Revista Revoluciones. Estudios en Ciencia Política, Humanidades y Sociales
Rev. Revoluciones. (2022). Vol. 4 Núm. 9
www.revistarevoluciones.com
Editada por: Instituto Universitario de Innovación Ciencia y Tecnología Inudi Perú

ORIGINAL ARTICLE

Use of active strategies for meaningful learning of physics in students of the National University of Altiplano

Uso de estrategias activas para el aprendizaje significativo de la física en estudiantes de la Universidad Nacional del Altiplano

Uso de estratégias ativas para a aprendizagem significativa de física em estudantes da Universidad Nacional del Altiplano

German Yabar-Pilco [1]
UNIVERSIDAD NACIONAL DEL ALTIPLANO, PUNO - PERÚ
geyapi@unap.edu.pe
https://orcid.org/0000-0003-3340-3714

Polan Ferró-Gonzales
UNIVERSIDAD NACIONAL DEL ALTIPLANO, PUNO - PERÚ
polanf@unap.edu.pe
https://orcid.org/0000-0003-4766-4982

DOI: https://doi.org/10.35622/j.rr.2022.09.003
Recibido: 17-VII-2021 / **Aceptado:** 01-VII-2022 / **Publicado:** 18-VIII-2022

Abstract

Learning outcomes of physics in university education have difficulties in most cases, especially in skills development. In this investigation, active methodological strategies were applied, through the paired differences test it was concluded that with the experimental method better results were obtained than with problem-based learning in a sample of 8 students, in addition to improving their skills for teamwork and capacity development of high cognitive demand.

Keywords: active strategies, competencies, experimental method, meaningful learning, problem-based learning.

Correspondence: geyapi@unap.edu.pe
[1] Professor of the Physics-Mathematics Specialty from Santa María de Arequipa Catholic University, Master in Educational Administration, and Doctor of Education from Inca Garcilaso de la Vega University in Lima

ISSN: 2710-0499 ISSN-L: 2710-0480

ISSN: 2710-0499 ISSN-L: 2710-0480

Resumen

Los resultados del aprendizaje de la física en la educación universitaria presentan dificultades en la mayoría de los casos, especialmente en el desarrollo de competencias. En esta investigación se aplicaron estrategias metodológicas activas, a través de la prueba de diferencias apareadas se concluyó que con el método experimental se obtuvieron mejores resultados que con el aprendizaje basado en problemas en una muestra de 8 estudiantes, además de mejorar sus habilidades para el trabajo en equipo y capacidad desarrollo de una alta demanda cognitiva.

Palabras clave: aprendizaje basado en problemas, aprendizaje significativo, competencias, estrategias activas, método experimental.

Resumo

Os resultados do aprendizado da física na educação universitária apresentam dificuldades na maioria dos casos, especialmente no desenvolvimento de competências. Ao se investigar a aplicação de estratégias metodológicas ativadas, a travessia da pesquisa de diferenças aparecidas se concluiu que com o método experimental obteve melhores resultados que com o aprendiz baseado em problemas em uma amostra de 8 estudantes, ademais de melhorar suas habilidades para o trabalho em equipo e capacidade de desenvolvimento de uma alta demanda cognitiva.

Palavras-chave: Estratégias ativas, competências, método experimental, aprendizagem significativa, aprendizagem baseada em problemas.

INTRODUCTION

Higher education centers (universities and institutes) face an unavoidable challenge regarding the configuration of their curricula according to the demands of society (Delgado-Linares et al., 2013). At the university level, competency-based education predominates, through practical learning experiences and not only theoretical knowledge, but also procedural and attitudinal knowledge (Turcio-Ortega & Palacios-Alquisira, 2015)

The learning of physics and chemistry triggers in the students more negative than positive emotions (Dávila, Cañada, Sánchez, & Mellado, 2016), being constructivism a theoretical framework of alternative reference for students to modify their deeply rooted traditional scientific concepts that are very difficult to modify (Bañas, Ruiz, & Mellado, 2011). Therefore, the teaching of Physics requires the application of innovative strategies focused on currents such as constructivism (Páez Pereira, 2018), whose learning results must be observable or measurable; and demonstrate in the development of competencies (Ros, Navarro, & Rambla, 2017).

