial stimulus and structure for learning. In PBL, students work in groups and teacher facilitates the groups during a tutorial process (McPhee, 2002; Hmelo-Silver, 2004).Deo, (2013) states that a typical PBL tutorial consists of a group of students, usually 8 to 10 and a teacher, who facilitates the lesson.

Initially, PBL appeared to be of interest exclusively in medical education. However, at present it is well recognized and has been implemented in educational programs in a variety of disciplines. A web-based report indicates that, there has been a strong trend of acceptance toward the use of PBL by many successful and progressive universities across the world (Acs distance education, 2015). Studies on PBL are in diverse dimensions covering areas such as student learning, student roles, instructor roles, problem design and use of technology (Hung, et al., 2008). Among others, PBL has been compared with the traditional education system and in most cases PBL is reported to be better in terms of long-term retention, skill development, satisfaction of students and teachers (Strobel, and van Barneveld, 2009). Research indicate that graduates from this form of education consistently achieve better and progress faster in their careers than graduates from comparable traditional classroom based education (Acs distance education, 2015). Nonetheless, achieving success in PBL does not come by chance. An essential component that allows successful PBL environments is the problem itself. According to Kukkamalla, et al., (2011) ineffective problem design results in failure of the learning process. Therefore, to design credible problems in PBL, facilitators' industrial experiences and exposure to real-world phenomena are required (Tik, 2014).

Introducing PBL into an institution's curriculum has several implications. Both human and infrastructural resources must be provided to allow effective leaning environments. Deo, (2013) proposed two main types of human resources required in PBL: first "facilitator" who is sufficiently trained in PBL processes and has acquired competencies in facilitation and management of group dynamics and secondly, "content expert" or "subject expert" who posses' specialization in the concerned discipline. Additionally, Coelho (2014) established that good facilitation requires proficiency in understanding the concepts behind learning theories. In PBL environments, students have access to infrastructural resources such as tutorial rooms equipped with technologies and electronic devices including interactive white boards, projectors, computers, internet, television, and telephones (Deo, 2013; Mathews-Aydinli, 2007). Moreover, other resources including books, magazines, brochures, newspapers among others are provided for students (Mathews-Aydinli, 2007).

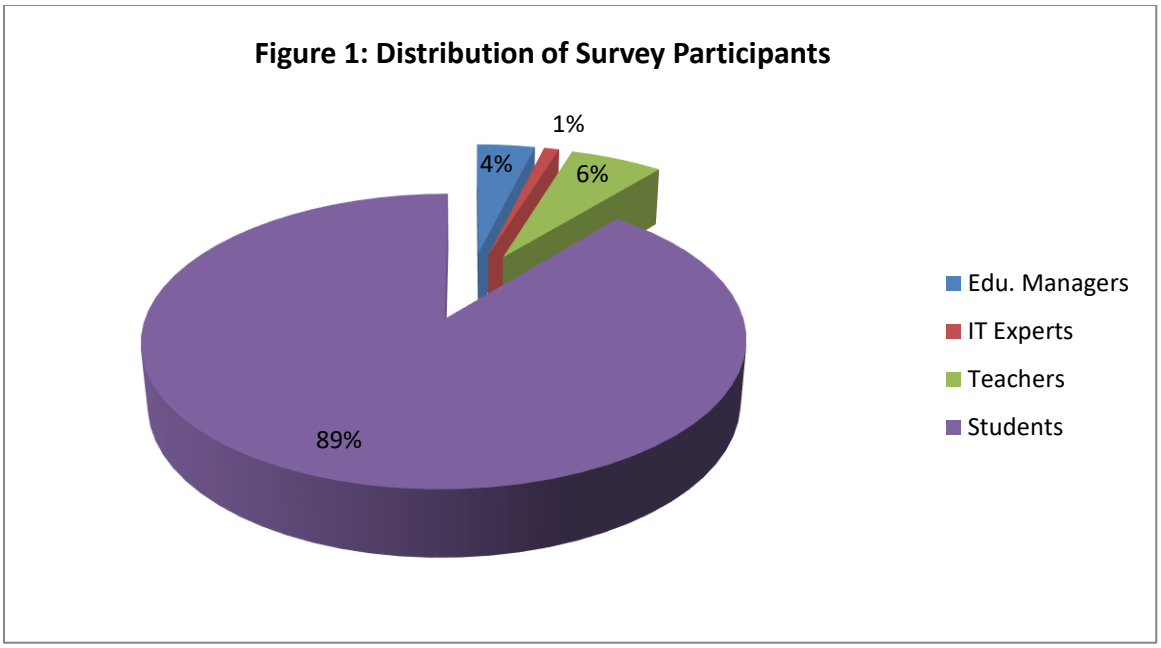
Whilst several universities have adopted PBL and have their names recorded as part of its history, literature on PBL in the context Ghanaian universities is limited. This has brought about uncertainties as to whether universities in the country are using this educational pedagogy. In this paper, we aim to outline the experiences and review the resources that are inclined to the environments of PBL in the setting of the Kwame Nkrumah university of Science and Technology (KNUST). A study in this regard is important to the university community and to the nation at large. The managers of the university and stakeholders need to better understand the PBL capabilities among students and teachers to ensure more strategic and coordinated PBL environments are provided.

