INQUIRY-BASED LEARNING AND COLLABORATIVE WORK IN UNDERGRADUATE STUDENTS

Manuela Daishy Casa-Coila, Paula Soledad Mamani-Vilca, David Pari-Achata, Eder Pacori-Zapana, Katia Perez-Argollo, Juan Segundo Paredes-Aliaga

ABSTRACT

Objective: The objective of the research was to establish the relationship between Inquiry Based Learning (hereafter IBL) and collaborative work in university students.

Method: The research methodology corresponds to a quantitative experimental approach, with a cross-sectional design. The population consisted of 279 students of the Science, Technology and Environment Studies Program (STE) of the Faculty of Educational Sciences (FCEDUC) of the National University of the Altiplano (UNA) Puno, whose sample consisted of 162 students selected by means of a probabilistic sampling, to which the questionnaire was applied, which allowed determining the relationship between the study variables.

Results: The results showed that there is a relationship according to Spearman's coefficient rho = 0.521** which is a positive correlation.

Conclusions: Concluding that if students work in teams with the IBL strategy, they could better develop their competencies and capabilities.

Originality/value: The implementation of this strategy is crucial to enhance meaningful learning in students in relation to the focus on Inquiry-Based Learning and collaborative work.

Keywords: learning, competency, strategy, research, teamwork.

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RESUMO

Objetivo: O objetivo da pesquisa foi estabelecer a relação entre a Aprendizagem Baseada em Investigação (IBL) e o trabalho colaborativo em estudantes universitários.

Método: A metodologia de pesquisa corresponde a uma abordagem experimental quantitativa, com um projeto de corte transversal. A população consistiu em 279 alunos do Programa de Estudos de Ciência, Tecnologia e Meio Ambiente (CTA) da Faculdade de Ciências da Educação (FCEDUC) da Universidade Nacional do Altiplano (UNA) Puno, cuja amostra consistiu em 162 alunos selecionados por meio de uma amostragem probabilística e aos quais foi aplicado o questionário, o que possibilitou determinar a relação entre as variáveis do estudo.

Resultados: os resultados mostraram que há uma relação de acordo com o coeficiente rho de Spearman = 0.521** que é uma correlação positiva média.

Conclusões: Concluindo que os alunos, se trabalhassem em equipes com a estratégia ABI, poderiam melhorar o desenvolvimento de suas competências e habilidades.

Originalidade/valor: A implementação dessa estratégia é fundamental para aprimorar a aprendizagem significativa dos alunos em relação ao foco na aprendizagem baseada em pesquisa e no trabalho colaborativo.

Palavras-chave: aprendizagem, competência, estratégia, pesquisa, trabalho em equipe.

APRENDIZAJE BASEADO EN INVESTIGACIÓN Y TRABAJO COLABORATIVO EN ESTUDIANTES UNIVERSITARIOS

RESUMEN

Objetivo: El objetivo de la investigación fue establecer la relación entre el Aprendizaje Basado en Investigación (ABI en adelante) y el trabajo colaborativo en estudiantes universitarios.

Método: La metodología de investigación corresponde al enfoque cuantitativo de tipo experimental, con diseño transversal. La población fue conformada por 279 estudiantes del Programa de estudios de Ciencia, Tecnología y Ambiente (CTA) de la Facultad de Ciencias de la Educación (FCEDUC) de la Universidad Nacional del Altiplano (UNA) Puno, cuya muestra fueron 162 estudiantes seleccionados mediante un muestreo probabilístico en ellos se aplicó el cuestionario, que permitieron determinar la relación entre las variables de estudio.

Resultados: Los resultados fueron que existe relación de acuerdo al coeficiente de Spearman rho = .521** ubicándose en una correlación positiva media.

Conclusiones: Concluyendo que los estudiantes si trabajan en equipo con la estrategia de ABI, podrían mejorar desarrollar sus competencias y capacidades.

Originalidad/valor: La implementación de esta estrategia es crucial para mejorar el aprendizaje significativo en los estudiantes en relación al enfoque en el Aprendizaje Basado en la Indagación y el trabajo colaborativo.

Palabras clave: aprendizaje, competencia, estrategia, investigación, trabajo en equipo.
1 INTRODUCTION

Research-based learning originated in the theories of John Dewey, which consists of a constructivist educational approach that considers learning as a social and active process. In this paradigm, students construct their own knowledge through interaction and collaboration with their peers and teachers, using various resources in a specific context. (García & Quevedo, 2021). The popularity of the ABI educational approach has increased significantly in recent years in science courses, research internationally and in the educational field, therefore this method involves students employing methods and practices similar to those used by professional scientists to build and strengthen their understanding and knowledge by encouraging the active construction of knowledge (Gamarra et al., 2022; Santana-Vega et al., 2020). Thus, inquiry-based teaching refers to curriculum design in which students need to make intellectual and practical connections between the content and skills set out in the program, and the research approaches and boundaries of the disciplines that make up the program. (Higinio et al., 2021).