Competence-based education refers to a practical experience, for which strategies such as Problem Based Learning (PBL), Case Analysis, Experimental Method and others should be considered (Adolfo Obaya, Yolanda Marina Vargas, & Graciela Delgadillo, 2011).

The PBL allows combining the acquisition of knowledge with the development of other essential skills (Morales Castillo & Ruiz, 2015) and apply them to solve a real or fictitious problem, where the teacher does not use the master or traditional lesson in the transmission of knowledge (González Morales & Díaz Alfonso, 2006). Therefore, it is a methodology that promotes teamwork and a desire to learn (Egido Gálvez et al., 2006), being of great help in basic sciences (mathematics, physics and chemistry), characterized by abstraction and modeling, that is, very abstract theoretical knowledge (Furió, 2006). PBL can increase student motivation and the possibility of transferring knowledge to new situations or problems (Morales Castillo & Ruiz, 2015).

To facilitate active learning, experimentation is considered as a motivational mechanism, which promotes teamwork and favors the understanding of scientific knowledge and reasoning (Bravo, Ramírez, Faúndez, & Astudillo, 2016; Pérez, Díaz-Mujica, González-Pienda, & Núñez, 2017), In addition to the application of concepts and development of inference procedures, generalization and abstraction, the preparation and justification of research, the issuance of hypotheses, the restructuring and accommodation of networks of individual concepts that give meaning to what is learned, knowledge of the alternative conceptions of students and the approach to the conflict between personal ideas and scientific models (G. Hernández, Irazoque, & López, 2018)

METHOD

To achieve the general objective of the research, which is to determine the influence of the use of active strategies in improving the level of significant learning of physics in students of the Faculty of Education Sciences of the National University of the Altiplano and the specific objectives of determine the influence of the use of the experimental method and the use of problem-based learning for meaningful learning of Physics in faculty students and finally compare the results of both strategies and determine whether they differ significantly from each other; the research design has been defined is the transectional or transversal which collects data in a single time (R. Hernández, Fernández, & Baptista, 2014) after the application of the experimental method and the use of problem-based learning. It is also framed within the quasi-experimental research guaranteeing internal and external validity criteria (Briones, 2002)

The results were collected through skills assessment instruments, according to Mejía (2005) these learning assessment instruments are based on a criterion previously established in this case the vigesimal scale. The active strategies used are: The experimental method and problem-based learning.

RESULTS AND DISCUSSION

For the analysis of the collected results, it was carried out independently for each of the active strategies and then those results were compared to determine which of the strategies obtained better results in the learning of Physics in students of the Faculty of Sciences of the Education.

ISSN: 2710-0499 ISSN-L: 2710-0480

Table 1.
Physics learning results by unit through the use of problem-based learning

Individual	Unit			Average
	I-U	II-U	III-U	
E1	11	10	13	11,33
E2	08	13	15	12,00
E3	00	08	11	6,33
E4	17	18	17	17,33
E5	05	10	16	10,33
E6	11	13	16	13,33
E7	05	11	12	9,33
E8	11	15	12	12,67

From table 1; Of the 8 students enrolled in Physics, the minimum average obtained is 6.33 and the maximum average is 17.33, with an overall average of 11.58 points on the vigesimal scale, making use of problem-based learning. Therefore, the ABP as a pedagogical tool is a strategy to achieve significant active learning of practical type (Castro & Papahiu, 2013) which favors the transfer of knowledge, procedures and application of attitudes in problem solving (Adolfo Obaya et al., 2011). This methodology encourages group work, making it essential to use resources such as books, scientific journals, Internet, etc (Fernández & Aguado, 2017).

