DA AVALIAÇÃO AO APRENDIZADO: AVALIAÇÕES OBJETIVAS EFICAZES NA EAD

FROM ASSESSMENT TO LEARNING: EFFECTIVE OBJECTIVE EVALUATIONS IN ONLINE EDUCATION

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Resumo. Este artigo discute estratégias para aprimorar avaliações objetivas na educação a distância (EaD), garantindo que elas não apenas meçam conhecimento factual, mas também promovam raciocínio crítico e integração do aprendizado. Com base na Taxonomia de Fink, no Learning Goals Inventory (LGI) e no Learning Assessment Techniques (LAT), este trabalho apresenta a reformulação de uma atividade avaliativa para um dos cursos do programa TIC em trilhas, considerando as limitações e possibilidades do LMS Canvas. São discutidas as adaptações realizadas para garantir que os objetivos de aprendizagem sejam atingidos, mesmo diante de restrições técnicas da plataforma. Os resultados apontam para a importância de metodologias inovadoras e flexíveis na construção e aplicação de avaliações na EaD.

Palavras-chave: educação a distância; avaliação objetiva; aprendizagem significativa; Learning Assessment Techniques; Taxonomia de Fink.

Abstract. This article discusses strategies to improve objective assessments in distance education (DE), ensuring that they not only measure factual knowledge, but also promote critical thinking and learning integration. Based on Fink's Taxonomy, the Learning Goals Inventory (LGI), and the Learning Assessment Techniques (LAT), this paper presents the reformulation of an assessment activity for one of the courses of the TIC em trilhas program, considering the limitations and possibilities of the Canvas LMS. The adaptations made to ensure that the learning objectives are achieved, even in the face of technical restrictions of the platform, are discussed. The results point to the importance of innovative and flexible methodologies in the construction and application of assessments in DE.

Keywords: online education; objective assessment; significant learning; Learning Assessment Techniques, Fink's Taxonomy.

1 Introduction

Distance learning (DE) has established itself as an essential modality for promoting access to education, especially with technological advances and changes in educational dynamics. The significant growth in enrollments in distance learning courses over the last decade reflects this trend.

Between 2011 and 2021, there was a significant increase in these enrollments in Brazil, with an increase of 274.3%, while in-person education there was a decrease of 8.3% in the same period (INEP, 2022). This growth reinforces a global trend, in which distance learning has been consolidating itself as an essential modality for democratizing access to education. Its flexibility allows students to combine studies with other activities, and its accessibility expands opportunities for different student profiles.

However, this progress also brings challenges, especially when it comes to assessing student learning. Unlike in-person teaching, where there are direct interactions and possibilities for applying different types of assessments, distance learning requires diverse assessment strategies, demanding more careful planning to ensure accuracy in knowledge verification processes and ensure scalability.

In this context, in distance learning assessment processes, we commonly observe a preference for the use of objective assessments. The use of assessment resources with objective questions has been widely adopted in online courses, as it allows for a scalable number of students to be served, since it offers automatic correction with agile feedback. However, it is observed that, in many cases, these questions are not prepared with the rigor and structure necessary to ensure an adequate assessment of concepts, with short, non-analytical statements that are often unrelated to the actual application of that knowledge. When well structured, this assessment format becomes an efficient tool, providing standardized and immediate correction, reducing subjectivity in the analysis of student performance. Furthermore, when integrated with learning management systems, it enables the automation of correction and feedback, making the assessment process more agile and scalable.

Therefore, given the growing number of online training courses available, we sought to identify strategies for constructing effective objective assessments in distance learning. To this end, we based ourselves on the theory of Learning Assessment Techniques (LAT) (BARKLEY & MAJOR, 2016). The objective is to propose a planned and structured assessment model focused on the application of knowledge acquired in the course, based on this theory, and how these assessments can not only measure learning, but also act as a central element in the teaching process, allowing students to develop real and applicable skills.

Therefore, we selected as a sample for our demonstration one of the courses from a free training program, the TIC em trilhas program. This program is an initiative coordinated by Softex, with support from the Ministry of Science, Technology and Innovation (MCTI) and is aimed at the free training of technology professionals. One of the proposals of TIC em trilhas is to use distance learning as a basis for offering asynchronous and far-reaching training. In this context, the choice of the ICT in trails program is justified because it is free, online, scalable and offers objective questions in some of its assessments.

2 Objective Assessments

Learning assessment, regardless of the method, is an essential element in the educational process, as it allows students' progress to be monitored and difficulties that may compromise the development of expected skills to be identified. Its role goes beyond simply classifying or measuring acquired knowledge. It should be understood as a descriptive and informative tool that helps both teachers and students understand the learning process, ensuring that educational objectives are achieved effectively.

