Problem-Based Learning and Academic Performance in Medical Technology at A Peruvian Public University

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Abstracts: Introduction: Problem-based learning is a didactic strategy that induces autonomous, meaningful, cooperative, and collaborative learning in students. Objective: To describe the relationship between the didactic strategy of Problem-Based Learning and the academic performance of Radiodiagnosis at the School of Medical Technology at the Universidad Nacional Mayor de San Marcos. Methods: A pedagogical research was conducted at the undergraduate level, of a descriptive type. The universe consisted of 144 students belonging to the Professional School of Medical Technology in the Radiology area of the Universidad Nacional Mayor de San Marcos, who were taking all the subjects, and the sample consisted of 30 students from the Radiodiagnosis subject. Theoretical and empirical methods were applied. To obtain the information, a survey was conducted, following informed consent. Results: The 43.3% have a good evaluation of problem management through the PBL method; 33.3% have a good evaluation of problem orientation and solution search; 36.7% have a good evaluation of team problem-solving; 63.3% have a good evaluation of the integration of previous knowledge; 30.0% have a good evaluation of conclusions in problem-solving; 56.7% have a good evaluation of the PBL method; 43.3% have good academic performance; 60.0% have a good learning category. Conclusion: There are potentials in problem-based learning in the Radiodiagnosis subject among students.

Keywords: Learning, Academic Performance, Higher Education, Virtual Educational Strategies.

1. INTRODUCTION

Problem-based learning emerges as a response to the demands of the Bologna Declaration, being a didactic strategy that adjusts to the challenges of a globalized world which requires a learning different from the traditional one, allowing students to achieve autonomous, meaningful, cooperative, and collaborative learning extended worldwide since the Bologna Declaration began at the School of Medicine of McMaster University in Ontario, Canada, in 1966.

In Peru (Becerra-Canales, Campos-Martinez 2021; Carrasco-Feria et al., 2022; Castañeda-Abascal et al.), proposals strategies for the improvement of education, and in relation to higher education, proposes the new University Law 30220 among others, in its Article 87 paragraph 87.4 states about University Teaching that teacher training must be constant in the acquisition of knowledge, with the teacher carrying out creative intellectual work. In relation to the National Educational Project up to 2021, optimal education for Peru in strategic objective 5 establishes how higher education favors national performance. Therefore, the evolution of Peruvian society is directly related to research, the culture of information, knowledge, professional competence, making it essential for the teacher to have an update in innovative methodological strategies in teaching that responds to student requirements.

Research (Cayo-Rojas et al., 2021; Contreras-Gala & Ramírez-Miranda, 2022; Fabro-Vivas, et al., 2021) presents a learning strategy that should be used as a general strategy outlined in the curriculum of a professional career such as Medical Technology or implemented as a mode of learning in a specific course such as Radiodiagnosis; where the main motivation is to minimize traditional education that minimizes the approach of asking and re-asking which gives rise to new knowledge that is not mechanical or memoristic. Vilca (2007) aimed to "analyze the impact of this didactic strategy and strengthen its use as an educational tool for meaningful learning as a pedagogical proposal. Its results are: Students of the III cycle of the Faculty of Industrial and Civil Engineering, there is a relationship with respect to our first variable for the acquisition of elementary competencies in the teaching of the Chemistry course, which presents a direct correlation. In addition, Rosario, (8) the objective was to establish the relationship of influence of the PBL methodology and academic performance in the Complementary Mathematics subject and statistically significant differences were demonstrated in the research, improving the reading of students in the I semester of the selected Faculty of UNMSM.

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The aforementioned premises and the various research on different topics at the Universidad Nacional Mayor de San Marcos, the Dean of America, combined with the purpose of continuous improvement in the institutional educational model, have motivated the emphasis on the didactic strategy which impacts the academic formation of specialty in Medical Technology students. Furthermore, it favors professional performance in pedagogical management by the teacher and encourages students to use conventional learning tools and the new tools of virtuality for the professional development in health sciences.

The objective was to describe the relationship between problem-based learning and student academic performance in Radiodiagnosis at the School of Medical Technology at the Universidad Nacional Mayor de San Marcos.

2. METHODS

Firstly, a basic, non-experimental, descriptive, and longitudinal research was conducted (Hernández-Sampieri and Mendoza, 2018; Ñaupas, 2018) during the period 2021. The research approach was mixed (Hernández-Sampieri and Mendoza, 2018; Ñaupas, 2018).

Secondly, the population consisted of 144 students in the Radiodiagnosis subject at the Professional School of Medical Technology of the Universidad Nacional Mayor de San Marcos in the Faculty of Human Medicine of San Fernando (FMH-SF), and the sample consisted of 30 students of both genders who were taking the aforementioned subject.

