Active Learning Strategies to Develop Student Skills in Information Systems for Management

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Abstract—Active learning strategies are at the center of any change process aimed to improve the development of student skills. This paper aims to analyze the impact of teaching strategies, including problem-based learning (PBL), in the curricular unit of information system for management, based on students' perceptions of how they contribute to develop the desired learning outcomes of the curricular unit. This course is part of the 1st semester and 3rd year of the graduate degree program in management at a private higher education institution in Portugal. The methodology included an online questionnaire to students (n = 40). Findings from students reveal a positive impact of the teaching strategies used. In general, 35% considered that the strategies implemented in the course contributed to the development of courses' learning objectives. Students considered PBL as the learning strategy that better contributed to enhance the courses' learning outcomes. This conclusion brings forward the need for further reflection and discussion on the impact of student feedback on teaching and learning processes.

Keywords—Higher education, active learning strategies, skills development, student assessment.

I. INTRODUCTION

ACTIVE learning in higher education is not a new topic. However, in the past years, it has received considerable attention by faculty and stakeholders looking for alternative ways to traditional teaching methods [1]-[5]. International reports have also called attention to the importance of student centered-learning and life-long learning skills and the impact of these issues to meet the standards and guidelines for quality assurance in Higher Education Institutions [6], [7]. The implementation of learning outcomes and student-centered learning – central reform goals of the Bologna Process – has contributed to the enhancement of learning and teaching, and in turn, this has impacted institutional strategies that support learning and teaching [6]. According to the report developed by the European University Association, some of the approaches identified to enhance student learning include teaching in small groups, PBL, peer learning (student learning with each other), community projects, flipped classrooms, to name a few [6]. These approaches share a common feature which is "learning by doing", as designated by Felder & Brent by as active learning [3]. However, there are different types of active learning that can be found in the educational literature. Prince [1] makes a tentative distinction of the key features of the main approaches of active learning, which include also collaborative learning, cooperative learning and PBL. Active learning involves student engagement and activity in the learning process, differing from passive traditional lectures. Collaborative learning involves students working together toward a shared goal, emphasizing interactions [8]. Cooperative learning is structured group work with individual assessment, focusing on cooperative incentives for learning rather than competition [9]. PBL introduces relevant problems to drive and motivate subsequent learning. It involves self-directed learning on the part of the students [10]-[15]. PBL is a teaching and learning approach in which students – in collaboration with teachers and others – explore and work together to solve a real-life problem or situation, closely related to the students' professional field or social reality in which it is inserted [16]-[19].

The literature on the effectiveness of active learning methods has also grown [1], [20], [21]. The link between learning outcomes and active learning strategies has also been explored with great interest [22]. Many studies assessing active learning's impact on student outcomes rely on self-reported data from students, focusing mainly on subject-specific knowledge within a course [22].

However, although the literature shows that active learning increases student learning, engagement and interest, the translation of this reality to classrooms has been slow and students tend to show resistance to active learning strategies [23], [24]. The literature has also identified several barriers to instructors' use of active learning, with fear of negative student responses being one of the most frequently cited barriers [2], [23], [25].

This paper aims to analyze the impact of the use of active learning strategies, in particular PBL, on the development of student skills. For this, a study was developed within a specific curricular unit (CU) called Information System for Management (ISM), which is part of the Management degree program, at a private higher education institution in Portugal.

The paper is organized in four main sections. The first section presents the introduction and review of the state of art on the field of active learning strategies. After presenting the theoretical background supporting the research, the context of the study is described as well as the methodology and research procedures used for data collection and analysis. Results are presented and discussed in the fourth section, followed by the conclusions and implications of findings for future research.

II. CONTEXT OF THE STUDY

In this section, a brief description of the context of the study and the previous research that led to the development of this

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International Journal of Educational and Pedagogical Sciences
Vol:18, No:9, 2024

study is presented and explored.

The Information System for Management is a curricular unit which is part of the study plan of the 1st semester of the 3rd year of the degree in management. The expected learning outcomes to be achieved by students, at the end of this curricular unit, are the following:

- To describe the concept of Information System (IS)
- To identify the role and impact of IS
- To identify and characterize types of IS
- To enumerate and recognize advantages of Emerging Technologies
- To describe the concept of "Digitalization"
- To enumerate barriers to the digitalization of organizations and identify good practices
- To use information systems: Enterprise Resource Planning-(ERP) and Business Intelligence (*Power BI*)
- To develop problems solving skills
- To apply in practice theoretical knowledge
- To develop written and oral communication skills
- To develop creativity skills
- To use of digital tools
- To develop critical thinking skills
- To develop teamwork skills
- To assess others and to self-assess

The teaching methods used in this curricular unit have undergone several changes over the past academic years. At the end of the 2017-2018 academic year, due to the considerable number of students who showed lack of interest in this subject, the high percentage of absenteeism and the low classifications achieved by students at the end of the semester, the curricular unit was reviewed by the lecturer. The changes made included the review of the teaching and learning strategies, as well as the behavioral skills that were intended to be developed by the

students. At the end of the 1st semester of the academic year of 2018-2019, student satisfaction with the changes implemented was evaluated and feedback was collected from students. Results from this survey indicated that at least half of the students revealed a positive perception regarding the active learning methodologies. They also considered the class to be more interesting and engaging with the use of these active learning methodologies [26].

