Formative Research Developing Applications with Augmented Reality: A Case Study of Attitude Assessment in University Students

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Abstract. Student attitudes towards formative research at a university can provide valuable information for understanding and addressing the barriers and challenges students face in this field. Even more so, with the advancement of artificial intelligence it is relevant to include augmented reality applications in formative research processes. In this sense, this case study aims to identify the level of attitude towards formative research developing applications with augmented reality. The research makes use of the quantitative approach of descriptive level and non-experimental design. A questionnaire with 28 statements was used, with categories to be evaluated through the Likert scale being skills,

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obstacles, positive assessment and negative assessment towards the investigation. It was identified that organising, writing, making decisions and working in a team are skills that students consider relevant to conduct formative research. While the obstacles indicated as relevant are the lack of time, lack of knowledge and the economic aspect. Finally, most students present a low or regular attitude towards research. Therefore, it is concluded that there is an urgent need to implement institutional policies that lead to a greater strengthening of formative research activities, even more so when these activities are aimed at applying emerging technologies such as augmented reality. This case study makes it possible to close a gap on what type of specific support students need and on what skills should be reinforced in a particular way so that they can move towards the development and growth of scientific production in the university environment.

1. Introduction

Formative research today is more relevant in university education, since quality systems more insistently demand evidence on impact projects, research and disclosures, considering it a fundamental function that every university institution must develop (García et al., 2018; Parra-Castrillón, 2018; Valero, 2021). Today's society, in the midst of technology and with all the accelerated development of communications, is more than ever immersed in the pressing need to train useful subjects, with investigative capacity, with an analytical and critical spirit (Flórez et al., 2018; Vera-Rojas et al., 2018); and it thus that the quality of higher education is closely associated with the practice of research (Rivas-Díaz et al., 2020). Thus, in the current university world, emphasis is placed on students developing their research potential from their academic training and the processes of linking with the community (Arnaiz et al., 2018; Gómez et al., 2019); Therefore, formative research has been incorporated as a demanded factor in the entire training process of the university student (Silva, 2018). In this way, formative research is a crucial part of the teaching and learning process in any educational situation (Hernández & Polanía, 2019).

From the conceptual point of view, formative research is an educational process to acquire skills related to the analysis of information, methodology, the formation of critical judgements and, in general, the structure of a research process within the established curricular framework by the university (Asis et al., 2021). In this way, formative research becomes the articulating axis of the curriculum, circumscribing itself in the field where the pedagogical and investigative components come together in means that activate the teaching-learning processes (Arias et al., 2019). Thus, it also represents a pedagogical strategy, with which it seeks to solve a problem by which, through the mediation of the teacher and the participation of the student, it is possible to formulate research questions in a specific context (Fields, 2020; Rojas et al., 2020). On the other hand, it has methods, techniques, procedures and investigative teaching practices, structured as training policies or as the result of teaching

experiences (Venegas et al., 2019).

However, formative research cannot be seen as one that seeks to generate new knowledge, but rather as one that tends to contribute to the student's training from existing contributions in science, within the training process itself (Velázquez et al., 2019). Although the subjects of methodology and statistics have been in the university curricula for a long time, it is believed that knowledge without practice has little impact on the learning of this type of concepts (Barrios et al., 2019). As a result of the weakness of the teaching that is currently being provided, it is urgent to seek strategies that allow the creation of autonomous knowledge, strengthen traditional knowledge and encourage students to care about their learning, and the best way is to educate them through formative research (García et al., 2019). As such, the integral formation of a student is understood from the fundamental principles of being, knowing, doing, having and transcending knowledge for sustainable, diverse and equitable integral human development that positively impacts the progress of society on a scale local and global (Tobón et al., 2019; Turpo-Gebera et al., 2020). However, it is necessary to reflect on some present limitations so that formative research has a greater and better impact on the training of professionals, one of these limitations is the attitude of the student (Castaño, 2019).

There is a concatenation of facts necessary to promote the research culture, from the promotion of the attitude to the motivation to investigate and contribute to the need for development and innovation in society (Palacios, 2021). Thus, favourable attitudes towards formative research are those that greatly facilitate the development of skills and habits for the generation of knowledge, as well as those that promote the creation of learning environments for inquiry and problem posing (Castro, 2017). Attitudes are defined as an acquired, organised, and persistent psychological disposition, made up of affective, cognitive, and behavioural components, which predispose individuals to react preferentially in a certain way (Aldana et al., 2020). Likewise, the attitude of students towards formative research can be taken as a parameter of the quality of education, since developing positive attitudes and aptitudes in this context implies the improvement of capacities and abilities that are transversal to the formation of all future university professional (Ortega et al., 2018). Therefore, the lack of interest and negative attitudes of students towards science and technology pose a problem for science education, since they lead to deficient knowledge about science and a lack of initiative and involvement in scientific projects (Quezada-Berumen et al., 2019). In this way, measuring attitudes towards formative research is part of the process of consolidating the research culture (Aldana et al., 2016).

In this sense, this article has as main objective to identify the level of attitude in university students towards formative research developing applications with augmented reality. The research is carried out under a quantitative approach, of a non-experimental design and at a descriptive level. For the data collection process, the survey technique was used, the same as applied to mechanical and electrical engineering students. Based on the above, this study aims to answer

the following research questions:

- RQ1: What are the most relevant formative research skills when developing applications with augmented reality?
- RQ2: What are the most relevant obstacles to formative research when developing applications with augmented reality?
- RQ3: What is the level of attitude towards formative research developing applications with augmented reality?

2. Literature Review

2.1 Applications of augmented reality in education

Augmented reality is a technology that allows combining virtual and real objects in real time through technological devices (Martínez et al., 2021). It is also considered as an interactive instrument that is based on information from the real world and adds new elements from the virtual, with the purpose of making the information more comprehensive (Aguirre-Herráez et al., 2020). In the educational world there are a large number of new technologies that are being increasingly applied in the teaching and learning process, one such being augmented reality (Cabero-Almenara et al., 2018; Lorenzo & Scagliarini, 2018). One of the possibilities for incorporation into education is in the form of books and notes enriched with augmented reality objects, which consists of specific parts of physical books being used as interfaces or bookmarks to virtually augment their contents (Cabero et al., 2019). In this regard, Blas et al. (2019), in their study on the use of augmented reality in the university educational field, point out that the didactic experience with augmented reality applications arouses real interest and motivation among students.