Thirdly, inclusion criteria were that the participating subjects were students belonging to the Professional School of Medical Technology in the Radiology area enrolled in the academic year 2021, who were taking the Radiodiagnosis subject for the first time and expressed their willingness to participate in the research, while exclusion criteria were that participating subjects were students belonging to the Professional School of Obstetrics, Professional School of Nursing, Professional School of Nutrition, and Professional School of Human Medicine enrolled in the academic year 2021, who were taking the Radiodiagnosis subject for the second time and expressed their unwillingness to participate in the research.

Fourthly, the variable called Problem-Based Learning was used in the principle of using problems as a starting point for the acquisition and integration of new knowledge in the Radiodiagnosis subject by students of the

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Professional School of Medical Technology. Additionally, the second variable called Academic Performance was the assessment that the teacher makes of learning in the Radiodiagnosis subject linked to objectives and content of the program and the performance of students of the aforementioned Professional School.

Students voluntarily chose to participate and gave their consent to fill out the questionnaire via email, including a handwritten digital signature. The research was evaluated by the research committee of Universidad Alas Peruanas, ensuring respect for the privacy and dignity of the participants.

Fifthly, the instrument used to determine the learning style of each student was assessment rubrics used as an instrument that evaluates the behavioral observational guidance of the student; this is because the didactic strategy of PBL allows for different learning spaces in the student that allows them to incorporate not only new knowledge but also skills, attitudes, and values; incentivized by the challenge of solving specific problems in the specialty. Additionally, to measure the PBL variable, an assessment rubric of the Radiodiagnosis chapters was applied to corroborate the achievement of learning objectives, and to measure academic performance, an evaluation test about the assigned chapters was applied. The knowledge acquired through PBL was verified by a checklist. For the validation of the rubrics, the participation of 5 expert judgments was requested, who granted validation for each rubric. Regarding academic performance, a data collection form was used, for which the registration of student grades was required, and its validation by the 5 expert judgments previously consulted was necessary.

Sixthly, processing and analysis techniques. Thus, for the organization of the collected data and its tabulation, processing was conducted that requires an evaluation and interpretation of the data when examined, related, and compared; obtaining responses to problems, achievements of objectives, and verifying the validation or nullification of hypotheses. In the research, a certain number of data deduced from the instruments used such as rubrics in problem-based learning were used to measure in the student their behavior in the search for solutions to clinical-radiographic problems of the Digestive and Urogenital chapters of the Radiodiagnosis subject. Data were also obtained from an Academic Performance Evaluation Test which aimed to measure its significant relationship with problem-based learning of the mentioned chapters. The data collected for this research were analyzed using Microsoft Excel 2016 and SPSS 23 statistical software applications. The spreadsheet for presenting results and for data analysis, respectively.

Seventhly, student participation was voluntary at all times, and their inclusion was carried out exclusively and exclusively with the signing of informed consent. Additionally, general law or personal identity data were included; for this reason, alphanumeric codes were used. Also, concerning the database, the integration of the collected information was cleaned up at the end of the research.

3. RESULTS

Below are six tables of research results.

Table 1 Test statistics Correlations

		Learning category and assessment of learning	Problem orientation and solution search
Academic performance	Pearson correlation	1	,728**
	Sig. (bilateral)		,000
	N	30	30
Problem orientation and solution search	Pearson correlation n	,728**	1
	Sig. (bilateral)	,000	
	N	30	30

** Correlation is significant at the 0.01 level (2-tailed).

Source: Radiodiagnosis Subject, UNMSM, 2021

Since sig=0.000 < 0.05, we reject Ho, meaning there is a significant relationship between problem orientation and solution search for the PBL didactic strategy with the learning category and assessment of learning in the

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Radiodiagnosis subject at the Professional School of Medical Technology at UNMSM. Additionally, a positive and high correlation of 0.728 was observed, indicating that as problem orientation and solution search improved, academic performance increased.

Table 2 Test statistics Correlations

		Learning category and assessment of learning	Problem-solving teamwork
Academic performance	Pearson correlation	1	,965[**]
	Sig. (bilateral)		,000
	N	30	30
Problem-solving teamwork	Pearson correlation	,965[**]	1
	Sig. (bilateral)	,000	
	N	30	30

[**]. The correlation is significant at the 0.01 level (2-tailed)

Source: Radiodiagnosis Subject, UNMSM, 2021

Since sig=0.000 < 0.05, we reject Ho, meaning there is a significant relationship between teamwork for problem-solving in the PBL didactic strategy with the learning category and assessment of learning in the Radiodiagnosis subject at the Professional School of Medical Technology at UNMSM. Additionally, a positive and high correlation of 0.965 was observed, indicating that as problem-solving teamwork improved, academic performance increased.