Likewise, in IBL, students can engage in the process of inquiry using the scientific method, which allows them to apply knowledge, skills and attitudes. Thus, the implementation of this approach develops research skills in students, allowing them to understand and experience the research process from the early years of educational training until the end of their academic education. (Rivadeneira & Silva, 2017). In that sense the implementation of IBL in teaching requires students to develop research skills to solve problems both within and outside their field of study, therefore this educational methodology differs from the traditional approach, as it involves the practice of research during the development of the course, it is a unique opportunity to learn to investigate actively and applied from the beginning of the studies (Peñaherrera et al., 2014).

The IBL-centered teaching method seeks to integrate learning with research in the educational environment, with the assistance of a facilitator. It is similar to other pedagogical approaches such as Project-Based Learning, Problem-Based Learning, which employ the scientific method to create knowledge, encouraging the conduct of current research (Casa et al., 2019; Universitat Pompeu Fabra [UPF], 2024).

Teamwork is an effective strategy to enhance the incorporation of recent information, based on collaboration among the members of a work group. (Santana et al., 2021) it is also situated within inter-training processes, where participants learn from each
other and reshape the object of study through dialogue, participation and joint construction of knowledge (López-Gil & Natera, 2018). In addition to promoting the active participation of students in the construction of knowledge, this strategy is based on principles such as teamwork, experiential activity, creativity and shared responsibility, so it is important that collaborative strategies meet criteria such as the formation of small and heterogeneous teams, the relationship of individual success with that of the group, and good organization to ensure shared responsibility. (Espinoza, 2022).

On the other hand, the process of learning together about scientific knowledge in educational settings is considered a socio-cognitive constructivist process, since it involves the joint construction of knowledge among group members, reflecting the social creation of knowledge. (Leiva et al., 2020).

Students in higher education face challenges that lead them to conduct collaborative research using the IBL approach, this not only improves the efficiency of the teaching-learning process, but also allows the application of (Delors, 1994) four pillars of education, which aim to improve methodological strategies and promote the development of interpersonal, socioemotional and creative skills in students.

2 METHODOLOGY

The study was conducted at FCEDUC UNA Puno, during the year 2023-II. The research methodology used was the positivist paradigm, non-experimental quantitative approach, with a cross-sectional correlational design characterized by describing the study variables IBL and collaborative work (Hernández-Sampieri & Mendoza, 2018). The study population consisted of 279 students of the STE study program, from which a probabilistic sample of 162 students was taken, to whom a survey was administered using the IBL questionnaire, which was taken and adapted from the IBL questionnaire. (Vergara, 2022) this instrument has been submitted to a pilot test of 28 students for reliability by means of Cronbach's Alpha which was $\alpha=0.910$, which had 20 items qualitatively and grouped with a rating scale from 1 to 5, where 1 is completely disagree, 2: disagree, 3: indifferent; 4: agree and 5: completely agree. And for the collaborative work study variable, the following was taken and adapted from (Orellana et al., 2014) which consists of 18 items, were also qualitative with a scale ranging from 1 to 5 with the following values: 1: completely disagree, 2: disagree, 3: indifferent, 4: agree and 5:
completely agree. Likewise, the reliability of the instrument was determined, which was $\alpha=0.873$. Both instruments had high internal consistency and reliability. Table 2 and 3 show their reliability.

### Table 1

**Sociodemographic characteristics of the sample**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Categories</th>
<th>Score</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Media 21 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>Female 91</td>
<td></td>
<td>56.2%</td>
</tr>
<tr>
<td></td>
<td>Male 71</td>
<td></td>
<td>43.8%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>162</td>
<td>100%</td>
</tr>
</tbody>
</table>

Source: own elaboration

### Table 2

**Reliability of the Inquiry-Based Learning questionnaire.**

<table>
<thead>
<tr>
<th>Reliability statistics</th>
<th>N of elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cronbach's alpha</td>
<td>20</td>
</tr>
</tbody>
</table>

Source: Own elaboration

When performing the reliability of the instrument on Research Based Learning Questionnaire the reliability according to Cronbach's Alpha $\alpha = 0.910$ whose internal consistency is high, this was performed to a pilot test of 28 students before being applied to the entire study sample.