Regarding augmented reality applications in engineering students, Córtes et al. (2019), in their study on the training of engineers in automotive systems through augmented reality, observe that the use of augmented reality by students can be a useful tool that, in addition to presenting visual information, is also a way of analysing objects in 3D rather than from a 2D view. So also, Alvarado et al. (2019) make use of virtual and augmented reality, for the teaching of technical drawing in which the applications developed were built from the practical exercises taught in the representation systems subject, obtaining a support tool for students in those cognitive learning processes that involves three-dimensional imaginary. In the same line of application, De Almeida and Cabero (2020) make use of augmented reality in the teaching of reinforced concrete, with which, based on the responses of the students, the use of 3D resources is believed to be positive and relevant through augmented reality. Regarding the application of augmented reality in mechanical engineering, Céspedes et al. (2020) point out that the interaction techniques implemented enable the individual and collective work of the students, creating a feedback space between them and the system.

2.2 Attitudes towards formative research

In relation to the attitude towards formative research Cota et al. (2019) in their study on a scale for evaluating attitudes in higher education students, point out that the relevance that the university has with respect to research and the

implications that should be derived from its leading role in the development of attitudes must be considered positive towards research. In this regard, Rocha et al. (2022) in their study on attitude and disposition for research in university students, affirm that a factor to determine the quality of education is the attitude that students have regarding scientific research, a fundamental element of university education. In addition, Paredes-Proaño and Moreta-Herrera (2020) note that the attitude towards research in university students can often be negative or unflattering, which means that, as a consequence, the postponement that occurs when starting an investigation, developing it and reaching its conclusion culmination.

Regarding previous research on the subject of study, Obermeier (2018) developed a study whose objective was to identify the attitude index of students in a university in Mexico towards research, as well as to determine if there was a correlation with the willingness to graduate by thesis and to know the concept they have on institutional conditions. In this same line of research, Olivera (2020) developed an investigation whose objective was to determine the attitudes towards research presented by bachelors in administration and psychology. So also Cruz et al. (2021) defined the objective of determining the attitude towards research of university students from a private university in Peru, in which the students were from the business sciences faculty. In addition, Bullón (2018) defined as the objective of his research as to determine and know the relationship between the level of research training and the level of attitude towards scientific research in students at a public university. Other studies similar to those mentioned include that of Chara-Saavedra (2018) who, using a cross-sectional descriptive correlational study with a quantitative approach, defined the attitude towards research as the main variable of his study, which was measured through the scale of attitudes towards research (EACIN) that consisted of 30 items. We also found a study carried out by Gálvez et al. (2019) who used the same EACIN data collection instrument, developing research with a quantitative, observational and cross-sectional approach, whose population consisted of 132 students in their last year of university education.

3. Methodology
3.1 Research focus
The research is carried out under a quantitative approach because data are collected, processed and analysed, ordinally categorised and numerically represented using a Likert scale. These numerical data are linked to the level of attitude towards formative research of engineering students regarding developing applications with augmented reality. In this regard, Polanía et al. (2020) indicate that research with a quantitative approach focuses fundamentally on observable, measurable and quantifiable aspects and uses statistical tests for data analysis. Likewise, Sánchez (2019) affirms that research under the quantitative approach deals with phenomena that can be measured, that is, they can be assigned a number and whose processing implies the use of statistical techniques for the analysis of the collected data.

3.2 Research design

The research has a non-experimental cross-sectional design, because no action or control was exercised on the variable under analysis, which in this study is the students' attitude towards formative research. It is also cross-sectional since the data were collected in a single period of time. This period was in the penultimate week of class, that is, in week fifteen, since the academic period of classes is comprised of sixteen weeks. In this regard, Diaz et al. (2021) establishes that an investigation is non-experimental of a cross-sectional type as a result of the data collection process being carried out in a single moment of the investigation.

3.3 Research level

The research is of a descriptive scope or level because it is intended to identify the characteristics regarding the attitude towards formative research of engineering students specialising in mechanics and electrical engineering at the National Technological University of Lima Sur, Peru, seeking to establish which are the most relevant skills and obstacles that determine the attitude towards research. In this regard, Ramos (2020) points out that, at this level of research, the characteristics of the phenomenon are already known and what is sought is to expose its presence in a certain human group. So also, Guevara et al. (2020) specify that descriptive level research is carried out when it is desired to describe through components or main dimensions of a variable in a specific context or reality.

3.4 Data collection technique

The technique used in this case study is the survey and the instrument is the questionnaire. This data collection instrument is an adaptation of the questionnaire designed and validated by Barrios and Ulises (2020) in their research on the attitude towards research in university students. This questionnaire was adapted for the context or scenario of how the research was developed through augmented reality applications. The questionnaire used, whose purpose is to determine the level of attitude of engineering students, is made up of two dimensions: positive attitude and negative attitude. In turn, the positive attitude category seeks to identify the level of "Abilities for Research", as well as to identify the "Positive Assessment" that students assign to research. On the other hand, the negative dimension seeks to identify the level of "Research Obstacles", as well as the "Negative Assessment" that students assign to the research. The Appendix shows the questionnaire used in this study, which details the 28 statements, which seek to evaluate certain indicators related to formative research. This questionnaire uses a Likert scale from 0 to 4, where 0 means "strongly agree", 1 "agree", 2 "disagree" and 3 "strongly disagree". Table 1 shows the composition of the instrument used for data collection, which specifies the dimensions, categories and associated statements.