Table 3 Test Statistics. Correlations

		Learning category and assessment of learning	Integration of prior knowledge with acquired knowledge;
Academic performance	Pearson correlation	1	,794[**]
	Sig. (bilateral)		,000
	N	30	30
Integration of prior knowledge with acquired knowledge,	Pearson correlation	,794[**]	1
	Sig. (bilateral)	,000	
	N	30	30

[**] The correlation is significant at the 0.01 level (2-tailed)

Source: Radiodiagnosis Subject, UNMSM, 2021

Since sig=0.000 < 0.05, we reject Ho, meaning there is a significant relationship between the integration of prior knowledge with acquired knowledge by the PBL didactic strategy with the learning category and assessment of learning in the Radiodiagnosis subject at the Professional School of Medical Technology at UNMSM. Additionally, a positive and high correlation of 0.794 was observed, indicating that as the integration of prior knowledge with acquired knowledge improves, academic performance increases.

Table 4 Test statistic Correlations

		Learning category and assessment of learning	Conclusions in problem-solving
Academic performance	Pearson correlations	1	,837[**]
	Sig. (bilateral)		,000
	N	30	30
Conclusions in problem-solving	Pearson correlations	,837[**]	1
	Sig. (bilateral)	,000	
	N	30	30

[**]. The correlation is significant at the 0.01 level (2-tailed).

Source: Radiodiagnosis Subject, UNMSM, 2021

Since sig=0.000 < 0.05, we reject Ho, meaning there is a significant relationship between the conclusions of problem-solving by the PBL didactic strategy with the learning category and assessment of learning in the Radiodiagnosis subject at the Professional School of Medical Technology at UNMSM. Additionally, a positive and high correlation of 0.837** was observed, indicating that as the conclusions in problem-solving improve, academic performance increases.

Table 5 Test statistic Correlations

		Academic performance	ABP
Academic performance	Pearson correlations	1	,949**
	Sig. (bilateral)		,000
	N	30	30
ABP	Pearson correlations	,949**	1
	Sig. (bilateral)	,000	
	N	30	30

**. The correlation is significant at the 0.01 level (2-tailed).

Source: Radiodiagnosis Subject, UNMSM, 2021

Since sig=0.000 < 0.05, we reject Ho, meaning there is a significant relationship between the Problem-Based Learning didactic strategy and the academic performance of Radiodiagnosis students at the School of Medical Technology of the Universidad Nacional Mayor de San Marcos. Additionally, a positive and high correlation of 0.949** was observed, indicating that as the Problem-Based Learning didactic strategy improves, academic performance increases.

4. DISCUSSION

In the research, the two variables used have a relationship with each other in the selected students for this purpose.

Firstly, the discussion process (Flores-Girón & Paz-Maldonado,2021; Gari-Calzada & Sewani-Rusike, 2022; Gavilondo-Mariño, et al, 2022) is based on the results obtained in the dimensions of the first variable such as Problem Setting in Radiodiagnosis, Problem Orientation and Solution Search in Radiodiagnosis, Teamwork for Problem Solving, Integration of Prior Knowledge with Acquired Knowledge, and Conclusions in Problem Solving, with the dimensions of the second variable such as Acquired Knowledge and Assessment of Learning Obtained.

Out of the total students (Huacho-Chávez et al., 2022; Iglesias & Saavedra-Camacho, 2020; Lima-Sarmiento, 2021), 43.3 % have a good evaluation of problem management by the PBL method; 33.3 % have a good evaluation of Problem Orientation and Solution Search; 36.7 % have a good evaluation of Teamwork for Problem Solving by the PBL method; 63.3 % have a good evaluation of Integration of Prior Knowledge with Acquired Knowledge by the PBL method; 30.0% have a good evaluation of Conclusions in Problem Solving by the PBL method; 56.7% have a good evaluation of the PBL method; 43.3 % have good academic performance; and 60.0% have a good learning category.

Secondly, concerning the hypotheses, it was found that there is a relationship between the management of the Problem-Based Learning didactic strategy and academic performance. Likewise, a positive and high correlation was observed, indicating that as problem management improves, academic performance increases (Miranda, López-Valencia & Serra, 2022; Mucha-Hospinal et al., 2022; Rizo-Vázquez et al., 2021). In the field of radiodiagnosis, it is identified based on the identification of the problem, previous empirical and academic research carried out at the university, the areas of interest of the students, the methodology, the didactics to establish how the teacher-student delve into the topic to formulate a question that can be problematized and then know how to respond from the PBL methodology.