In addition, assessment has a formative nature, as it not only provides information about students' level of knowledge, but also guides pedagogical practice to improve the teaching-learning process. By describing the difficulties faced by students, assessment makes it possible to adapt teaching strategies to better meet individual and collective needs. In this way, teachers can intervene more assertively, providing targeted support to students who need reinforcement and encouraging those who already demonstrate mastery of the content. For students, this process is equally valuable, as it helps them recognize their own difficulties and seek ways to overcome them, becoming active agents in the construction of their own learning (KRAEMER, 2005).

Objective assessments are widely used tools for measuring learning, characterized by structured questions that allow for precise and standardized responses. This type of assessment generally includes formats such as multiple choice, true or false, column association and fill-in-the-blank, allowing for faster and more objective correction. One of the main advantages of this model is the possibility of automating the assessment process, especially in virtual learning environments,

where learning management systems (LMS) can correct responses immediately using predefined templates.

Despite this context, automated grading of objective assessments presents some challenges and limitations. One of the main concerns is the possibility of superficial grading, since objective questions tend to measure factual knowledge rather than more complex skills such as critical thinking or problem solving. In addition, the lack of flexibility to correct partially correct answers or to formulate more open-ended questions may limit the effectiveness of this type of automation. While LMS systems are excellent for repetitive tasks, automation is still not capable of capturing nuances and broader contexts of learning, which can lead to an inaccurate assessment of the student's overall performance. Thus, while automation improves the efficiency of the assessment process, it should not completely replace the more qualitative and personalized analysis of the teacher.

Objective assessments tend to focus on memorization of information and may not adequately measure deep understanding of concepts, problem-solving skills, or the ability to apply knowledge in real-world contexts. As Gage (2007) points out, objective assessments can encourage superficial learning, where students focus on memorizing answers rather than understanding the content. In addition, they may favor students who are comfortable with the question format, but not necessarily those who have a more holistic or applicational mastery of the content.

Another critical point in this scenario is the lack of personalization and the risk of bias. Objective assessments often do not consider the diverse ways in which students learn, leaving aside critical and creative thinking skills. According to Biggs and Tang (2011), for effective assessments, it is essential that assessment methods are aligned with the learning objectives and the different skills that students must develop. Therefore, although objective assessments may be practical for measuring factual knowledge, they are not sufficient to comprehensively assess the skills essential for academic and professional success. A more balanced model that combines different types of assessment is recommended to promote more meaningful and inclusive learning.

3 Integrated Approach to Enhancing Learning Assessment

3.1 Application Context

TIC em trilhas is a national professional training program in Information and Communication Technology (ICT). The goal is to fill the gap in qualified professionals in the sector by offering free and accessible training.

The courses, or learning trails, are divided into modules, with videos, readings, assessment activities and forums, allowing each participant to progress at their own pace. A micro-certificate is issued for each stage completed, and full certification is issued at the end of the course. The content is based on skills aligned with market needs, with assessment activities that encourage the application of acquired knowledge.

Due to the scalable nature of the distance learning trails model, these trails were designed to include automatic corrections provided by the LMS. In this context, objective assessment has become essential, allowing automatic verification of acquired knowledge through quizzes, multiple-choice tests and other standardized forms of correction. This approach can guarantee scalability for this model without compromising the quality of the training.

In order to continually improve the processes and quality of the program's offerings, in this study, we applied the Learning Goals Inventory (LGI) (BARKLEY & MAJOR, 2016) to one of the modules

of the Introduction to Artificial Intelligence track to identify and prioritize the most relevant learning objectives. Based on this analysis, we restructured the assessment activity of this module in order to understand how we could achieve better alignment between the content covered, the educational objectives, and the assessment. The chosen module covers essential topics in Artificial Intelligence (AI), including Classical AI - Logic and Reasoning, Planning and Routing, Genetic Algorithms, Recommendation Algorithms, and Fundamentals of Reinforcement Learning, as well as an introduction to their practical application. Our goal, therefore, was to improve the quality of the assessment and the effectiveness of the learning, making the students' experience more aligned with the expected competencies in the field of artificial intelligence of that specific module.

To address the challenges identified and make assessment more aligned with skills development, we propose a structured approach based on three main elements: the clear definition of objectives through the use of the Learning Goals Inventory (LGI) and the selection of assessment activities using the Learning Assessment Techniques (LAT) model. This methodology not only allows for a diversification of assessment instruments, but also reduces the time required of teachers without compromising the depth of student learning.