Table 1: Composition of the instrument used for the collection – Dimensions, categories and indicators

Dimension	Category	Statements
Positive attitude	Research skills	S1, S5, S9, S13, S17, S21, S25
	Positive assessment towards research	S4, S8, S12, S16, S20, S24, S28
Negative attitude	Barriers to research	S2, S6, S10, S14, S18, S22, S26
	Negative assessment towards research	S3, S7, S11, S15, S19, S23, S27

In addition, for purposes of internal validation of the data collection instrument, it was submitted to a reliability analysis for which the SPSS statistical software was used, with the purpose of identifying Cronbach's alpha. The value obtained was 0.825. Likewise, Table 2 shows Cronbach's alpha if the statement evaluated had been suppressed or withdrawn from the data collection instrument.
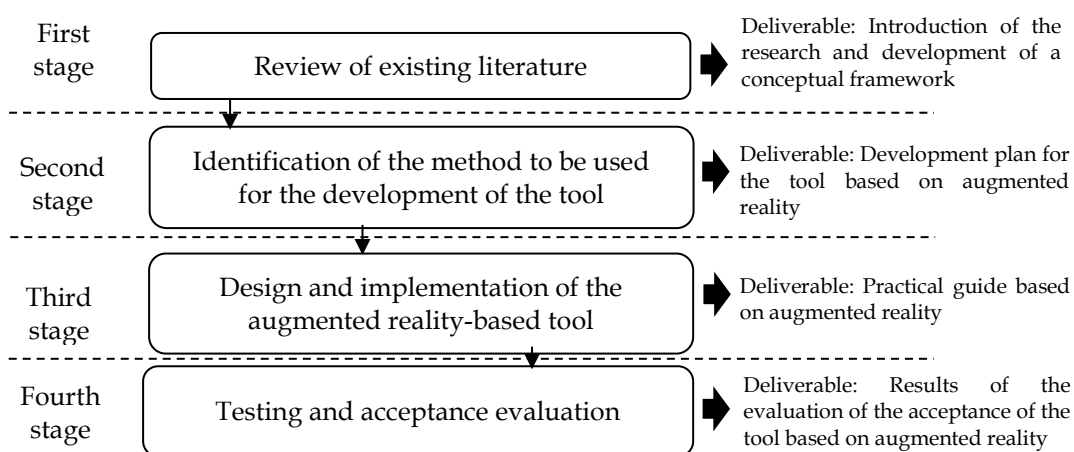
Table 2: Cronbach's alpha if the statement evaluated had been suppressed

Statement evaluated	Cronbach's alpha if the statement had been suppressed
S1	0.816
S2	0.794
S3	0.809
S4	0.835
S5	0.816
S6	0.829
S7	0.841
S8	0.836
S9	0.829
S10	0.809
S11	0.829
S12	0.822
S13	0.812
S14	0.820
S15	0.805
S16	0.826
S17	0.821
S18	0.805
S19	0.810
S20	0.817
S21	0.816
S22	0.808
S23	0.824
S24	0.826
S25	0.829
S26	0.820
S27	0.809
S28	0.815

4. Study Scenario

The study was carried out during the academic semester 2023-I, with the population made up of 32 students enrolled in the Automatic Process Control subject, belonging to the eighth cycle of the professional School of Mechanical and Electrical Engineering. As part of the implementation of the formative research in the subject, it was planned to develop activities from the first class session that would lead to the development of a tool applying augmented reality relating them to topics related to the thematic contents of the subject. The tools developed were part of a global project called "Practical Guides for Automatic Process Control using Augmented Reality". That is, the work included transforming the practical guides traditionally used in learning the subject to practical guides with the ability to explain the solution through the sample of a video stored in a repository. In addition, in the generated metaverse, it provides the ability for the student to interact with simulation software so that the student has the ability to enter input values and obtain different responses that lead to their analysis and interpretation.

The purpose established for each work team consisted of evaluating the acceptance of the tool developed with augmented reality. For which they followed four stages. Figure 1 shows the stages that were part of the formative research process that the students followed with the purpose of developing the tool by applying augmented reality. As can be seen, the first stage consisted of carrying out a review of the existing literature regarding augmented reality tools applied to university education. In the second stage, the identification of the method to be used was carried out. In this second stage, it was sought that each work team present the development plan of the tool based on augmented reality. The third stage consisted of carrying out the design and implementation of the tool, managing to show its use and operation. Finally, the tool was put to the test for a period of time among all the students, to then proceed to carry out an evaluation of the acceptance of the tool.

First stage	Review of existing literature	Deliverable: Introduction of the research and development of a conceptual framework
Second stage	Identification of the method to be used for the development of the tool	Deliverable: Development plan for the tool based on augmented reality
Third stage	Design and implementation of the augmented reality-based tool	Deliverable: Practical guide based on augmented reality
Fourth stage	Testing and acceptance evaluation	Deliverable: Results of the evaluation of the acceptance of the tool based on augmented reality

Figure 1: Stages of the development process of formative research based on the development of a tool applying augmented reality

5. Results

Considering the research questions, the following results are specified below. Firstly, the results corresponding to statements S1, S5, S9, S13, S17, S21 and S25 were analysed as part of the "Research skills" category. Although the results were obtained based on the responses of the students based on four ordinal categories, Figure 2 shows the percentages grouping the percentage of students who considered to be "strongly agree" and "agree", as well as in "disagree" and "strongly disagree". Through this comparison of results, it is possible to identify that the students consider the most relevant skills for conducting formative research are knowing how to organise (S17), knowing how to write (S9), knowing how to make decisions (S21) and knowing how to work in a team (S5).
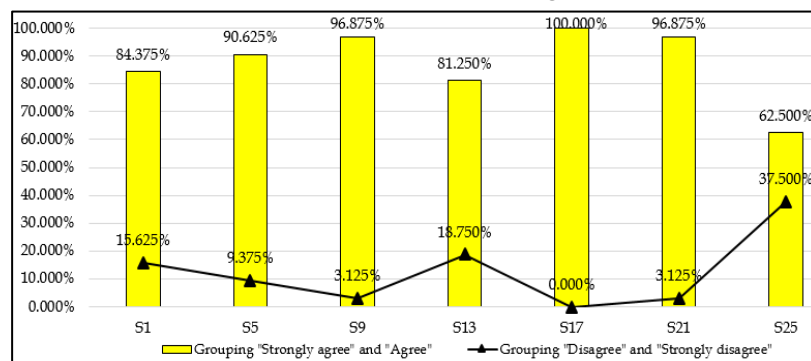