Table 2.
Physics learning results by unit through the use of experimental method

Individual	Unit			Average
	I-U	II-U	III-U	
E1	16	12	15	14,33
E2	18	14	15	15,67
E3	0	13	0	04,33
E4	17	15	16	16,00
E5	16	13	16	15,00
E6	16	15	15	15,33
E7	12	15	14	13,67
E8	18	16	16	16,67

According to Table 2, of the 8 students enrolled in Physics the minimum average obtained is 4.33 and the maximum average is 16.63 with a general average of 13.88 points on the vigesimal scale using the Experimental Method which It is characterized in that the teacher manages to induce the group of students to design their work strategy and follow their own procedures (Turcio-Ortega & Palacios-Alquisira, 2015). These results agree with what was found by Bravo et. al. (2016) where their results show that the students obtained a high conceptual gain in learning observed in the increase in grades and there was a change in the work dynamics of the students. Therefore, there is an improvement in conceptual learning compared to traditional teaching (Rosales, Mercado, Monasterolo, & Ribotta, 2016) when interacting with objects and with other subjects. Most science teachers believe that familiarization with scientific methods, through the completion of abundant laboratory practices, is a priority objective of science education (G. Hernández et al., 2018).

Table 3.

Paired sample test of Physics learning outcomes through the use of Problem Based Learning (PBL) and Experimental Method (EM)

	Paired differences				t	degrees of freedom	Sig. (bilateral)
	Average	Standard deviation	95% confidence interval of difference				
			Inferior	Superior			
EM - PBL	2,29	2,58	0,13	4,45	2,51	7	,040

According to Table 3, when analyzing the paired differences test, the results using both strategies have a tc of 2.51 and the Sig value is less than 0.05, therefore the Experimental Method shows better results than Problem Based Learning. The results show that appropriate constructivist strategies must be applied to achieve significant learning in students (Páez Pereira, 2018) according to the characteristics of the subject and the students. In accordance with the above, Braga, Gallardo, Calderón, Morales, & Kling (2011), they propose that students entering the area of physics must achieve a set of skills and abilities which must be possessed to ensure an effective teaching-learning process.

CONCLUSION

The results obtained show evidence that the use of active methodological strategies promotes the development of competences in Physics, however, the experimental method shows better results than problem-based learning, mainly due to the characteristics of the subject and the contents developed. In addition to improving their development in teamwork and the development of capacities of high cognitive demand.

Consideraciones éticas y financiamiento

Conflicto de intereses / Competing interests:

Los autores declaran que no incurren en conflictos de intereses.

Rol de los autores /Authors Roles:

No aplica.

Fuentes de financiamiento / Funding:

Los autores declaran que no recibió un fondo específico para esta investigación.

Aspectos éticos / legales; Ethics / legals:

Los autores declaran no haber incurrido en aspectos antiéticos, ni haber omitido aspectos legales en la realización de la investigación.

REFERENCES

Adolfo Obaya, V., Yolanda Marina Vargas, R., & Graciela Delgadillo, G. (2011). Aspectos relevantes de la educación basada en competencias para la formación profesional. *Educación Química*, *22*(1), 63–68. https://doi.org/10.1016/S0187-893X(18)30116-2

Bañas, C., Ruiz, C., & Mellado, V. (2011). Un programa de investigación – acción con profesorado de secundaria sobre la enseñanza – aprendizaje de la energía. *Educación Química*, *22*(4), 332–339. https://doi.org/10.1016/S0187-893X(18)30153-8

Braga, L., Gallardo, R., Calderón, M., Morales, J., & Kling, N. (2011). *Espectro de dificultades que presentan los alumnos que ingresan a la Universidad de Concepción en las carreras de ingeniería y licenciatura en física*.

Bravo, A. A., Ramírez, G. P., Faúndez, C. A., & Astudillo, H. F. (2016). Propuesta didáctica constructivista para la adquisición de aprendizajes significativos de conceptos en física de fluidos. *Formacion Universitaria*, *9*(2), 105–114. https://doi.org/10.4067/S0718-50062016000200012

Briones, G. (2002). *Metodología de la investigación cuantitativa en las ciencias sociales*. Bogotá.