Therefore, since 2018-2019, new active learning methods have been progressively introduced in this curricular unit. At each new academic year, the main results and conclusions of the survey applied at the end of the semester of the previous academic year are considered for planning the current semester. The main findings are that students have a positive opinion about group work, with a preference for practical group work which enables them to apply the course material in real-world cases. Students have also suggested increasing the number of seminars. However, every academic year, there are still students who consider that classes could be made even more interactive. Table I presents a summary of the evolution of the teaching and learning strategies, since 2018-2019 to 2021-2022.

TABLE I
EVOLUTION OF TEACHING AND LEARNING STRATEGIES IN THE COURSE

School year	Teaching and learning strategies
2018-2019	Flipped classroom, Team-based learning, Brainstorming, Lecture, Demonstration, Video Analysis, Case study and article analysis
2019-2020	Seminar, Flipped classroom, Team based learning, Brainstorming, Lecture, Demonstration.
2020-2021	Seminar, Flipped classroom, Think-pair-share, Lecture, Seminars, Demonstration, Video Analysis, Article and Case study, Guided practice
2021-2022	Flipped classroom, Project-based Learning (PBL), Think-pair-share, Lecture, Seminars, Guided practice, Video Analysis, Case study and articles analysis, Quizzes, Mental map

TABLE II
TEACHING AND LEARNING STRATEGIES USED FOR EACH LEARNING OUTCOME IN 2021-2022

	Video Analysis	Flipped classroom	Case study and article analysis	Think-pair-share	Guided practice	Lecture	Quizzes	PBL	Seminars	Mental map
Describe the concept of IS				X		X	X			X
Identify the role and impact of IS	X			X		X	X	X		X
Identify and characterize types of IS	X			X		X	X		X	X
Enumerate and recognize advantages of Emerging Technologies		X	X			X	X			X
Describe the concept of "Digitalization"				X		X	X		X	X
Enumerate barriers to the digitalization of organizations and identify good practices			X			X	X		X	X
Use: ERP					X			X		
Use Power BI					X			X		
Problems solving				X			X	X		
Apply in practice theoretical knowledge			X		X		X	X		
Written and Oral communication		X	X	X			X			
Creativity		X					X			
Use of digital tools							X			
Critical capacity	X	X	X	X						
Teamwork				X			X			
Ability to assess others and to self-assess						X	X			

In the 2021-2022 academic year, some new strategies were used, namely PBL, Quizzes and Mental map. The mental map and the quizzes were used at end of each learning objective. The first was used to summarize and interconnect the main concepts

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and the second was used as a formative assessment tool. This technique was used since it is commonly found in management environments, but it was applied only to one programmatic topic. Finally, the PBL was introduced to develop some learning objectives, as can be seen in Table II.

This paper aims to analyze the impact of the teaching and learning strategies used in the 2021-2022 curricular unit of ISM, in particular the PBL. This research intends to step further in the analysis of previous work carried out by the authors [26] which aimed to analyze students' perceptions of the use of traditional methods and active learning strategies, in the context of the same curricular unit, but now with the introduction of PBL approach.

The aim of the PBL project is to provide students with the opportunity to simulate real situations from the current job market in information systems and technologies. All groups worked with a fictitious retail company that already uses Excel and ERP Primavera and that intends to improve its digitalization level. So, the project had two parts each one representing two situations/problems: 1) to conduct a digital intervention project in an organization 2) to use ERP and BI systems to conduct daily business activities and to analyze business data respectively. So, part 1 aimed to simulate a study to improve the digitization level of a company (in the retail field area) and part 2 aimed to simulate daily and current activities in the same company that would allow implementing and evaluating the "Christmas Campaign". The project was developed in the context of contact and non-contact hours.

In general, the intention behind the introduction of the project-based methodology was to help students develop the following learning objectives of the curricular unit: i) Identify the role and impact of information systems in organizations, ii) Enumerate and recognize advantages of emerging technologies, iii) Use information systems (ERP and Power BI), iv) Apply theoretical knowledge in practice, v) Use of digital tools, vi) Teamwork, vii) Problem solving, viii) Creativity, ix) Ability to assess others and to self-assess, and x) Written and oral communication. At end of the semester the students were again asked to evaluate their experience with this curricular unit, so that new feedback could be gathered and used for further improvement, both for the teaching and learning strategies.

