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ORIGINAL

Statistics with emphasis on formative research as a desirable transversal requirement at IDEAD Universidad del Tolima

Estadística con énfasis en investigación formativa como requerimiento transversal deseable en el IDEAD Universidad del Tolima

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ABSTRACT

The purpose of this review article was to describe the characteristics and principles of the implementation of a virtual learning object to recognize the importance of statistics as a desirable transversal requirement in the students (and teachers) of the IDEAD of the University of Tolima in the scenario of formative research. To locate bibliographic documents, different databases and academic search engines, electronic books and journal portals were used, which were prioritized according to those documents that highlighted the theoretical foundations of formative research, virtual learning objects, the importance of statistics in the scenario of administrative and financial programs, virtual training in the distance education modality and research seedbed. At the beginning of writing the article, the documentary analysis and evaluation of the quality of the articles found were carried out. It was concluded that the review of the pedagogical, didactic and disciplinary references related to the construction of a virtual learning object, as well as the knowledge of the principles and characteristics for its implementation, allows the integration of virtual training in the university context of the distance education modality. Likewise, the generation of research seedbeds invites the strengthening of formative research with the purpose of recognizing the importance of statistics in the context of programs related to administration and finance in the exercise of learning by researching, and not learning by repeating.

Keywords: Virtual Learning Object; Statistics; Formative Research; Research Seedbed.

RESUMEN

El presente artículo de revisión tuvo por finalidad describir las características y principios de la implementación de un objeto virtual de aprendizaje para reconocer la importancia de la estadística como requerimiento transversal deseable en los estudiantes (y docentes) del IDEAD de la Universidad del Tolima en el escenario de la investigación formativa. Para la localización de documentos bibliográficos se utilizaron distintas bases de datos y motores de búsqueda académicos, libros electrónicos y portales de revistas que se priorizaron de acuerdo con aquellos documentos que destacaban los fundamentos teóricos de la investigación formativa, los objetos virtuales de aprendizaje, la importancia de la estadística en el escenario de los programas administrativos y financieros, la formación virtual en la modalidad de educación a distancia y los semilleros de investigación. Al inicio de la escritura del artículo, se realizó el análisis documental y la evaluación de la calidad de los artículos encontrados. Se llegó a la conclusión de que la revisión de los referentes pedagógicos, didácticos y disciplinares referentes a la construcción de un objeto virtual de aprendizaje, así como el conocimiento de los principios y características para su implementación, permite la integración de la formación virtual en el contexto universitario de la modalidad de educación a distancia. Así mismo, la generación de semilleros de investigación, invita al fortalecimiento de la investigación formativa en el propósito de reconocer la importancia de la estadística en el contexto de los programas relacionados con administración y finanzas en el ejercicio de aprender investigando, y no de aprender repitiendo.

Palabras clave: Objeto Virtual de Aprendizaje; Estadística; Investigación Formativa; Semillero de Investigación.

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INTRODUCTION

The Distance Education Institute of the University of Tolima (IDEADUT) has established itself in Colombia as an accredited, high-quality university institution emphasizing interdisciplinary academic organization, research, and innovation geared towards leadership and recognition of educational transformation.[1] Hence, the educational community's interest in embracing the transformations, processes, and advances taking place in science, culture, research, and technology within the framework of the global order of sustainable human development and the sustainable development goals of the 2030 Agenda of the United Nations Educational, Scientific and Cultural Organisation.[2]

With an eye on the labor and professional scene, it is pertinent to consider the academic, pedagogical, and research dynamics of IDEADUT teachers and students and the need to forge processes that truly impact society through competent financial administrators who can solve problems and face social and economic challenges, respond favorably to current requirements and overcome prevailing limitations. However, as Ramos[3] warns, we must also ask ourselves about the implications that teacher training and the role of teachers may have in transforming these attitudes.

The educational transformation implicit in these academic and research aspirations requires that, in our role as research tutors in the Financial Administration Programme of the Distance Education Institute of the University of Tolima, Tunal Tutorial Assistance Centre in Bogotá (CATIDEADTunal), we ensure that all students have the opportunity to acquire a basic research culture that enriches their technical vocabulary, their knowledge of administrative and financial sciences, the appropriate use of technological mediations and learning platforms, and, in particular, an understanding of statistics, a discipline that has managed to position itself in countless areas of scientific work, making it a cross-cutting science and, according to Ramos[3], "one of the subjects with the most significant presence in the curricula of all university courses. However, there are some gaps in the teaching and learning processes at universities.