Figure 2: Percentage distribution of the response of students related to the category - Research skills

Secondly, the results corresponding to statements S4, S8, S12, S16, S20, S24 and S28 were analysed as part of the category "Positive assessment towards the investigation". Although the results were obtained based on the responses of the students based on four categories of ordinal type, Figure 3 shows the percentage distribution of the response of the students related to the category obstacles to research, in which they are grouped as the percentage of students who considered "strongly agree" and "agree", as well as "disagree" and "strongly disagree". Through this comparison of results, it is possible to identify the factors students consider contribute to a greater extent in developing formative research are: Strengthening ethics (S4), Fostering creativity (S8) and Making thought more flexible (S24). While to a lesser extent they consider that formative research contributes to improving frustration tolerance (S25).
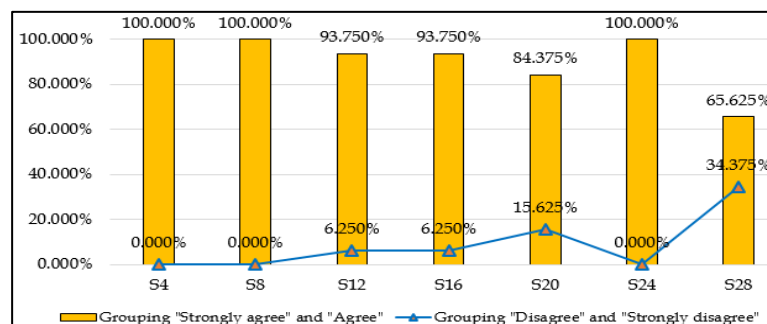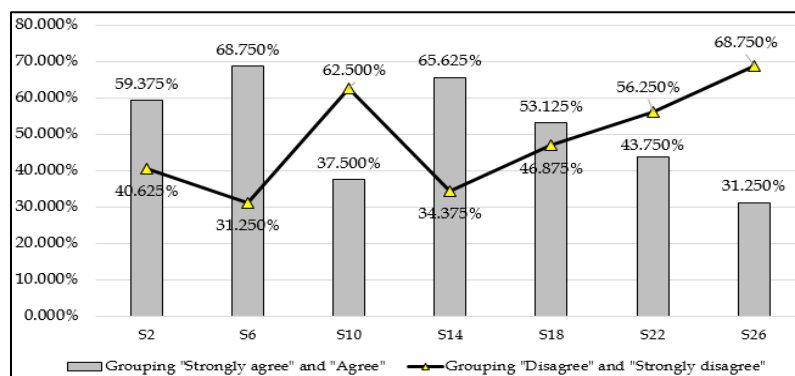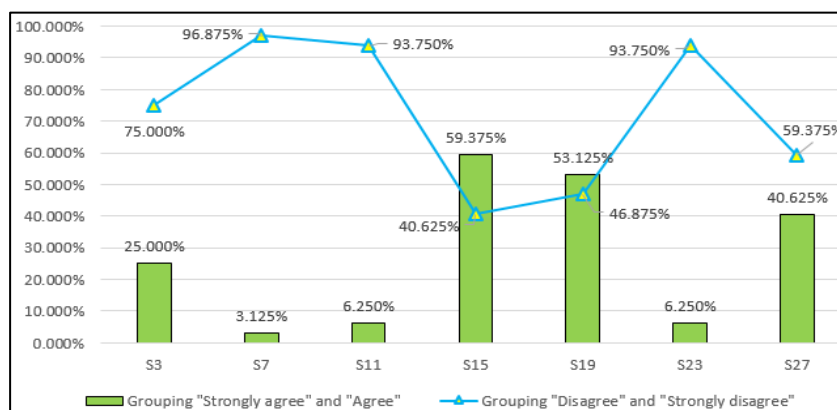

Figure 3: Percentage distribution of the response of students related to the category – Positive assessment towards research

Thirdly, the results corresponding to statements S2, S6, S10, S14, S18, S22 and S26 were analysed as part of the "Obstacles to the investigation" category. Figure 4 shows the percentage distribution of the response of the students related to the category obstacles to research, in which the percentage of students who considered "strongly agree" and "agree", as well as "disagree" and "strongly disagree" are grouped. Through this comparison of results, it is possible to identify that the students consider the most relevant obstacles to conducting formative research are time (S6), lack of knowledge (S14) and the economic aspect (S2), representing 68.750%, 65.625% and 59.375%, respectively. While, to a lesser extent, students consider the lack of support from teachers (S10) and the lack of credibility (S26) as obstacles to research.

Figure 4: Percentage distribution of the response of students related to the category – Obstacles to research

Fourthly, the results corresponding to statements S3, S7, S11, S15, S19, S23 and S27 were analysed as part of the category "Negative assessment towards the investigation". Figure 5 shows the percentage distribution of the responses of the students related to the category negative assessment towards the research, which groups the percentage of students who considered "strongly agree" and "agree", as well as "disagree" and "strongly disagree". Through this comparison of results, it is possible to identify the factors students regard most valued as negative are considering the research difficult (S15) and tedious (S19). However, the other aspects evaluated in this category have not been considered with a relevant negative assessment.

Figure 5: Percentage distribution of the response of students related to the category – Negative assessment towards research

In order to carry out a cross-tabulation analysis between the categories of the "Positive attitude" dimension towards formative research, a new ordinal categorisation scale was defined. This new scale contemplates the "low", "regular" and "high" levels. Based on what is indicated in Table 3, the results of the cross-tabulation between the categories "Abilities for research" and "Positive assessment towards research" are shown. The results indicate that out of 31.3% of students who show a high level in "research skills", 21.9% of students show a "regular level" and 9.4% show a "high level" with respect to positive assessment towards research. In addition to 28.1% of students who show a low level in "research skills", 15.6% of students show a "fair level" and 12.5%, show a "low level" regarding the positive assessment towards research.