With the learning objectives well mapped, the next step was to select types of assessment activities that would truly allow these skills to be measured, considering the context in which they were applied. LAT (Learning Assessment Techniques) provides a set of practical strategies for assessing different levels of learning, going beyond traditional objective tests. Based on the objectives defined by the LGI, LAT helps in choosing assessment methods that promote greater engagement and in-depth knowledge.

3.2 Learning Goals Inventory

The LGI (Learning Goals Inventory) is a questionnaire developed by Barkley & Major (2015) to assist teachers in identifying and prioritizing learning objectives based on Fink's Taxonomy.

The Fink Taxonomy of Meaningful Learning was designed to meet the needs of university students for access to soft skills:

> He believed that higher education was expressing a need for new kinds of learning – learning that went beyond just thinking and the acquisition of knowledge to learning that includes leadership and interpersonal skills, ethics, communication skills, character, tolerance, and the ability to adapt to change (BARKLEY & MAJOR, 2016, p.6)

This Taxonomy is divided into six areas, as described in the table:

Table 1 - Fink's Taxonomy of Significant Learning

Domain	Description
Fundational Knowledge	Understanding and remembering the information, ideas, and perspectives that form the basis for other kinds of learning in the subject.
Application	Applying knowledge to real situations through critical and creative thinking, problem solving, performance, and skill so that foundational knowledge becomes useful.
Integration	Making connections between ideas, learning experiences, and different realms of life so that everything is put into context and learning is more powerful.

Human Dimension	Learning about the personal and social implications of what learners are learning, thus giving the learning significance as learners learn about themselves and others.
Caring	Developing new feelings, interests, and values that help learners care about what they are learning, which gives them the energy they need for learning more about it and making it part of their lives.
Learning How to Learn	Learning about the process of learning, including a particular kind of inquiry (such as scientific method) as well as how to become a better, more self-directed learner, which enables learners to continue learning and do so with greater effectiveness.

Font: BARKLEY & MAJOR, 2016, p.6.

The instrument is divided into two stages: in the first, the teacher assesses the relevance of different aspects of learning according to the domains proposed by Fink. In the second stage, the teacher uses a rubric to determine which of these domains are most significant for the content being taught. This process allows for a clearer and more strategic definition of educational objectives, ensuring alignment between teaching and learning.

The LGI result is presented in points for each of the learning domains. Based on the score obtained, we calculate the approximate weight of each of the domains in order to understand the number of questions necessary to assess each of the items.

Table 2 - LGI Abstraction

Domain	Points	Weight (rounded)
Fundational Knowledge	21	20
Application	27	30
Integration	45	50
Human Dimension	9	0
Caring	9	0
Learning How to Learn	13	0

Based on this preliminary evaluation, our analysis indicated the following:

- **Integration Domain:** "[...] place a high value on students developing the ability to integrate information and demonstrate connections between concepts, people, and different realms of life." (BARKLEY & MAJOR, 2016, p. 430)
- **Application Domain:** "[...] place a moderately high value on students developing the ability to apply what they have learned in new situations and to demonstrate critical, creative, or practical thinking." (BARKLEY & MAJOR, 2016, p. 430)
- **Foundational Knowledge:** "[...] place a moderately low value on students developing the ability to remember and understand important facts and concepts." (BARKLEY & MAJOR, 2016, p. 429-430)

After completing the LGI and now with the objectives defined, we moved on to choosing the LATs according to the domains above. It was taken into account that the main objective is for the assessment to be automatically corrected by the content management system (LMS). The LATs chosen were the following:

Table 3 - Selected LATs

Domain	**Technique**	**Brief Description**
Integration	Sequence Chains	Students analyze and visually represent a sequence of events, actions, roles, or decisions.
Integration	Case Study	Students are given a real-life case related to the course, which includes a brief history and a dilemma faced by a key character.
Application	What's the problem?	Students examine examples of common problem types and identify the specific type of problem each represents.
Foundational Knowledge	Guided Reading Notes	Students are given notes with blanks for key words, and they fill in the missing content as they read.

Font: Adapted from BARKLEY & MAJOR, 2016, p.38-42.

Finally, assessment can be strategically planned to promote the comprehensive development of learning domains in students.

3.3 Proposed Assessment Activity

Based on the analysis of the educational objectives and the assessments carried out, we propose an activity to optimize both the way the content is presented and the students' interaction with it, with the aim of stimulating the development of more complex skills, such as information integration, application of knowledge in new situations and critical thinking. This assessment proposal was structured to more effectively align the educational objectives with teaching strategies, favoring deeper and more meaningful learning.