III. METHODOLOGY

The following research questions guided this study:

- How do students evaluate the level of development of the learning objectives of the curricular unit?
- To what extent did the teaching and learning strategies used contribute to achieve the learning outcomes of the ISM curricular unit?
- How do students evaluate the contribution of PBL to develop some learning outcomes?

Data collection was based on an online questionnaire applied to students at the end of the semester. The questionnaire was elaborated based on previously used questionnaires used to collect the students' opinions on changing the strategies adopted in this unit. The questionnaire was organized three parts, including a total of 11 questions, mainly multiple-choice answer. The questionnaire included questions about sociodemographic characterization of students, teaching and learning strategies for the development of the learning outcomes, positive and less positive aspects and suggestions for improvement.

The participants in the study consisted of 179 students enrolled in this curricular unit. The students who responded to the questionnaire (n = 40) are mainly female (57.5%), and 35% are aged between 20 and 22 years old, with 97.5% of them attending the curricular unit for the first time. Of these students, 12.5% had the status of working students. The rate of valid responses was 29,2%.

IV. ANALYSIS OF RESULTS

This section presents the most relevant results obtained in the following two dimensions: strategies/learning outcomes development and improvements suggestions.

A. Development of Learning Outcomes of the Curricular Unit

In order to evaluate the effectiveness of the teaching and learning strategies used, students were asked the following questions: 1) For each of the learning outcomes presented, evaluate the degree to which it was developed in the curricular unit (Likert scale: completely developed, well developed, fairly developed, partially developed and not developed at all); 2) considering the teaching strategies used, evaluate the contribution of each of them for the development of skills…; 3) Regarding the PBL, evaluate the degree to which the skills were developed.

TABLE III
LEVEL OF DEVELOPMENT OF THE TECHNICAL LEARNING OUTCOMES

	completed developed	well developed	fairly developed	partially developed	not developed at all
Describe the concept of IS	27,5%	52,5%	12,5%	5%	2,5%
Identify the role and impact of IS	25%	50%	20%	2,5%	2,5%
Identify and characterize types of IS	22,5%	47,5%	25%	2,5%	2,5%
Enumerate and recognize advantages of Emerging Technologies	27,5%	50%	17,5%	2,5%	2,5%
Describe the concept of "Digitalization"	22,5%	47,5%	25%	2,5%	2,5%
Enumerate barriers to the digitalization of organizations and identify good practices	25%	40%	27,5%	7,5%	0
Use: ERP	35%	30%	20%	7,5%	7,5%
Use Power BI	32,5%	32,5%	20%	7,5%	7,5%

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Concerning the technical learning outcomes (Table III), in global terms 65% responded that they were completed or well developed. In particular, the least favorable opinion was on the development of the following three objectives: Enumerate barriers to the digitization of organizations and identify good practices, Use of Enterprise Resource Planning (ERP) and Use of Power BI. In contrast, the most favorable opinion was on: Describe the information system concept and enumerate and recognize advantages of Emerging Technologies.

Regarding the strategies used, at least 35% responded that they contribute completely or well to the learning outcomes of the curricular unit. The most favorable was on the PBL, with 40% of students responding that it contributed completely and 50% responding well to skills development. Table IV summarizes the students' feedback. The other three new teaching and learning strategies introduced (Quizzes and Mental Maps) in 2021-2022 academic year are also well appreciated.

Regarding the contribution of the PBL work for the development of the learning outcomes (Table V), students considered that the outcomes which it develops the most (completely or well) were the following three (77,5% answers): Enumerate and recognize advantages of Emerging Technologies, Use of digital tools (word, ...), and Problem solving. The two least developed (with 57,5% and 65% respectively) were: Creativity and Oral and written communication.

TABLE IV
CONTRIBUTION OF THE TEACHING AND LEARNING STRATEGIES FOR THE ACHIEVEMENT OF THE LEARNING OUTCOMES

	contribute completely	contribute well	contribute fairly	contribute partially	do not contribute at all
Project based learning	40%	50%	7,5%	0%	2,5%
Video analysis	17,5%	35%	22,5%	12,5%	12,5%
Case analysis	20%	30%	30%	7,5%	12,5%
Think-pair-share	17,5%	47,5%	7,5%	10%	17,5%
Guided practice	20%	40%	12,5%	15%	12,5%
Lecture	17,5%	45%	20%	10%	7,5%
Quizzes	25%	45%	17,5%	5%	7,5%
Seminars	20%	40%	20%	7,5%	12,5%
Mental map	27,5%	30%	15%	15%	12,5%