Materials and Methods

Data and method of data analysis

The analyses of the present study are based on data extracted from the KNUST-based Building Stronger University (BSU) phase two project. This project is a cross sectional survey of 1,145 participants being workers and students of KNUST. The survey was conducted in the year 2014 with well structured questionnaires built from a proposed matrix for mapping PBL. The working survey participants were educational managers, teachers and Information Technology (IT) experts of the university. However, in this study data on the IT experts were not used. In the data there is greater proportion of students (89%), followed by teachers who constitute 6% (Figure 1). The educational mangers occupied 3.8% of the entire sample (Figure 1).

Among students the target population was those at level 200, 300 and postgraduate level. Students were drawn from College of Science, College of Agriculture, College of Architecture, College of Health and Allied Sciences, College of Arts and College of Engineering. They were engaged through focus group discussions in their various lecture halls. The educational managers consist of provosts and head of departments of the university. Educational managers, teachers and IT experts were engaged individually in their offices.

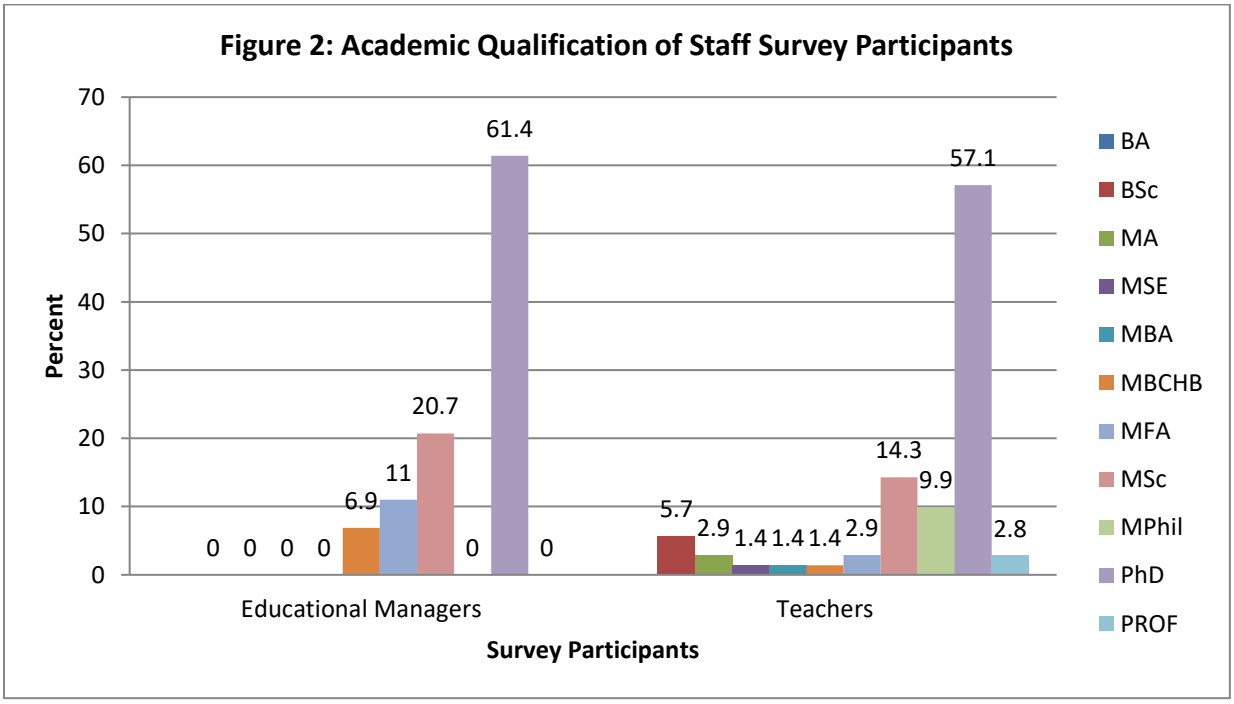