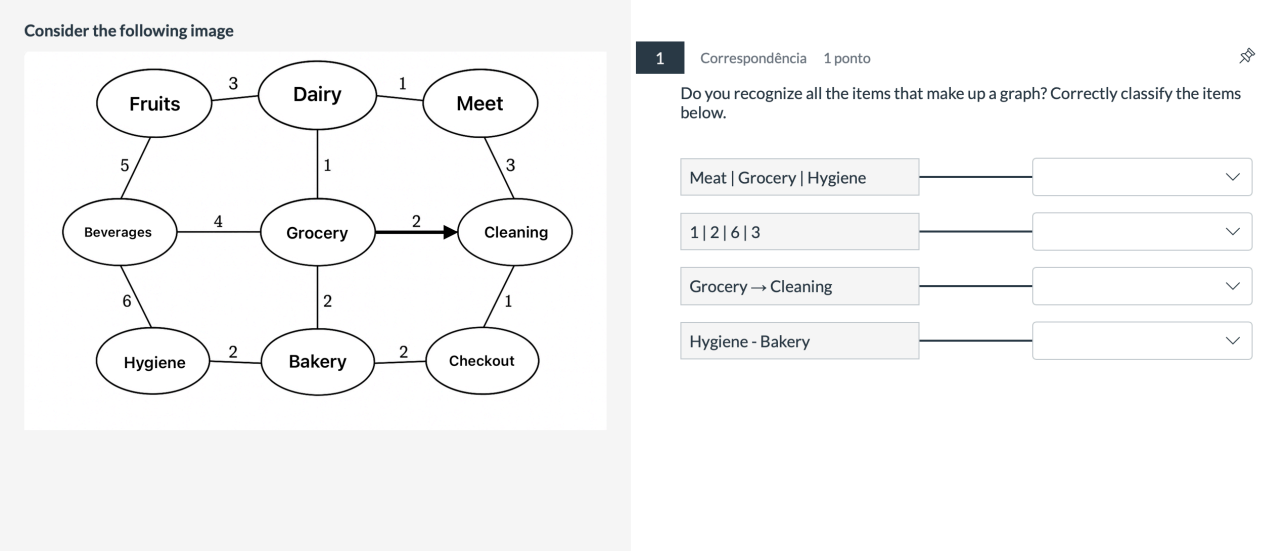
The proposal consisted of six questions, distributed as follows among the domains: three questions in the Integration domain, two questions in the Application domain and one question in the Foundational Knowledge domain.

- Sequence Chains (Questions 1 & 2): Using the hotspot tool, the student must correctly fill out a conceptual map covering the following topics: Search Algorithms and Recommendation Systems.
- Case Study (Question 3): The student will be presented with a case study and must identify the most appropriate search algorithm or recommendation system to solve the proposed problem.
- What's the problem (Questions 4 & 5): The student will be presented with two cases in which the search or recommendation system is not effective. The student must analyze each situation and suggest the most appropriate recommendation system or search algorithm to solve the problem.
- Guided Reading Notes (Question 6): The student will receive a reading notes file in the first class, which can be filled out while watching the video lessons. During the learning challenge, the student must record their answers in this file to obtain the necessary score.

3.4 Implementation in the LMS system

In question 1, the intention was to use a Hotspot-type question to assess the student's ability to identify the characteristics of a graph in an image. However, we realized that this functionality limits the interaction to just one point in the image, making the planned activity unfeasible. To get around this limitation, we adapted the question using the matching functionality: we present the image and then ask the student to correctly associate the concepts, ensuring that the student performs the same analysis as would do in Hotspot, but in text format.