Table 3: Cross-tabulation analysis between the categories of positive attitude
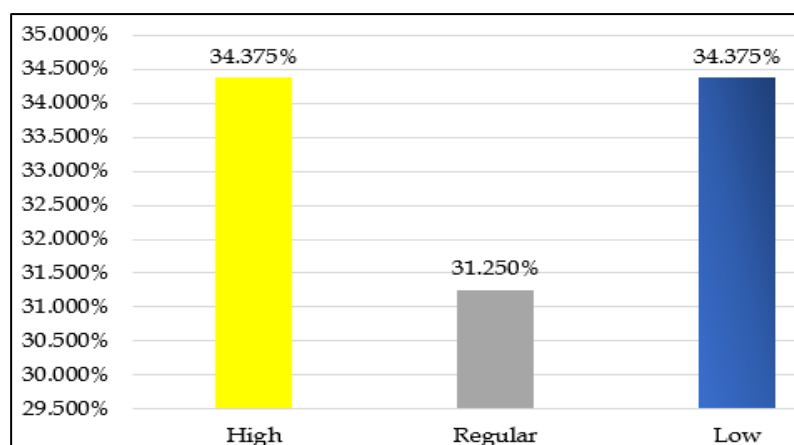
		Research skills			Total
		Low	Regular	High	
Positive assessment towards research	Low	12.5%	6.3%	0.0%	18.8%
	Regular	15.6%	18.8%	21.9%	56.3%
	High	0.0%	15.6%	9.4%	25.0%
Total		28.1%	40.6%	31.3%	100.0%

Likewise, Table 4 shows the results of the cross-tabulation between the categories "Obstacles to research" and "Negative assessment towards research". The results indicate that of the 28.1% of students who indicate that there is a high level of "Obstacles to research", 15.6% of students show a "high level", 6.3% show a "regular level" and 6.3% show a "low level" with respect to the negative assessment of the research. In addition to the 28.1% of students who indicate that there is a "low level" of "Obstacles for research", in their entirety they show a "low level" with respect to the negative assessment of research.

Table 4: Cross-tabulation analysis between the categories of negative attitude

		Barriers to research			Total
		Low	Regular	High	
Negative assessment towards research	Low	28.1%	9.4%	6.3%	43.8%
	Regular	0.0%	18.8%	6.3%	25.0%
	High	0.0%	15.6%	15.6%	31.3%
Total		28.1%	43.8%	28.1%	100.0%

Finally, with the purpose of determining the level of attitude towards formative research developing applications with augmented reality, we proceeded to carry out a categorisation of the variable under study (Attitude towards research) whose ordinal scales are "low", "regular", and "high". In this way, it was identified that 34.375% of students showed a high attitude, 31.250% a regular attitude, while 34.375% showed a low attitude.

Figure 6: Attitude level towards formative research

6. Discussion

From the results as to the most relevant skills towards formative research, it was identified that these are "Knowing how to organise", "Knowing how to write", "Knowing how to make decisions" and "Knowing how to work in a team". Although no studies were found that refer to these four identified skills, as the only most relevant ones, we can refer to studies in which there is a coincidence in at least one of these identified aspects. In this regard, Barrios and Ulises (2020) identified that the most important skills to develop research are knowing how to use the APA (American Psychological Association) format, knowing how to write, and knowing how to organise. Also Rocha et al. (2021) in their study on attitude and disposition as key elements for research, conclude that students mainly recognise the importance of "teamwork", knowing a second language, and knowing how to manage bibliographic managers. However, studies such as that of Chara-Saavedra and Olortegui-Luna (2018) in which the factors associated with the attitude towards research were investigated, a greater difference was found in the most relevant skills, since they point out that these are the availability of work time, the number of books or articles read per week and participation in training.

From the results obtained linked to the most relevant obstacles to formative research, it was identified that these are the availability of time, the lack of knowledge and the economic aspect. These identified aspects coincide in part with what was indicated by Rocha et al. (2021) who identified that the obstacles for students not to carry out research are the lack of finance, little support from professors, generating negative attitudes in them such as that research is tedious, boring and stressful. Another study in which it is possible to partially coincide is that by Barrios and Ulises (2020) who identified that the biggest obstacle to doing research is the lack of knowledge and the availability of time. Although in both cited studies it is highlighted separately that the economic aspect and time are obstacles to take into account for carrying out the research, there are other studies in which the obstacles are focused on teaching performance. In this regard Estrada et al. (2021) determined in their research work on attitude towards research that the majority of students consider that their teachers in the

research area do not have scientific production, apply few didactic strategies, as well as a limited conceptual mastery of research methodology.

Finally, from the results obtained regarding the level of attitude towards formative research developing applications with augmented reality, it was identified that 34.375% of students showed a high attitude, 31.250% a regular attitude, while 34.375% showed a low attitude. These results coincide with findings identified by Obermeier (2018) in his study on the index of attitude towards research and willingness to graduate by thesis, and who points out that most students have a low or medium index. In this same line of opinion, Olivera (2020), in his research on attitudes towards research in psychology students, identified that 67% of students show an unfavourable attitude, while only 33% of students show a favourable attitude. In addition, Gálvez et al. (2019), in their study on the attitude towards research in students who are finishing the nursing specialty, determined that the level of attitude of students towards research is negative in 58.8%, while only 41.3% of students show a positive attitude. Likewise, Chara-Saavedra and Olortegui-Luna (2018), in their research on the factors associated with the attitude towards research, point out that more than half of the students surveyed showed a moderately favourable attitude towards research. Consequently, these studies support the results found regarding the low level on the attitude of students towards research, which should be taken into account by teachers and university authorities in order to create strategies and mechanisms that contribute to increasing these rates even more, because most of the students who are developing their degree theses today have had to carry out formative research in conditions of social isolation.