Data analyses in this study were performed with a range of statistical methods. First, graphical procedures including clustered and stacked bar charts were employed to explore patterns in the responses of survey participants. Test of proportions were also employed. Furthermore, count regression analyses were conducted on students' exposure to PBL within the university. In this context, the Poisson regression model and the negative binomial regression model were employed. The Poisson model assumes that data is equidispersed (Mouatassim and Ezzahid, 2012). However, the negative binomial model is used when the equidispersion assumption is violated (Zeileis, et al., 2008). Data preparation and graphical procedures were computationally handled in Ms Excel. Also, the test of proportions was performed with MINITAB and the count regression models were executed using R.

Results and Discussions

The BSU survey data used in this study provides responses on educational managers (3.8%), teachers (6.1%) and students (89.1%)of KNUST. Considering the educational attainment of educational managers, 61.4% had PhD, whilst 20.7% and 11.0% had MSc and MFA respectively (Figure 2). Among the teaching participants, 57.1% had attained PhD at the time of the survey.

In addition, 14.3%, 9.9%, 5.7%, and 2.9% had MSc, MPhil, BSc and MFA respectively. Only few of the teaching participants had attained Professorship (2.8%) during the time of the survey. These participants are content experts who have mastery and proficiency in their respective subject areas.

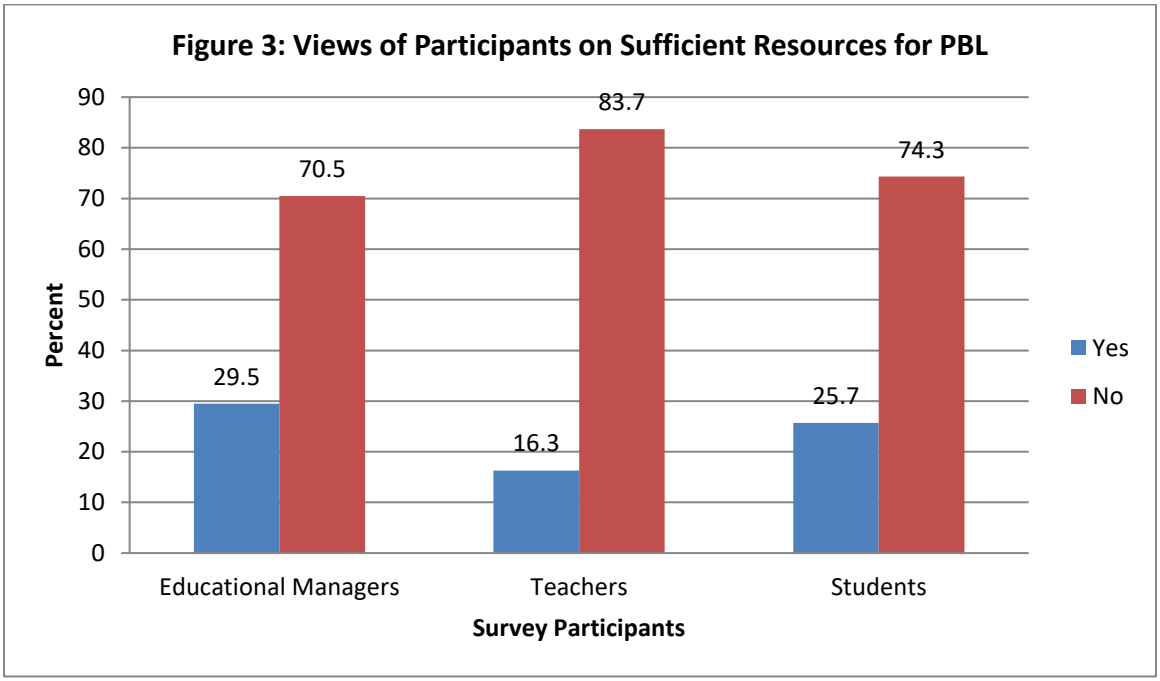


The educational managers, teaching and student participants were asked to indicate the resources the university has at present for PBL. In line with the question the responses below were given by participants.