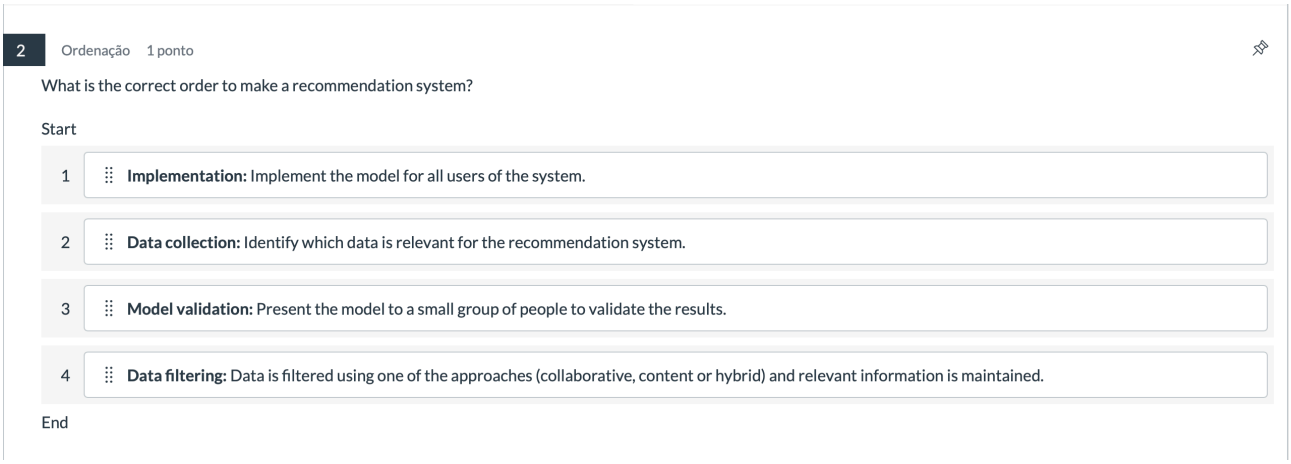
Figure 1 - Application of question 1 on Canvas LMS



Source: authors

In question 2, the limitation of the Hotspot functionality persisted. However, the objective in this case was to assess the student's understanding of the sequence of activities necessary for the proper functioning of a recommendation system. Given this need, we chose to use an ordering type question, allowing the student to correctly organize the steps of the process, ensuring a more effective assessment of their understanding.