7. Conclusion

This case study made it possible to identify that organising, writing, making decisions and working in a team are relevant skills to carry out formative research in developing augmented reality applications. In the same way, the case study also contributed to determine the obstacles that students most frequently point out as relevant, these being the lack of availability of time, the lack of knowledge and the economic aspect. Finally, it was also identified that only 34.375% of students have a high attitude towards formative research, evidencing that most of them concentrate among students with a low or regular attitude. Based on the above, it is concluded that there is an urgent need to implement institutional policies that lead to a greater strengthening of formative research activities in students, even more so when these activities are aimed at applying emerging technologies such as augmented reality. This case study makes it possible to close a gap on what type of specific support students need and on what skills should be reinforced in a particular way so that they can move towards the development and growth of scientific production in the university environment.

It should be noted that this study was limited to a population made up of students in the eighth cycle of the automatic process control subject, so it is recommended that future studies address a larger population, including

different specialties and identifying whether the obstacles and skills are the same or different when developing research on augmented reality applications.

8. References

Aguirre-Herráez, R. G., García-Herrera, D. G., Guevara-Vizcaíno, C. F., & Erazo-Álvarez, J. C. (2020). Augmented reality and education in Ecuador. *Revista Arbitrada Interdisciplinaria KOINONIA*, *5*, 415-438. http://dx.doi.org/10.35381/r.k.v5i5.1052

Aldana, D. B. G. M., Caraballo, M. G. J., & Babativa, N. D. A. (2016). Scale of Attitudes toward Research (EACIN): Content Validity and Reliability. *Revista Aletheia*, *8*, 104-121. http://dx.doi.org/10.11600/21450366.8.2aletheia.104.121

Aldana, G. M., Babativa, D. A, Caraballo, G. J., & Rey, C. A. (2020). Scale of attitudes towards research (EACIN): evaluation of its psychometric properties in a Colombian sample. *Revista CES Psicología*, *13*, 89-103. http://dx.doi.org/10.21615/cesp.13.1.6

Alvarado, Y., Jofré, N., Rosas, M., & Guerrero, R. (2019). Virtual Reality and Augmented Reality applications to support the teaching of Technical Drawing. *Enseñanza y Aprendizaje de Ingeniería de Computadores*, *9*, 65-74. https://dialnet.unirioja.es/servlet/articulo?codigo=7183579

Arias M. L., García R. G., & Cardona-Arias, J. A. (2019). Impact of professional practices on formative investigation competences in undergraduate students of Microbiology from University of Antioquia-Colombia. *Revista Virtual Universidad Católica del Norte*, *56*, 2-15. https://revistavirtual.ucn.edu.co/index.php/RevistaUCN/article/view/1034

Asis, L. M. E., Monzón, B. E., & Hernández, M. E. (2022). Formative research for teaching and learning in universities. *Mendive Revista de Educación*, *20*, 675-691. https://mendive.upr.edu.cu/index.php/MendiveUPR/article/view/2676

Barrios, E., & Ulises, D. (2020). Design and validation of the questionnaire Attitude towards research in university students. *Revista Innova Educación*, *2*, 280-302. https://doi.org/10.35622/j.rie.2020.02.004

Barrios, G. E. E., Delgado, S. U., & Hernández, P. E. (2019). Qualitative Differences between Investigative Training and Formative Research of University Students. *Revista Digital de Investigación en Docencia Universitaria*, *13*, 68-85. https://doi.org/10.19083/ridu.2019.735

Blas, P. D., Vázquez-Cano, E., Morales, C. M. B., & López M. E. (2019). Use of augmented reality Apps in university classrooms. *Campus Virtuales*, *8*, 37-48. http://uajournals.com/ojs/index.php/campusvirtuales/article/view/379

Bullón, L. E. (2018). Research training and attitude towards scientific research in social sciences students from the Universidad Nacional del Centro del Perú. Socialium *Revista Científica de Ciencias Sociales*, *3*, 1-11. https://doi.org/10.31876/sl.v3i2.10

Cabero-Almenara, J., Vázquez-Cano, E., & López-Meneses, E. (2018). Use of Augmented Reality as a Didactic Resource in the university teaching. *Formación Universitaria*, *11*, 25-34. http://dx.doi.org/10.4067/S0718-50062018000100025

Cabero, J., Barroso, J., & Llorente, C. (2019). Augmented reality in university education. *Revista de Docencia Universitaria*, *17*, 105-118. https://doi.org/10.4995/redu.2019.11256

Campos, O. P. J. (2020). The importance of formative research as a learning strategy. *Revista Científica de la facultad de Humanidades*, *8*, 88-94. https://doi.org/10.35383/educare.v8i1.397

Castaño, R. C. E. (2019). Formative research in accounting programs: the case of the University of Antioquia. *Revista Visión Contable*, *20*, 136-154. https://doi.org/10.24142/rvc.n20a5

Castro, M. S. P. (2017). Diseño y validación de un instrumento para evaluar la actitud hacia la investigación formativa en estudiantes universitarios. *Actualidades Pedagógicas*, *70*, 165-182. https://doi.org/10.19052/ap.3996

Céspedes, I. M., Leyva R. J. A., & Leyva, R. J. A. (2020). Augmented Reality Software for the teaching learning of the Computer Science subject in Mechanical Engineering. *Enseñanza y Aprendizaje de Ingeniería de Computadores*, *10*, 67-74. https://doi.org/10.30827/Digibug.64783

Chara-Saavedra, P. (2028). Factors associated with the attitude toward research in university nursing students. *Revista de investigación y casos en salud, 3*, 83-88. https://doi.org/10.35626/casus.2.2018.73

Cortés, C. J. M., Pérez, M. A. A., Mejía, V. J. E., Fabila, B. D. A., & Hernández, Q. L. F. (2019). Systems engineering training automotive through augmented reality. *Innovación Educativa*, *20*, 25-44. https://dialnet.unirioja.es/servlet/articulo?codigo=8861733

Cota, V. L. V., Beltrán, S. J. A., Tánori, Q. J., & Vázquez, G. M. A. (2019). Psychometric properties of a scale of attitudes towards scientific research (EACIN): Study in Mexican university students. *Revista Iberoamericana de Psicología*, *12*, 43-54. https://doi.org/10.33881/2027-1786.rip.12305