### Table 3

**Reliability of the collaborative work questionnaire**

<table>
<thead>
<tr>
<th>Reliability statistics</th>
<th>N of elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cronbach's alpha</td>
<td>18</td>
</tr>
</tbody>
</table>

Source: Own elaboration

Table 3 shows the reliability of the collaborative work instrument, which was $\alpha = 0.873$, showing that it has a high internal consistency, which was applied to a pilot test of 28 students.

To test the research hypothesis, the normality test was performed to determine the inferential statistics.
Table 4

Normality test

<table>
<thead>
<tr>
<th></th>
<th>Kolmogorov-Smirnov</th>
<th>Statistician</th>
<th>gl</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inquiry-based learning</td>
<td>0.382</td>
<td>162</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>Collaborative work</td>
<td>0.365</td>
<td>162</td>
<td>0.000</td>
<td></td>
</tr>
</tbody>
</table>

Source: Own elaboration

Table 4 shows the normality test with 162 degrees of freedom, which means that the sample is greater than 50, which means that the Kolmogorov-Smirnov normality test was used and the significance level was less than 0.05, so the data have a non-normal distribution, so the nonparametric Spearman's Rho test was used to test the hypothesis.

3 RESULTS AND/OR DISCUSSION

The results of the study are shown below:

Table 5

Degree of relationship between inquiry-based learning and collaborative work

<table>
<thead>
<tr>
<th></th>
<th>Correlations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inquir. learning</td>
</tr>
<tr>
<td>Spearman's Rho's coefficient</td>
<td>Correlation</td>
</tr>
<tr>
<td>Inquiry-based learning</td>
<td>Spearman's Rho</td>
</tr>
<tr>
<td>Collaborative work</td>
<td>Correlation</td>
</tr>
</tbody>
</table>

**. The correlation is significant at the 0.01 level (bilateral).

Source: Own elaboration

Table 5 shows the degree of correlation that exists between the IBL study variables and collaborative work and according to Spearman's Rho correlation coefficient $r_s = 0.521^{**}$ it is located in medium positive correlation, with a significance level $p = 0.000$ showing that as the application of the IBL increases, the effectiveness of collaborative work among university students also increases.

The results obtained are similar to those found by Vergara (2022) who found a relationship between the IBL study variables and research skills, with a Spearman correlation coefficient of $0.313^{**}$, indicating a low positive correlation and the $p=.001$
(<.05) value rejecting the null hypothesis and the alternate hypothesis is accepted, demonstrating a connection between the study variables. On the other hand, another research work has some similarity, where it presents a positive correlation of (0.231**); (0.198**) and (0.128*) between teachers sharing their research in class during the semester and the use of scientific information for learning improvement. (Espinel-Guadalupe et al., 2017). Likewise, the IBL shows substantial improvements in the evaluations that use rubrics, the results obtained by means of Friedman's non-parametric test indicate that the p-value (0.002) is lower than the established significance level (0.05) (Gamarra et al., 2022). Another study indicates that the IBL approach has enabled students to conduct in-depth research, collaborate on joint projects, and participate in discussions, thus stimulating their critical thinking during the class period. (Coutinho et al., 2022). The results of ANOVA and t Student statistical analyses show a high significance (p=0.000) and a considerable effect size (d=1.664), suggesting significant differences between the groups studied in the post-tests, supporting the conclusion that the IBL strategy has had a significant impact on the scientific competence of the students, who have demonstrated outstanding performance in all stages of the research work. (Cueva, 2021). Complementing this, the application of IBL is not limited to specific courses, but can be integrated into any pedagogical approach or extracurricular activities to enhance skills that traditional methods do not fully promote. (Mendoza, 2020).

Meanwhile, with respect to collaborative work Monroy (2021) the results show that 91.1% of the students of the Faculty of Education participate regularly in collaborative work activities, while 9% do so occasionally. In addition, it is observed that, in general, as the age of the students increases, their propensity to participate in collaborative work also increases, with a slight difference between genders, being slightly higher the willingness of males compared to females. Also Cotán et al. (2021) the students consider that collaborative work in Higher Education is an essential pedagogical activity and tool, being a strategy that gives them the opportunity to broaden their vision, put into practice social skills and apply relevant theoretical contents for their future career as teachers. It is therefore necessary to approach collaborative learning from an interdisciplinary perspective and ensure that it is adequately organized, planned and taught in higher education programs, technological tools act as mediators in the collaborative learning process and should not be considered as the ultimate goal of the educational process (García-Chitiva, 2021).
Table 6