On the one hand, knowledge and applications of statistics are not very visible because students perceive its study with a particular antipathy and lack of awareness of its possibilities; its understanding is not assumed to be a necessity required by the academic or professional context, or by life itself as Zapata, cited by Ramos[3], states, 'ordinary citizens face the constant challenge of reading and interpreting statistical data from different sources. Unfortunately, our citizens have insufficient statistical literacy to meet these challenges our culture demands successfully', even though they know its importance in their professional training.

On the other hand, the approach to technological mediations and learning platforms does not reflect their use and importance in the training, academic, and research processes of distance education, which is necessary to achieve products and learning outcomes that meet the expectations of the third decade of the 21st century.

Finally, there is a lack of research centers that address the inherent problems of the administrative and financial context from the perspective of educational research as a process of exploration and discovery rather than the repetition of decontextualized content.

Statistics as a desirable requirement for IDEAD students

The evolution of computer and telecommunications technology has led to the widespread promotion of statistical methodology. Skills in the use of statistical methods and techniques are necessary to fully take advantage of technology. According to Díaz[4], studies on the importance of teaching statistics in the training of administrators identify that 'the use of technology in teaching is no longer a trend; it is a necessity'.

Existing statistical software is diverse and accessible to various types of users. According to Barreto[5], 'statistical methods are increasingly being applied in the management of projects and budgets of all types and sizes; the management of health and social security systems is now inconceivable without statistical methodologies'.

Continuing with Barreto[5], it is relevant to distinguish other applications of statistics in areas closely or very closely related to financial management: A wide variety of studies in economics, business, and social sciences require the use of statistical methods; opinion polls, marketing, economic dynamics, risk, and decision-making, to name a few, are statistical studies.

Statistics applied to business, economics, and social sciences occupies a prominent place among the areas of statistical methodology. National and departmental governments invariably have a system of statistics that includes demographic, economic, and social aspects. Improving quality and productivity, both in manufacturing processes and in services, requires statistical methodology.

However, due to traditional teaching practices, the range of possibilities and applications offered by statistics as a cross-disciplinary subject is not very visible in the university classroom. Some studies on the teaching and learning of statistics, such as that carried out by Hernández and Romero[6], point to actions that describe the passive position of the student and the 'protagonism' of the teacher in their educational work:

Teachers use various teaching strategies, including lectures, mind maps, problem-solving, and concept maps. Students say these strategies are sometimes very routine, with teachers explaining the class and then presenting a series of exercises to be completed prior to individual assessment.

This weak interaction between teachers and students hinders motivation and joint participation in the construction of knowledge. The educational purpose seems determined by the teacher's diligence in delivering the content and the student's passing of the course. This situation diminishes interest in learning and places statistics not in terms of its potential value in solving real social problems but as a subject that is a curriculum requirement.

Rather than exploring, describing, and solving a problem in context, beyond following a recipe book of 'incomprehensible' statistical formulas and using instructions for statistical software, the research interests of the supervising teacher and their students (learners) should be directed towards answering questions such as the following in detail and with clarity: Which statistical

technique is appropriate? Is the application of the method valid? Are the requirements for its use met? Do the results have practical significance?".[7]

In this regard, Behar et al.[8] warn of one of the permanent duties of statistics teachers: "to make our students aware of the nature of a particular class of problems that they will have to solve in the exercise of their profession or the exercise of their citizenship, for which they are not yet prepared.

Similarly, Corral, cited by Patiño[9], highlights actions required of teachers: 'There is a need to apply teaching methodologies that remedy existing problems, based on the active participation of students, to develop the ability to learn how to learn'.

Recent research confirms the need to include statistics in administration and finance programs. One such study is the doctoral thesis by Díaz[4], which, based on a qualitative study with an action research approach, presents different aspects of the teaching and learning process of statistics in administrative, economic, and accounting degrees. Its objective is to design and implement a teaching model based on financial simulations as a tool for constructing a robust meaning of statistical volatility and its applications through computer-assisted simulations.