Figure 2 - Application of question 2 on Canvas LMS

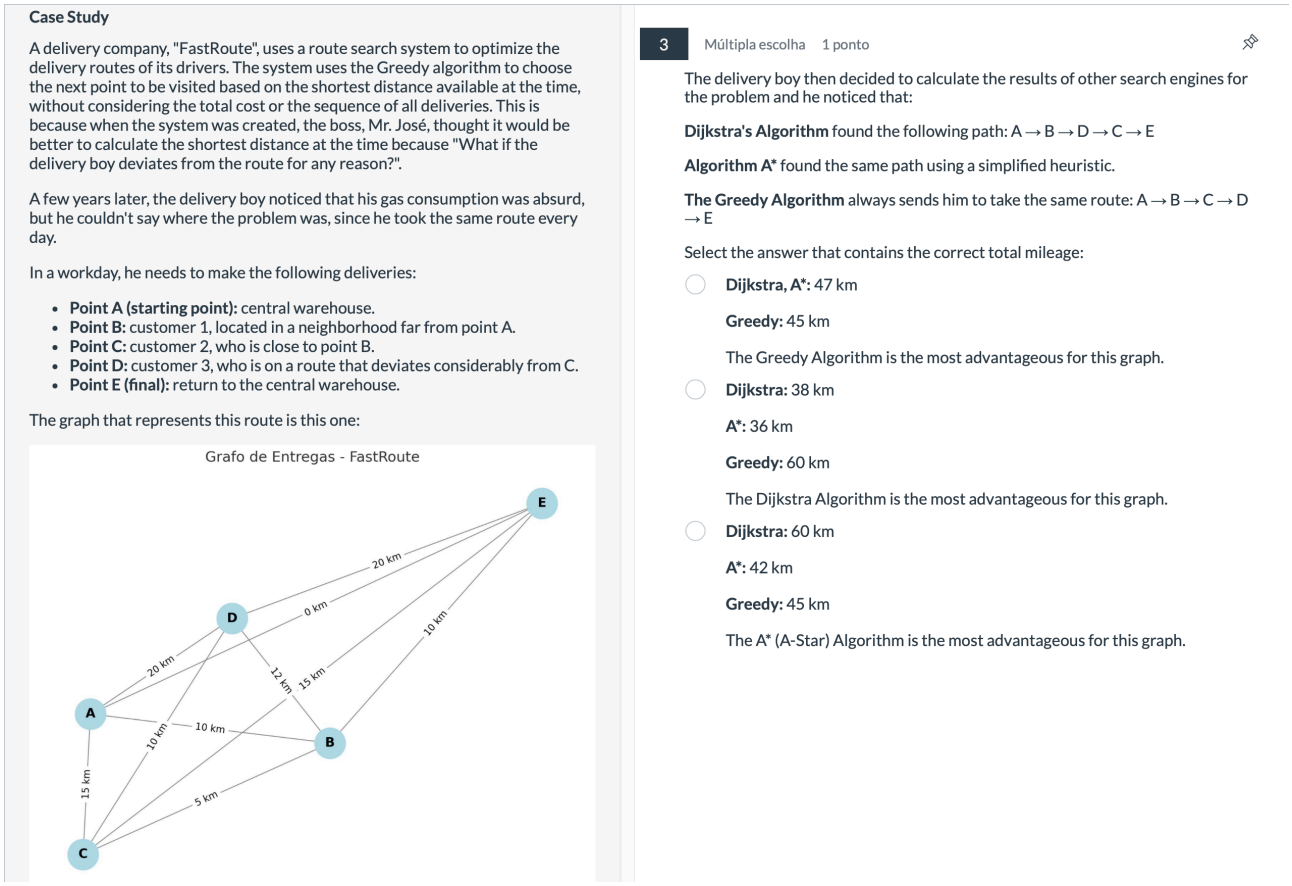


Source: authors

In question 3, the challenge was to balance the conciseness of the text with the need to provide enough information for a detailed analysis of the problem. Since the activity involves the

application of search algorithms to optimize routes, it was essential to present a realistic and accessible context, describing how the company FastRoute works and the routine of the motorcycle courier. In addition, the statement needed to clearly explain the differences between the algorithms used – Dijkstra, A* and Greedy – highlighting their impact on the choice of routes. The inclusion of the graph was essential for students to visualize the structure of the problem and better understand the algorithmic decisions involved.

Figure 3 - Application of question 3 on Canvas LMS

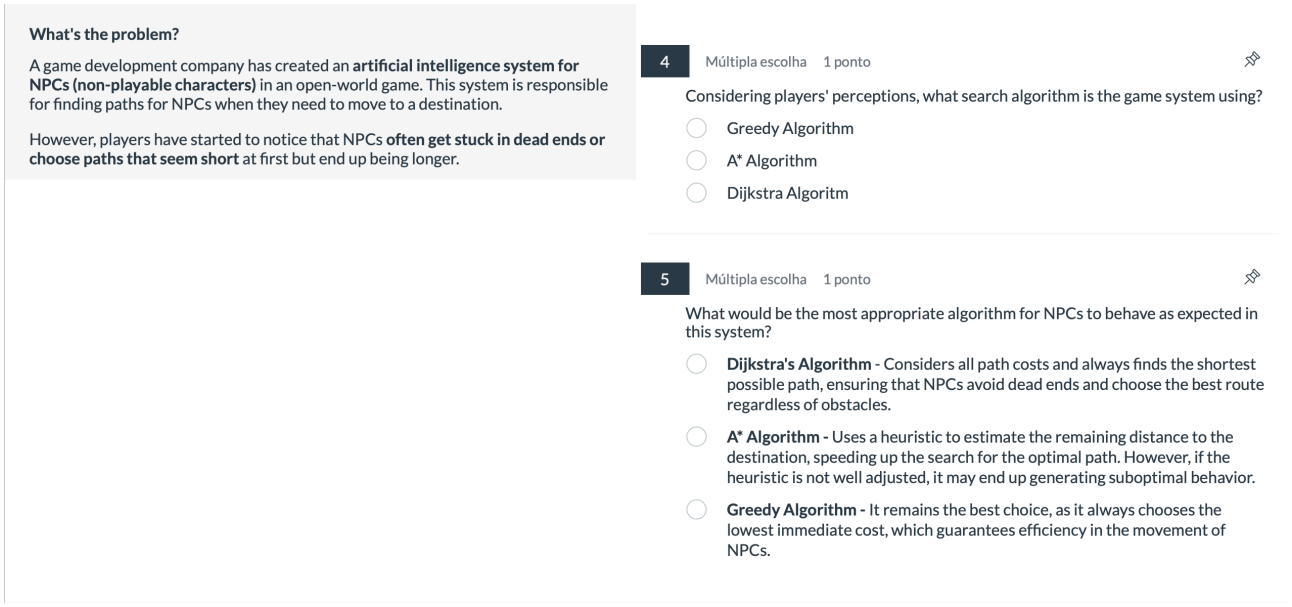


Source: authors

In the fourth question, we chose to divide the assessment into two stages to ensure that the student not only correctly identified the problem, but was also able to suggest an appropriate solution. The statement introduces a context in which an AI system for NPCs presents flaws, causing characters to choose suboptimal paths or get stuck in dead ends. Based on this description, the first question requires the student to relate the observed behavior to the algorithm that is likely being used in the game.