Degree of relationship between information processing and collaborative work

<table>
<thead>
<tr>
<th></th>
<th>Processes scientific information</th>
<th>Collaborative work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spearman's Rho</td>
<td>Correlation coefficient</td>
<td>1.000</td>
</tr>
<tr>
<td></td>
<td>Sig. (bilateral)</td>
<td>0.578***</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>162</td>
</tr>
<tr>
<td>Collaborative work</td>
<td>Correlation coefficient</td>
<td>0.578***</td>
</tr>
<tr>
<td></td>
<td>Sig. (bilateral)</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>162</td>
</tr>
</tbody>
</table>

**. The correlation is significant at the 0.01 level (bilateral).

Source: Own elaboration

Table 6 shows the degree of correlation between the study dimension information processing and the study variable collaborative work, and according to Spearman’s Rho correlation coefficient, $r = 0.578$, which is a medium positive correlation, with a significance level of $p = 0.000$, showing that as the implementation of the IBL approach increases, the effectiveness of collaborative work among university students is also enhanced.

These findings have similarity with Vergara (2022) who refers that according to Spearman's correlation coefficient (Rho) was $0.266**$, indicating a low level positive correlation, in addition, the $p=0.006 (<0.05)$ value establishes a relationship between the ability to process scientific information and research skills, which leads to the rejection of the null hypothesis. Also another study by Espinel-Guadalupe et al. (2017) showed a significant increase in the use of scientific papers by students with 76.32%, as well as an increase in scientific production by teachers, inferring that there is a connection between students employing more scientific information in their independent work and teachers sharing their research in the classroom.
Table 7

*Degree of relationship between information management and collaborative work*

<table>
<thead>
<tr>
<th>Source: Own elaboration</th>
</tr>
</thead>
</table>

Table 7 shows the degree of correlation between scientific information management and collaborative work, and according to Spearman's Rho correlation coefficient, \( r_s = 0.471^{**} \), a weak positive correlation, with a significance level of \( p = 0.000 \), showing that as the application of the IBL approach increases, the effectiveness of collaborative work among university students also improves.

Results that resemble with the study of Aramendi et al. (2018) regarding information management, students express their preference to search for information on the web, with a mean of 3.07 and with a Whitney Mann U of 21948.000 and with a significance level of 0.054. Also the study by Coutinho et al. (2022) refers that the ABI strategy has enabled students to conduct detailed research, collaborate in the work and participate in discussions, which has allowed them to activate their critical thinking during classes, thus managing scientific information.
Table 8

Degree of relationship between the elaboration of scientific information and collaborative work

<table>
<thead>
<tr>
<th></th>
<th>Elaborates scientific information</th>
<th>Collaborative work</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Spearman’s Rho</strong></td>
<td><strong>Correlation coefficient</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sig. (bilateral)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Elaborates</td>
<td>1.000</td>
<td>0.450**</td>
</tr>
<tr>
<td>Collaborative</td>
<td>0.450**</td>
<td>1.000</td>
</tr>
<tr>
<td>work</td>
<td>Sig. (bilateral)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td></td>
</tr>
<tr>
<td></td>
<td>162</td>
<td>162</td>
</tr>
</tbody>
</table>

**. The correlation is significant at the 0.01 level (bilateral).

Source: Own elaboration

Table 8 shows the degree of correlation between the dimension of scientific information processing and the collaborative work study variable, where according to Spearman's Rho correlation coefficient $r_s = 0.450^{**}$, it is a weak positive correlation, with a significance level of $p = 0.000$, showing that as the implementation of the IBL method increases, the effectiveness of collaborative work among university students also increases.

Coutinho et al. (2022) report that the IBL strategy is used for the purpose of cultivating students' critical thinking, and that the application of this approach has contributed to students' developing awareness of their environment and their independent search for answers to their questions. On the other hand, Jaramillo-valencia & Quintero-arrubla (2021) indicate that in any group work activity, it is essential to have communication and responsibility, since, although the dynamics may change according to its nature (whether it is cooperative or collaborative), the effectiveness of teamwork would be affected if it lacked either of these two components.

Similarly, Khasawneh et al. (2022) refers that IBL promotes autonomy and motivation, encouraging learners to strive harder and develop independent and sophisticated skills. In contrast to the traditional lecture approach, where students are passive recipients, inquiry-based learning offers a more exciting and meaningful experience, thus raising academic performance with deeper and longer lasting learning.
4 CONCLUSION

It is concluded that research-based learning and collaborative work are positively related according to the results obtained, indicating that this correlation is statistically significant, which reinforces the validity of the relationship identified, so it can be concluded that there is a significant positive association between the implementation of IBL and the promotion of collaborative work in higher education. This approach is adaptable to various disciplines and can complement other didactic techniques, such as project-oriented learning or collaborative learning, among others.

REFERENCES


103–128.