From a theoretical perspective, the study is relevant because it presents a teaching model that facilitates the interaction of teaching resources and a series of processes that promote the construction of the meaning of statistical concepts in students of administrative, economic, and accounting degrees.

The path to formative research

According to Asis et al.[10], formative research is 'a set of learning strategies for inquiry, exploration of reality and knowledge construction'. Its difference from scientific research lies basically in form and substance: formative research insists on preparing students to acquire research habits and qualities for constructing knowledge in a somewhat flexible environment, while scientific research tends towards exclusive scientific production, without the two being mutually exclusive.

In the same vein, Parra, cited by Asis et al.[10], believes that 'if formative research is worked on transversally throughout the curriculum, it can significantly improve pedagogical and didactic processes, as it helps to reinforce them through the implementation of the scientific method in the resolution of specific problems.'

This cross-cutting approach should promote the axiological elements inherent in all human processes. In the words of López-Espitia, cited by Asis et al.[10], formative research 'promotes reflection on the process and the culture of research, understood as the creation of an appropriate space for teaching and research practice, as well as the norms, values, and attitudes associated with it.'

From these positions, which emphasize the process rather than the result, pedagogical and academic reconciliation is possible between the teacher, conceived as a guide and mentor of the research process, and the student, who has the role of learner and active participant in the construction of knowledge inside and outside the classroom.

Barrios et al.[11] highlight the actions of the teacher in their research role: The educator researcher has the extraordinary task of creating school activities that help their students investigate and generate methods to solve problematic situations, as well as developing methodologies and techniques to analyze the results of their school interventions and disseminate their most relevant findings.

In the same vein, Maggio[12] adds aspects that should be integrated into our teaching practices:

'When thinking about our practices as teachers, it is one type of contribution among many others because the creation of teaching methods requires us to bring into play multiple theoretical approaches, including curricular, disciplinary, cultural, pedagogical, and didactic, to name but a few'.

Therefore, the educational slogan should be to work on the responsible intellectual growth of teachers and teacher-researchers who have the ability and judgment to produce knowledge, together with their students, that has an impact and is helpful in the neighborhood, the locality, and the city; to systematize and disseminate this knowledge.

As Guerrero[13] states, 'it is necessary, from the undergraduate level onwards, to design and implement programs that promote the development of skills for the productive development of research and innovation activities'. Shared research between learners and teachers allows for reconciled perspectives in favor of learning.

An outstanding piece of research promoting formative research in the administrative and accounting field is the doctoral thesis by Patiño.[9] The author raises a relevant question when carrying out actions based on formative research in academic programs, namely, whether the purpose is to train researchers or to train through research. From a qualitative paradigm and a critical-social approach, through a study of the characteristics of formative research, the researcher uses the multiple case method through a documentary review and focus groups to analyze the concepts and strategies of formative research based on the development of critical thinking and by professional and social needs.

This paper highlights research work as a substantive function that corresponds to the university, that is, fundamental within the educational process in particular. It also concludes that formative research aims to improve professional accounting training through various strategies to enhance education and develop critical thinking and personal and communication skills necessary for professionals. Less important is that formative research focuses on the definition of training through research and not for research.

Everything expressed in this section leads us to the purpose of formative research proposed by Miyahira[14]: 'to disseminate existing information and encourage students to incorporate it as knowledge, that is, to develop the necessary skills for lifelong learning, which is necessary for updating the knowledge and skills of professionals'.

Distance education and virtual education

According to Ramírez and Benavides[15], from its first generation (correspondence teaching) to its sixth generation (web 2.0-based

teaching), distance education has combined different methodologies, each of which has demonstrated advances in pedagogy and approaches to technology, promoting a shift towards virtual environments. Similarly, Arboleda and Rama[16] state that 'most open universities have also opted for the use of virtual learning environments as another way of diversifying distance education methodologies'.

The permanent pedagogical use of digital platforms and technological tools, such as mobile phones, computers, and digital tablets, integrated with distance education, allows for the construction of 'an educational community that understands and accepts that learning takes place in multiple settings and with an infinite number of tools and strategies'.[17] This approach motivates the integration of distance education with virtual education by implementing an OVA.