Castro, J. C. P., & Papahiu, P. C. (2013). La enseñanza de la biología en el bachillerato a partir del aprendizaje basado en problemas (ABP). *Perfiles Educativos*, *35*(139), 93–109. https://doi.org/10.1016/s0185-2698(13)71811-7

Dávila, M., Cañada, F., Sánchez, J., & Mellado, V. (2016). Las emociones en el aprendizaje de física y química en educación secundaria. Causas relacionadas con el estudiante. *Educacion Quimica*, *27*(3), 217–225. https://doi.org/10.1016/j.eq.2016.04.001

Delgado-Linares, J. G., Gutiérrez, C., Salazar, F., Guevara, M., Mercado, R., & Pereira, J. C. (2013). Aplicación de conceptos clásicos de la física en la práctica ingenieril. La ley de Stokes como herramienta conceptual en el análisis de procesos de deshidratación del petróleo. *Educacion Quimica*, *24*(1), 57–62. https://doi.org/10.1016/s0187-893x(13)73196-3

Egido Gálvez, I., Aranda Redruello, R., Cerrillo Martín, R., Herrán Gascón, A., Miguel Badesa, S., Gómez García, M., … Pérez Serrano, M. (2006). Aprendizaje basado en problemas (ABP) Estrategia metodológica y organizativa del currículum para la calidad de la enseñanza en los estudios de Magisterio. *Revista Interuniversitaria de Formación Del*

Profesorado, *20*(57), 137–150. Retrieved from https://www.redalyc.org/pdf/274/27411311007.pdf

Fernández, C., & Aguado, M. (2017). Aprendizaje basado en problemas como complemento de la enseñanza tradicional en Fisicoquímica. *Educacion Quimica*, *28*(3), 154–162. https://doi.org/10.1016/j.eq.2017.03.001

Furió, C. (2006). La motivación de los estudiantes y la enseñanza de la Química. Una cuestión controvertida. *Educación Química*, (17), 222–227. Retrieved from https://chemistrynetwork.pixel-online.org/data/SMO_db/doc/78_pdf961.pdf

García, E., & Ruiz, L. (2015). Técnicas e Instrumentos de Investigación. *PhD Proposal*, *1*, 1–9. https://doi.org/10.1017/CBO9781107415324.004

González Morales, D., & Díaz Alfonso, Y. (2006). La importancia de promover en el aula estrategias de aprendizaje para elevar el nivel académico en los estudiantes de Psicología. *Revista Iberoamericana de Educación*, *40*(1), 8.

Hernández, G., Irazoque, G., & López, N. (2018). ¿Cómo diversificar los trabajos prácticos? Un experimento ilustrativo y un ejercicio práctico como ejemplos. *Educación Química*, *23*(Extraord. 1), 101–111. https://doi.org/10.1016/s0187-893x(17)30142-8

Hernández, R., Fernández, C., & Baptista, P. (2014). *Metodología de la Investigación* (6ta ed.; McGrawHill, Ed.). México.

Morales Castillo, J. D., & Ruiz, M. V. (2015). El debate en torno al concepto de competencias. *Investigación En Educación Médica*, *4*(13), 36–41. https://doi.org/10.1016/s2007-5057(15)72167-8

Páez Pereira, A. R. (2018). Estrategias Constructivistas Aplicadas por el Docente para el Aprendizaje de la Física en el Nivel Superior. *Revista Scientific*, *3*(7), 37–56. https://doi.org/10.29394/scientific.issn.2542-2987.2018.3.7.2.37-56

Pérez, M. V., Díaz-Mujica, A., González-Pienda, J. A., & Núñez, J. C. (2017). Docencia para facilitar el aprendizaje activo y autorregulado. *Revista Diálogo Educacional*, *10*(30), 409. https://doi.org/10.7213/rde.v10i30.2509

Ros, L., Navarro, Y., & Rambla, T. (2017). La enseñanza en Radiología: un nuevo método para planificar y evaluar por competencias. *Revista Argentina de Radiologia*, *81*(4), 279–284. https://doi.org/10.1016/j.rard.2017.02.002

Rosales, F., Mercado, V., Monasterolo, R., & Ribotta, S. (2016). Implementación de un

laboratorio de física en tiempo real para el aprendizaje activo de circuitos eléctricos. *Formacion Universitaria*, *9*(6), 3–12. https://doi.org/10.4067/S0718-50062016000600002

Turcio-Ortega, D., & Palacios-Alquisira, J. (2015). Experiencias en la enseñanza experimental basada en competencies. *Educacion Quimica*, *26*(1), 38–42. https://doi.org/10.1016/S0187-893X(15)72096-3