TABLE V
CONTRIBUTION OF PBL FOR THE ACHIEVEMENT OF THE LEARNING OUTCOMES

	completed developed	well developed	fairly developed	partially developed	not developed at all
Identify the role and impact of information systems in organizations	25%	47,5%	17,5%	7,5%	2,5%
Enumerate and recognize advantages of emerging technologies	35%	42,5%	12,5%	7,5%	2,5%
Use information systems: ERP	35%	40%	17,5%	0	7,5%
Use information systems: Power BI	35%	40%	20%	2,5%	2,5%
Apply theoretical knowledge in practice	27,5%	40%	25%	2,5%	5%
Use of digital tools	35%	42,5%	17,5%	5%	0%
Teamwork	30%	45%	15%	7,5%	2,5%
Problem solving	30%	47,5%	12,5%	10%	0%
Creativity	20%	37,5%	25%	15%	2,5%
Written and oral communication	20%	45%	35%	0%	0%
Ability to assess and self- assessment	30%	40%	17,5%	5%	7,5%

B. Overall Evaluation and Suggestions for Improvement

The most positive aspects referred by students in the questionnaire can be summarized as the following: i) the use of ERP and power Bi, ii) the introduction of concepts about information systems for management, iii) the methods used which allow for group work and approaching the job market. Some quotes from students can confirm this:

"I found the curricular unit very interesting. I really enjoyed learning how to use Primavera ERP and Power BI, as I had a much more different and realistic idea about a company's accounting. After all, accounting isn't that bad."

"The most positive aspect of this curricular unit was that we carried out a work that at the end of it we managed to see a great evolution in our skills and abilities to use tools. I believe that we work in this course with the following skills: approach to a real problem with a systematic response, creativity in approaching problems, analytical thinking, data reading, critical thinking and oral presentation skills."

"Approaching the business reality, both through knowledge of the technologies that are increasingly present in organizations, and through the completion of the second part of the work, as it is more practical."

"Quality of materials available (practical component); Method of exposing theoretical material in a debate/ conversation format; Teachers' commitment."

Finally, as suggestions for improvement, the students suggested increasing the number of practical classes, such as

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those that focused on using Power Bi and ERP.

"As mentioned before, the adoption of more programs is essential to acquire more knowledge and to help us in the job market. From my perspective, I really learn with practice and, effectively, I will always know how to use the ERP and PowerBi tools, as I used them directly. In this way, I think that the adoption of more tools will be more beneficial for students."

V. CONCLUSIONS

Based on the study carried out, it is possible to draw some conclusions on the impact of the teaching and learning strategies used, as well as the assessment methods, in order to develop student skills and achieve the intended learning outcomes of the curricular unit of Information Systems Management. For this, the research questions which guided the study will be revisited and tackled.

First, it is possible to conclude that students are in general satisfied with the level of development of the learning objectives of the curricular unit, enhanced by the teaching and learning strategies used. In fact, this curricular unit has been subject to a continuous and systematic improvement process in terms of pedagogic strategies used [26]. This is evident when we analyze the Table I, where a wide and diverse range of teaching and learning strategies are presented, which have been implemented since the year 2018-2019. Most of the strategies presented focus on active learning principles, which is a positive indicator of the concern with developing student-centered learning environments at this graduate program. Some of the active learning strategies included PBL, flipped classroom, team-based learning, brainstorming, think-pair-chair, demonstration, gallery walk, video analysis, case study, article analysis, guided practice, quizzes and mental maps. When analyzing the level of complexity of these strategies, it is possible to observe a continuum of complexity, driving from simple, feasible, interactive moments (e.g. brainstorming, think-pair-chair, quizzes and mental maps), to more sophisticated and resource intensive approaches (team-based learning, flipped classroom, PBL).

Finally, it is possible to highlight the role of the PBL approach to develop the learning outcomes of the ISM curricular unit. With PBL, students were able to experience and discuss real situations in the area of information systems and technologies, which will be part of their future jobs. From students' perceptions, PBL specially contributed to develop specific learning outcomes, but on the other hand did not facilitate the achievement of certain competences such as creativity and written and oral communication. This is an interesting finding which should be analyzed deeper in future work, as research has shown that PBL supports the development of those competences. In future editions of the ISM curricular unit, a deeper approach of the implementation of PBL should be considered, by integrating the several active learning strategies in a broader and integrated perspective. The expected role of the students should also be carefully defined at the start of the project, as well as the project milestones, assessment, and feedback moments to meet the student expectations.

Specific moments for monitoring the team projects and more time available in class to work on the project are some suggestions provided by students that can help improve the curricular unit in the future. These suggestions will be included in future editions of this approach, to better improve the development of student skills with active learning strategies.

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