Virtual Learning Object (OVA)

In curriculum proposals aimed at improving higher education, the use of ICT every day since, according to Veytia, cited by Moreira et al.[18]: They have digital resources that combine technology, mediation, and teaching to help students build their knowledge. In this regard, Virtual Learning Objects (VLO) become a valuable support to accompany the training of university students in the best possible way.

According to the Colombian Ministry of Education, cited by Morales et al.[19], an OVA is 'material structured in a meaningful way, associated with an educational purpose and corresponding to a digital resource that can be distributed and consulted via the Internet'.

As a learning (or teaching) tool, OVAs allow students (and teachers) to learn independently, making the most of their time and adapting to their digital skills. As stated by Meza[20], OVAs shift the focus of attention in the educational process from the teacher to the student "based on what the learner "should know" and not on what the teacher "knows" or "believes they know".

According to Vera[21], this pedagogical resource (OVA) must meet certain instructional principles required in the design of a virtual course: student motivation, planning of learning objectives and content, learning theories and teaching methodology, course organization, course assessment or monitoring, tutoring and cooperation, interactivity, and adaptability and availability of the learning environment.

In addition to these principles, OVA has specific characteristics that depend on the vision of its creator. In the chapter Development and Publication of virtual learning objects: A Challenge for Teachers, Galindo[22] establishes nine characteristics:

1. Self-contained: autonomy for presenting the different elements that comprise it.
2. Reusable: the possibility of being used by other users in different contexts of the educational process.
3. Granularity: small capsule of knowledge on a specific topic.
4. Educational: contributes to the teaching and learning process.
5. Identifiable: easily located from the metadata located in the OVA repositories.
6. Durable: long-lasting.
7. Interoperable: can be published on different learning management platforms.
8. Usability: easy, intuitive and agile navigation.
9. Accessible: the possibility of adapting the information for anyone with a disability.

This interaction of knowledge and practices makes it possible to train students comprehensively in theoretical, methodological, technological, social, and management aspects, as well as human development.

The use of an OVA in this study prioritizes four aspects: the appropriate use of technological mediations and learning platforms such as Tuaula at the University of Tolima; the importance of learning statistical methods and techniques that demonstrate applications and projects in the administrative and financial areas; the development of capacities and skills to train ideal, well-rounded individuals: learning to know, learning to do, learning to live together and learning to be;[20] based on these capacities and skills, the development of research skills through Formative Research, as a practice that allows students 'not only an immediate view of the world but one that enables them to see in greater detail, as well as historically, the problems of social reality'.[23]

Educational research seedbeds

The creation and development of research seedbeds in higher education institutions is an academic, pedagogical, and administrative action that enables and highlights this research mission about the importance of learning statistics.

According to Castro[24], a university research seedbed is a 'learning community whose purpose is to encourage a culture of research and skills training among its members; interventions carried out with seedbeds have shown an improvement in research skills and an increase in student scientific output.'

These academic spaces, often organized and run paradoxically 'outside' university classrooms but administratively immersed in higher education institutions, require space, time, coordination, operating conditions, and regulations to function, mainly because, according to Quintero et al.[25], "they have come to occupy an important place in development plans and institutional evaluations that seek to ensure a quality accreditation system".[26,27,28]

Based on the above, it should not be too bold to establish a pedagogical and training proposal that combines virtual training with distance education through the implementation of an OVA in an early education environment in formative research through the ongoing work of a research seedbed to promote the relevance of learning statistical techniques and procedures in the field of financial administration. This integration will enable statistics to impact as a desirable cross-cutting requirement at IDEADUT.

Similarly, it offers students (and tutors) of Financial Administration the opportunity to apply their social and technological skills

to solving simple, common, and complex problems, searching for creative and dynamic strategies and procedures as they face their personal and social progress within the comprehensive training offered by IDEADUT's institutional pedagogical project.

Regulations for research seedbeds at the University of Tolima

For the University of Tolima, research seedbeds are learning communities in which students, teachers, and researchers come together to seek comprehensive training with an emphasis on research to promote a culture of research. Several considerations support the research intention of the research seedbeds:

- The University's General Statutes (Article 20, paragraph 2) regulate the role of the Academic Council as the decision-making body on the academic development of the University about research.
- The Academic Council (Agreement 0018 of 2003, Articles 21 to 14), which establishes procedures for training students in research; and Agreements 038 of 2005 and 0115 of 2011, which regulate the activities of the seedbeds.