However, in our research, a notable fact was that this first dimension (Rodríguez-Pérez et al., 2022; Sánchez-Correa et al., 2021; Sánchez-Trujillo & Rodríguez-Flores, 2021) had difficulties in forming groups of three by breaking with innovative proposals. Initiative is encouraged by proposing from the university's official syllabus how to explain the causes and solutions from different perspectives to generate a variety of problems with variant responses. Students empower themselves to generate meaningful learning experiences by turning information into the means of their learning, thereby minimizing memorization or rhetoric in class through innovative and interconnected questions related to the studied specialty.

Thirdly, there is a significant relationship between problem orientation and solution search by the Problem-Based Learning didactic strategy and the academic performance of Radiodiagnosis students at the Professional School of Medical Technology at UNMSM. Likewise, a positive and high correlation of 0.728 was observed, indicating that as problem orientation and solution search improve, academic performance increases (Soler-Morejón and Borjas-Borjas, 2020; Vialart-Vidal, 2020). Regarding orientation to media and methods, designing their problem-solving tools leads them to use the internet in class, as well as using a portfolio to provide evidence of their progress in possible resolutions according to their specialty through essays, mind maps, intervention proposals, among others.

Fourthly, there is a significant relationship between teamwork for problem solving by the Problem-Based Learning didactic strategy and the academic performance of Radiodiagnosis students at the Professional School of Medical Technology at UNMSM. Additionally, a positive and high correlation of 0.965 was observed, indicating that as problem-solving teamwork improves, academic performance increases because it formalizes the responsibility of learning in students, stimulates the concerns of each participant, and fosters building knowledge together.

Fifthly, there is a significant relationship between the integration of prior knowledge with acquired knowledge by the Problem-Based Learning didactic strategy and the academic performance of Radiodiagnosis students at the Professional School of Medical Technology at UNMSM. Additionally, a positive and high correlation of 0.794 was observed, indicating that as integration of prior knowledge with acquired knowledge improves, academic performance increases. Radiodiagnosis students, by living with research, encourage self-learning by strengthening their higher thought processes with their prior knowledge.

Sixthly, there is a significant relationship between the conclusions of problem solving by the Problem-Based Learning didactic strategy and the academic performance of Radiodiagnosis students at the Professional School of Medical Technology at UNMSM. Additionally, a positive and high correlation of 0.837** was observed, indicating that as conclusions in problem solving improve, academic performance increases. Thus, drawing conclusions requires discipline, interest, commitment, and willingness to improve formulating their categorical statements. In terms of attitude, tools such as blogs and Facebook were used responsibly for groups to work orderly.

Seventhly, there is a significant relationship between the Problem-Based Learning didactic strategy and the academic performance of Radiodiagnosis students at the Professional School of Medical Technology at UNMSM. Additionally, a positive and high correlation of 0.949** was observed, indicating that as the Problem-Based Learning method improves, academic performance increases. These results demonstrate the relationship between both because they are educational institutions that assume policies, models, culture, and educational management influencing academic performance based on evidence from evaluations.

Eighthly, among the main limitations was that the Problem-Based Learning didactic strategy was applied only in two of the 15 chapters belonging to the annual Radiodiagnosis subject at UNMSM.

Ninthly, the difference with Vilca-Arana (7) was elaborated in industrial and civil engineering at a confessional university before the pandemic. Their contribution to critical thinking and self-learning and collaborative work occurred in the chemistry subject face-to-face, thus having a dialogical interaction in real-time. It differs from our research by having a different epistemological field. It is worth noting the research by Rosario-López (8), who focuses on the PBL methodology from the teacher who supervises the learning. In this case, the student acted in an instrumentalized way since their results are based on fulfilling and optimizing learning without any connection with their profile of entry and the profile of graduate.

CONCLUSIONS

First, to monitor to ensure that students apply their knowledge according to their specialty in the Radiodiagnosis subject of the School of Medical Technology at the Universidad Nacional Mayor de San Marcos, in Lima, during the year 2021. This involves analyzing the connection between problem formulation through the Problem-Based Learning educational strategy and the learning and evaluation category.

Second, the relationship between problem orientation and solution search by the Problem-Based Learning didactic strategy requires continuous support so that each student selects reliable sources for their learning in the subject.

Third, the relationship between teamwork for problem-solving by the Problem-Based Learning didactic strategy has required students to develop soft skills to collaboratively complete the assignments assigned each week in the subject.

Fourth, the relationship between the integration of prior knowledge with acquired knowledge by the Problem-Based Learning didactic strategy has required guiding questions, both structured and semi-structured, for the student to link their prior knowledge with the new knowledge of the subject.

Fifth, the relationship between conclusions in problem-solving by the Problem-Based Learning didactic strategy has required an elaboration of the epistemological, methodological, and ontological aspects in order to have knowledge in a way that fulfills a procedure or several in an honest manner without plagiarism.

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