- General library
- Lecturers/ teachers
- Internet access
- Study space
- Inaccessible ICT center

Moreover, on a question regarding whether the available human and infrastructural resources for PBL within the university are sufficient, less than 50.0% (sample proportion=29.5%, CI 16.8%-

45.4%; p-value=0.010) of the education managers responded that the university has sufficient resources for PBL (Table 1). Likewise, 16.3% of the teaching participants were of the same view (Figure 3). Among the student participants, 25.7% indicated that the university has sufficient resources for PBL whiles 74.3% responded otherwise.



The teaching participants were asked to indicate whether they use PBL in their teaching activities. Also the student participants were required to report whether they have been exposed to PBL within the university. From Figure 4, 23.8% of the teaching participants indicated that they have been utilizing PBL in their teaching activities within the university. Also, 37.5% of the student participants indicated that they have been exposed to PBL. The participants outlined the following as their experiences in PBL.

Teachers:

- Projects were given to students, students did their research and presented their findings where teachers were facilitators; students worked in groups
- Engineering students engaged in engineering in society attachment

Students:

- Engaging in internship programs and field activities at the end of every academic year
- Educational trips for research
- Moderating lectures
- Organize group meeting where we meet and share ideas to increase our understanding
- We embarked on an activity where we collected data from the market and analyzed it using SPSS
- We engage in laboratory projects and community works
- Go to the field to survey lands and draw conclusion from our results

Table 1: Test of Proportion for Sufficient resources for PBL

	QUESTION: Does the university/college/department (u/d/c) in your opinion have sufficient resources, both human and infrastructural, for PBL or similar student centered teaching and learning?			
Survey Participants	**Sample Proportion (%)**	**95% Confidence Interval**		**P-Value**
Educational Managers	29.5	16.8	45.2	0.010
Teachers	16.3	4.2	39.9	0.004
Students	25.7	23.0	28.5	0.000

The identified experiences such as engaging internship programs, allowing student groupings, utilizing field land surveys, and engaging teachers as facilitators agrees with the PBL processes reported in literature (McPhee, 2002; Hmelo-Silver, 2004). However, the teaching participants reported that, they have not received any pre-requisite training for PBL. Though these participants have mastery and proficiency in their subject areas, lacking the pre-requisite training for PBL is a limitation. We emphasize on the work of Deo, (2013) who indicated that PBL pedagogies demand "content expert" or "subject expert" who have specializationin their concerned discipline and "facilitator" who is well trained in PBL processes and has acquired competencies in facilitation and management of group dynamics. Moreover, to allow design of credible problems in PBL, it is established that facilitators' must have industrial experiences and real-life phenomena exposure (Tik, 2014). As stated by Kukkamalla, et al., (2011) ineffective problem design will lead to failure of the learning process. These therefore draw attention to the

importance of training teachers on the science of facilitation and providing platform for industrial interactions and exposure to real life occurrences.