In the second part of the question, the challenge is to evaluate which search algorithm would be most suitable for improving the movement of NPCs. To do this, we present the characteristics of three algorithms – Greedy, A* and Dijkstra –, encouraging the student to reflect on which approach would be most effective in avoiding the problems initially described. In this way, the question not only tests the student's theoretical knowledge of search algorithms, but also their ability to apply them to a practical context.

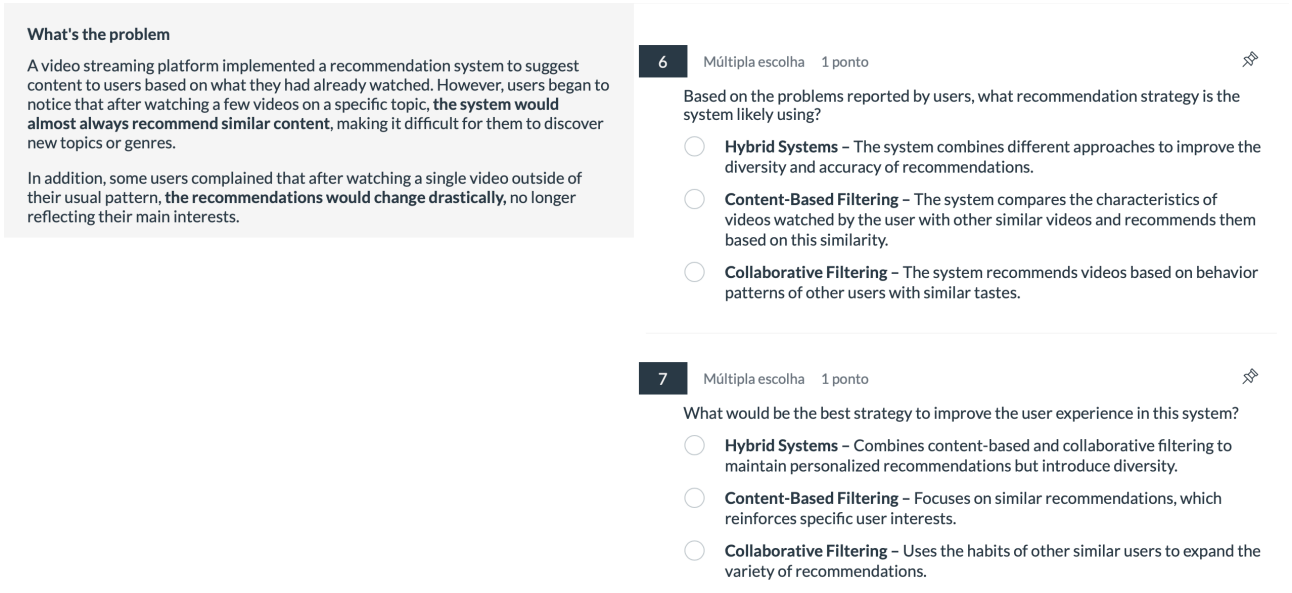
Figure 4 - Application of question 4 on Canvas LMS



Source: authors

For the fifth question, we chose to follow the same pattern as the previous question, structuring the problem in a clear and contextualized way so that students can identify the challenges of recommendation systems. The statement presents a streaming platform that faces common difficulties in personalizing content, such as the formation of “recommendation bubbles” and the drastic change of suggestions after a few atypical interactions. By dividing the assessment into two stages, we first ask the student to identify which recommendation strategy is in use, encouraging a critical analysis of the limitations of content-based filtering. Then, we ask them to choose the best solution to improve the system, encouraging an understanding of the advantages of hybrid systems. This approach allows us to assess both the recognition of theoretical concepts and the ability to apply them to practical scenarios.