In addition, research seedbeds at the University of Tolima must belong to a research group approved by the Research Committee of each Faculty.

The Academic Council standardizes the regulation of research seedbeds at the University of Tolima, according to Agreement 007 of 2017, which consists of 13 articles that establish, among other aspects, the profile of the members: a coordinator (professor or tutor) and between five and fifteen students from semesters I to IX; the operating conditions: submission of an annual work plan, identification, and profile of its members, mission, vision, and objectives of the seedbed, archive of minutes of weekly meetings, ways of disseminating results and products at institutional, regional and national seedbed meetings; the academic and administrative benefits of its members, as well as their respective duties and penalties.

DISCUSSION AND RESULTS

In higher education institutions, the scope of educational objectives in statistics cannot be achieved solely with technology and digital resources, although we would love to! It requires passion, desire, and concrete actions on the part of the teacher; it is a time-consuming task as it involves studying and understanding theories, recognizing the importance of statistics in administrative and financial settings, proposing hypotheses, converting ideas into teaching projects through the systematic recording of findings, applying and customizing methodologies, testing teaching methods, managing statistical programs and packages, using technological mediations and learning platforms, and harnessing one's own and others' emotions... always with the participation of the students, who are the heart of the alma mater. In other words, it involves conducting research with the dedication of time and space beyond that required by the daily work routine and a sincere desire to transform the lives of students (and teachers) and their professional prospects.

Focused on the importance of knowledge and the application of statistics in educational research, the scope of pedagogical and educational objectives requires extracurricular institutional space and time to move from traditional classrooms to spaces that allow students to explore and discover. This work is facilitated by creating and implementing research seedbeds because they stimulate a culture of research and the development of research skills in students, elements that enable scientific production in contrast to the repetition of traditional school content and practices.

Through the use of technological mediation and engaging learning platforms, students and teachers can engage with pleasure and excitement in an environment they recognize and use frequently, i.e., interactive tools deployed in a virtual environment that allow them to interact permanently from their work and their homes but especially manage their personal, work, and family time and space.

It should not be considered bold to suggest that studying the importance of statistics integrated with knowledge of administrative and financial theories through a virtual learning object in a flexible formative research environment under the flexible discipline of a research seedbed offers students and teachers the possibility of applying their social and technological skills to solving simple, everyday and complex problems, and find creative and dynamic strategies and procedures when facing their personal and social progress.

The joint purpose, then, between teacher-tutors and students is to challenge traditional teaching and learning methods in statistics in distance education. This is not focused on obtaining statistical knowledge in situ but rather on achieving basic guidelines for embarking on the path towards formative research, which allows us space for creative training, reflection, and exploration.

CONCLUSIONS

The review of pedagogical, didactic, and disciplinary references related to the construction of an OVA and knowledge of the principles and characteristics for its implementation allows for the integration of virtual training in the university context of distance education. Likewise, the creation of a small research group of students and a supervising teacher, called a research seedbed, encourages the strengthening of formative research by recognizing the importance of statistics in the exercise of learning by researching rather than learning by repeating.

This staging of attractive teaching methods and methodologies for students in favor of the perception of the relevance of learning and using statistics as a cross-cutting discipline in the IDEADUT Financial Administration Programme requires ongoing analysis of theoretical approaches and educational practices that are broadly informed by the educational experiences of students and research teachers, who are the ones who propose and implement actions based on formative research in integration with digital systems and networks.

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Students who are in the early stages of formative research in a research seedbed with some academic intention, such as using statistical applications and software in an OVA environment on a learning platform such as Tuaula, may be more likely to ask questions, consult, compare, and investigate and may be more easily motivated to join future research projects that match their personal or professional interests.

The various IDEADUT programs must emphasize the need and obligation to conduct research. In these research scenarios, the search for and use of ICT and statistical resources should be reflected in higher standards in academic products. Promoting an interdisciplinary view of statistics in its various fields of application is essential.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHORSHIP CONTRIBUTION

Conceptualization: Luis Guillermo Caro Pineda, Yolima Chica Roa.
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