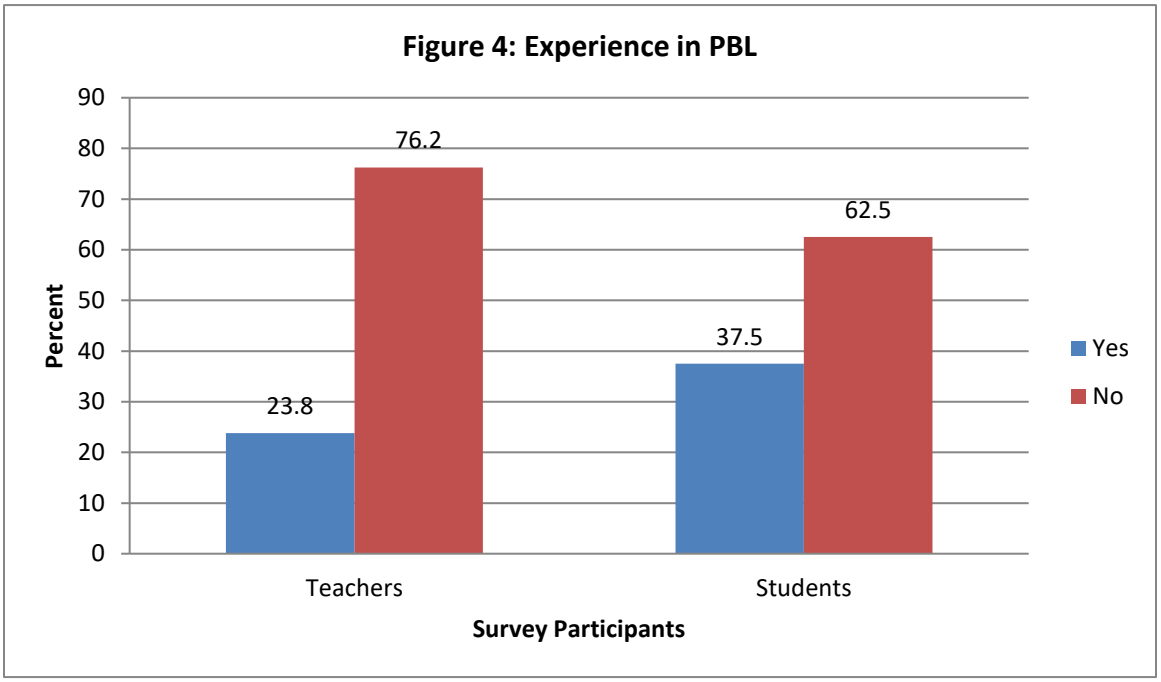
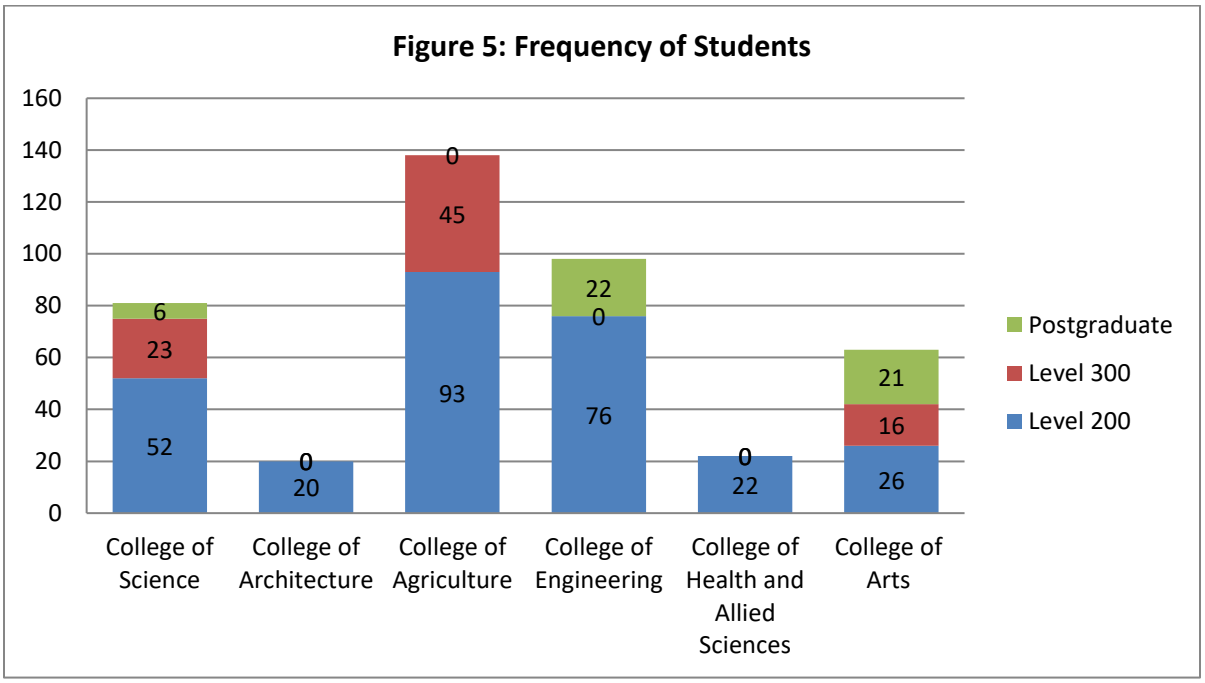