Cruz, T. J. J., Pinedo, Z. G. M., & Lescano C. J. M. (2021). Attitude towards research: An affective, cognitive and behavioral analysis in university students. *Revista Iberoamericana de Tecnología en Educación y Educación en Tecnología*, *29*, 20-26. https://doi.org/10.24215/18509959.29.e2

De Almeida, M. G. N., & Cabero A. J. (2020). Augmented reality in the teaching of reinforced concrete: perception of the students. *Alteridad Revista de Educación*, *15*, 12-24. https://doi.org/10.17163/alt.v15n1.2020.01

Díaz, V. J. P., Ruiz, R. A. K., & Eguez C. C. (2021). Impact of ICT: challenges and opportunities for Education Superior against COVID-19. *Uisrael Revista Científica*, *8*, 113-134. https://doi.org/10.35290/rcui.v8n2.2021.448

Estrada, A. E. G., Córdova, A. F. E., Gallegos, R. N. A., & Mamani, U. H. J. (2021). Attitude towards scientific research in Peruvian students of pedagogical higher education. *Apuntes Universitarios*, *11*, 60-72. https://doi.org/10.17162/au.v11i3.691

Estrada, G. A. D., & Estrada G. J. (2019). Formative research from transdisciplinarity, for the reform of thought within professional training. *Uniandes Episteme*, *6*, 194-216. https://revista.uniandes.edu.ec/ojs/index.php/EPISTEME/article/view/1288

Flórez, R. N., Giraldo, G. F. L., & Flórez, R. A. L. (2018). Formative research: Elements and proposal for a didactics from the classroom; beyond a trend. *Revista Espacios*, *39*, 9-21. https://www.revistaespacios.com/a18v39n25/a18v39n25p09.pdf

Gálvez, D. N.D.C., Gonzáles, H. Y., & Monsalve, M. M. (2019). Attitude towards the scientific investigation at the end of the career of Infirmary in Perú. *Gaceta Médica Boliviana*, *42*, 32-37. https://www.redalyc.org/journal/4456/445674686006/html/

García, N. M., Paca, N. K., Arista, S. M., Valdez, B. R., & Gómez, I. I. (2018). Formative research in the development of communicative and investigative skills. *Journal of High Andean Research*, *20*, 125-136. http://dx.doi.org/10.18271/ria.2018.336

Gómez, M. O. M., Morales, R. M. E., & Plata, P. P. A. (2019). Knowledge transfer and research formative: lessons learned and challenges for research seeds. *Revista Palabra, palabra que Obra*, *19*, 203-221. https://doi.org/10.32997/2346-2884-vol.19-num.2-2019-2551

Guevara, A. G. P., Verdesoto, A. A. E., & Castro, M. N. E. (2020). Educational research methodologies (descriptive, experimental, participatory, and action research). *Revista Científica Mundo de la Investigación y el Conocimiento*, *4*, 163-173. http://recimundo.com/index.php/es/article/view/860

Hernández-Gil, C., & Polanía-González, E. (2019). La investigación formativa y la didáctica para la enseñanza y el aprendizaje del mercadeo. *Revista Ánfora, 26*, 39-64. https://doi.org/10.30854/anf.v26.n46.2019.552

Martínez, P. S., Fernández, R. B., & Barroso, O. J. (2021). Augmented reality as a resource for training in higher education. *Campus Virtuales*, *10*, 9-19. http://uajournals.com/ojs/index.php/campusvirtuales/article/view/644

Lorenzo, L. G., & Scagliarini, G. C. (2018). Bibliometric review on augmented reality in Education. *Revista General de Información y Documentación*, *28*, 45-60. http://dx.doi.org/10.5209/RGID.60805

Obermeier, P. M. L. (2018). Index of attitude towards research and willingness to graduate by thesis. *Perspectivas metodológicas*, *21*, 113-134. https://doi.org/10.18294/pm.2018.1900

Olivera, C. E. S. (2020). Attitudes to the research of bachelors in administration and psychology of a Peruvian university. *Revista de Ciencias Sociales y Humanidades CHAKIÑAN, 11*, 70-81. https://doi.org/10.37135/chk.002.11.05

Ortega, C. R. I., Veloso, T. R. D., & Hansen, O. S. (2018). Perception and attitudes towards scientific research. *ACADEMO Journal of Research in Social Sciences and Humanities, 5*, 101-109. http://dx.doi.org/10.30545/academo.2018.jul-dic.2

Palacios, S. L. I. (2021). A systematic review: Attitude towards research in Latin American universities. *Revista de Investigación en Comunicación y Desarrollo*, *12*, 195-205. https://doi.org/10.33595/2226-1478.12.3.533

Paredes-Proaño, F., & Moreta-Herrera, R. (2020). Attitudes towards research y self-regulated learning in university students. *CienciAméric*a, *9*, 1-16. http://dx.doi.org/10.33210/ca.v9i3.263

Parra-Castrillón, J. E. (2018). Construction of investigative competence in engineering. *Revista de educación en Ingeniería*, *13*, 12-19. http://dx.doi.org/10.26507/rei.v13n25.812

Polanía, R. C. L., Cardona, O.F.A., Castañeda, G. G. I., Vargas, I. A., Calvache, S. O. A., & Abanto, V. W. I. (2020). *Metodología de la investigación Cualitativa y Cuantitativa*. Institución Universitaria Antonio José Camacho. https://repositorio.uniajc.edu.co/handle/uniajc/596

Quevedo A. N., García, A. N., & Cañizares, G. F. (2018). Analysis of the reflection and collaboration in the formative research of the student at UNIANDES. *Revista digital de Ciencia, Tecnología e Innovación*, *5*, 998-1008. https://core.ac.uk/download/pdf/235987372.pdf

Quezada-Berumen, L., Moral, D. L. R. J., & Landero-Hernández, R. (2019). Validation of the Scale of Attitude towards Research in Mexican psychology students. *Revista Evaluar, 19,* 1-16. https://doi.org/10.35670/1667-4545.v19.n1.23874