Table 2: Test of Proportion for Participants Experience in PBL

	QUESTION: Teachers- are you practicing any form of PBL or similar student centered teaching and learning in your teaching activities? Students- Have you at any time in connection with your studies here at the u/c/d been exposed to student centered teaching/learning?			
Survey Participants	**Sample Proportion (%)**	**95% Confidence Interval**		**P-Value**
Teachers	23.8	38.4	81.9	0.383
Student	37.5	34.6	40.6	0.000

Figure 5 shows the frequency distribution of students who were exposed to PBL in their study activities within the university. The data seems to suggest that college and level of study are

good candidates for predicting the number students who reported to have had PBL exposure. This is because the frequency of student participants with PBL exposure varies across colleges and levels of study.



Poisson and negative binomial (NB) regression analysis were performed to assess the hypothesis that the college of study and level of study are predictors of the proportion of student participants with PBL exposure. The fit statistics for the models are presented in Table 5.

Table 5: Fit Statistics of Poisson and NB Models for PBL Exposure

Statistic	Poisson model	Negative Binomial Model
Residual Deviance	151.12	14.03
DF	10	10
Dispersion parameter (Residual dev./DF)	15.11	1.40
AIC	229.07	231.06

The dispersion parameter of the Poisson model is 15.11. This depicts that the data is over dispersed, hence suggesting that the Poisson model is inconsistent with the data. However, in the negative binomial model, the dispersion parameter is sufficiently close to 1, therefore providing adequate fit for the data. In that regard, in the analysis presented below, the negative binomial model was used (Table 6).

Table 6: NB Regression Estimates of Rate Ratios for PBL Exposure

Variables	Rate Ratios (RR)	95% CI for Ratio Rate		p-value
Intercept	55.70	43.85	69.12	0.000***
College of Science				
College of Architecture	0.25	0.15	0.39	0.000***
College of Agriculture	1.70	0.30	2.25	0.000***
College of Engineering	1.21	0.90	1.63	0.246
College of Health and Allied Sciences	0.27	0.17	0.43	0.000***
College of Arts	0.78	0.56	1.08	0.135
Level 200				
Level 300	0.29	0.23	0.37	0.000***
Postgraduate	0.17	0.12	0.23	0.000***

When controlled for the level of study, College of Agriculture appeared to be the College with highest proportion of PBL exposure in students (RR=1.70; 95% CI=0.30-2.25) compared with College of Science. In addition, student participants of College of Engineering had 21% PBL exposure more than College of Science. Whilst the association between College of Agriculture and students' exposure to PBL appeared to be significant, a non-significant association was found for the case of College of Engineering. Students' exposure to PBL was significantly lower among survey participants of College of Health and Allied Sciences. Of the aforementioned College, students exposure to PBL was about 73% less than students participants of College of Science. Similarly, College of Architecture (RR=0.25), and College of Arts (RR=0.56) had fewer proportion of students with PBL exposure.

Secondly, controlling the college factor, PBL exposure in level 300 student participants was 71% less than participants of level 200. Equally, postgraduate student participants' exposure to PBL was 83% less than students of level 200. Both level 300 and postgraduate level were significantly associated with the number of students with PBL exposure.

Conclusion

This study demonstrates that a proportion of the teaching and student participants of the KNUST-based BSU survey have experiences that fit into the principles of PBL. However,this

proportion is found to be substantially low in both groups. The study further shows that KNUST has insufficient support for PBL in terms of human and infrastructural resources. With the available human resources, lack of requisite training on the science of facilitation of PBL is evident.To consider PBL as an active backbone of the university, we highlightthe need for introducing standard infrastructural resources, organizing in-service training for teachers on the principles of facilitating PBL and providing platforms for industrial and other real-life situational exposure.

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