Ramos, G. C. (2020). Los alcances de una investigación. CienciAmérica, *9*, 1-5. https://dialnet.unirioja.es/servlet/articulo?codigo=7746475

Rivas-Díaz, L.H., Loli, P. R. A., & Quiroz, V. M. F. (2020). Perception of nursing students on formative research in undergraduate. *Revista Cubana de Enfermería, 36,* 1-15. https://revenfermeria.sld.cu/index.php/enf/article/view/3486

Rocha, N., Calcina, C., Sucari, W., Esteves, A., & Lujano, Y. (2022). Attitude and disposition: two key elements for the investigation. *Revista de Investigación Apuntes Universitario*s, 12, 250-264. https://doi.org/10.17162/au.v12i2.1049

Rojas, A. I. D., Durango, M. J. A., & Rentería, V. J. A. (2020). Formative research as a pedagogical strategy: industrial engineering case study of the I.U Pascual Bravo. *Estudios Pedagógicos*, *46*, 319-338. http://dx.doi.org/10.4067/S0718-07052020000100319

Sánchez, F. F. A. (2019). Epistemic Fundamentals of Qualitative and Quantitative Research: Consensus and Dissensus Fundamentos epistémicos da pesquisa

qualitativa e quantitativa: consensos e dissensos. *Revista digital de investigación en docencia universitari*a, *13*, 102-122. https://doi.org/10.19083/ridu.2019.644

Silva, N. O. R (2018). *Razonamiento cuantitativo y la investigación formativa en estudiantes de ingeniería de la Universidad Peruana de Ciencias Aplicadas, 2018.* M. S. Thesis, Education Faculty, University of San Martin de Porres, Perú. https://repositorio.usmp.edu.pe/handle/20.500.12727/3922

Tobón, M. F. Á., López, G. L. A., & Londoño, A. C. D. (2019). Formative research and integrative academic practices within the framework of University Social Responsibility: An analysis based on mixed methodology. *Revista Entramado*, *15*, 188-200 http://dx.doi.org/10.18041/1900-3803/entramado.2.5693

Turpo-Gebera, O., Mango, Q. P., Cuadros, P. L., & Gonzales-Miñán, M. (2020). Formative research at the university: meanings assigned by the teaching staff of a Faculty of Education. *Educação e Pesquisa* , *46*, 1-19. https://www.scielo.br/j/ep/a/bvYGHxgCpxB8sKNNp6zd3sN/?lang=es

Valero, A. V. N. (2021). Formative research in the university. *Revista Latinoamericana Ogmios*, *1*, 7-8. http://dx.doi.org/10.53595/rlo.2021.1.001

Velásquez, M. R., Abreu, M. A., Andrade, S. D. R., Jiménez, M. R., & Cisneros, Z. C. P. (2019). Development of formative investigative competences: challenges and perspectives for the University. *Contemporary Dilemmas Magazine: Education, Politics and Values*, *6*, 1-26. https://dilemascontemporaneoseducacionpoliticayvalores.com/index.php/dilemas/article/view/1472

Venegas, M. V., Esquivel, G. J., & Turpo-Gebera, O. (2019). Reflections on educational research and formative research in the Peruvian university. *Revista Conrado*, *15,* 444-454. http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S1990-86442019000500444

Vera-Rojas, M. D. P., Chávez, A. S., & González S. E. C. (2018). Formative research at the Ecuadorian university: a personal experience. *Boletin Redipe*, 7, 89-98. https://dialnet.unirioja.es/servlet/articulo?codigo=6523255

Appendix

Dear student, the purpose of this questionnaire is to identify the level of attitude towards formative research, developed during the 2023-I academic semester. Therefore, you are requested to mark with a cross (X) the box that you deem convenient and appropriate. There is no right or wrong answer. The information collected will be used strictly for research purposes, complying with all the ethical aspects that the development of the research implies.

	Statements	Strongly agree	Agree	Disagree	Strongly disagree
S1	I must know how to use the APA format to do research regarding the development of applications in augmented reality				
S2	The lack of money is my biggest problem to do research regarding the development of applications in augmented reality				
S3	It seems to me that doing research in the development of augmented reality applications is boring				

S4	Doing research in the development of augmented reality applications strengthens professional ethics				
S5	I must know how to work in a team to do research regarding the development of augmented reality applications				
S6	The lack of time is my biggest problem to do research in the development of augmented reality applications				
S7	It seems to me that doing research regarding the development of augmented reality applications is not something interesting				
S8	Doing research regarding the development of augmented reality applications encourages creativity				
S9	I must know how to write to do research in the development of augmented reality applications				
S10	The lack of support from my teachers is a problem for doing research regarding the development of augmented reality applications				
S11	It seems to me that research in the development of augmented reality applications is not necessary for my profession				
S12	Doing research in the development of augmented reality applications develops responsibility				
S13	I must know a second language to do research regarding the development of applications in augmented reality				
S14	The lack of knowledge is an obstacle to doing research in the development of applications in augmented reality				
S15	It seems to me that research in the development of augmented reality applications is difficult				
S16	Doing research in the development of augmented reality applications makes you more engaged				
S17	I must know how to organise to do research regarding the development of applications in augmented reality				
S18	The lack of support from my school is an obstacle to doing research in the development of augmented reality applications				
S19	It seems to me that doing research in the development of augmented reality applications is tedious				

S20	Doing research in the development of augmented reality applications develops personal security				
S21	I must know how to make decisions to do research regarding the development of augmented reality applications				
S22	The lack of information is the reason why I do not do research regarding the development of applications in augmented reality				
S23	It seems to me that research is only done on augmented reality applications for the thesis				
S24	Doing research in the development of augmented reality applications makes thinking more flexible				
S25	I must know statistics to do research regarding the development of applications in augmented reality				
S26	Lack of credibility as a student is why I don't do research in AR app development				
S27	I find that doing research in augmented reality app development is stressful				
S28	Doing research on augmented reality applications develops a tolerance for frustration				