Figure 5 - Application of question 5 on Canvas LMS

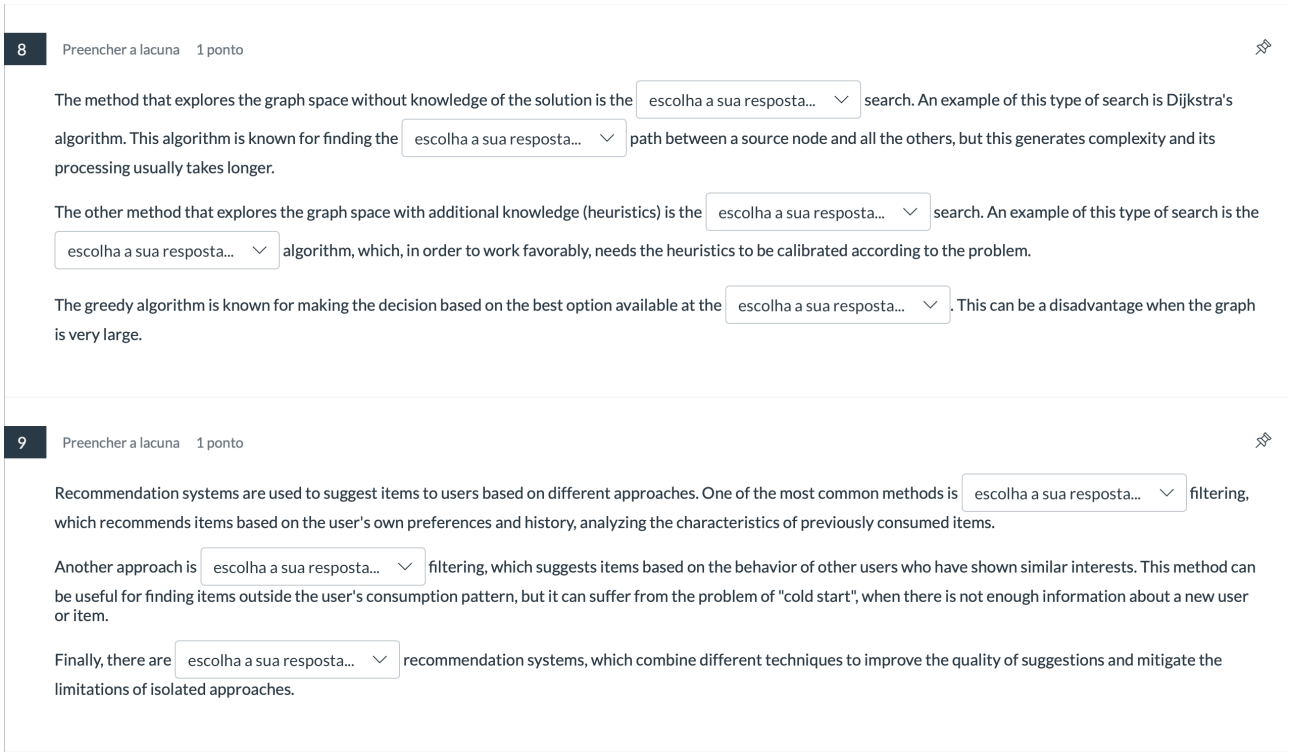


Source: authors

In the case of the Guided Reading Notes question, we chose to use the "Fill in the Blank" tool to create the questions, as this format allows us to assess students' knowledge in an objective and interactive way. However, Canvas has a limit of up to five blanks per question, which led us to divide the content into two separate questions.

The first question addresses search algorithms, differentiating between informed, uninformed and greedy search, while the second question deals with recommendation systems, exploring the types of content-based, collaborative and hybrid filtering. In this way, we were able to maintain an adequate level of detail without exceeding the platform's restrictions, ensuring that students can respond in a clear and organized manner.

Figure 6 - Application of question 6 on Canvas LMS



Source: authors

Implementing assessment questions in the Canvas LMS required strategic adaptations to ensure that the learning objectives were achieved. The impossibility of using the Hotspot question type to name elements directly in the image led to a reformulation of the approach, using matching and ordering questions. Similarly, when structuring questions that required identifying problems and proposing solutions, we chose to divide them into two multiple-choice questions, respecting the limitations of the tool and maintaining coherence with the objectives of the activity. In the case of the Guided Reading Notes technique, it was also necessary to segment the content into smaller themes, since the system allows a maximum of five gaps per question. These choices demonstrate the importance of flexibility in developing objective assessments so that, even in the face of technical restrictions, it is possible to maintain effectiveness in verifying learning. To this end, it is essential that the teacher maintains constant focus on the learning objectives, because, by understanding them clearly, it becomes easier to adapt the questions without compromising their pedagogical intentionality and coherence with the expected skills.

4 Strategies to Ensure Assessment Quality

In addition to multiple choice, diversifying question formats can improve the quality of the assessment and allow for a more accurate measurement of knowledge. Matching questions, for example, can be used to relate concepts such as programming paradigms and their corresponding languages. Sorting questions may require the student to correctly reorder the steps of an algorithm. True or false questions can be reformulated to include code snippets, where the student needs to identify whether a certain behavior occurs as expected.

> The assessment should consider a broader perspective, as it involves the development of a set of attitudes that future professionals are expected to adopt (Bitencourt et al., 2013, p. 212). *[Translated by the author]*.

To avoid assessments that only test memorization, it is essential to structure questions that require logical reasoning and problem analysis. In programming courses, an effective approach is to present small code snippets and ask what the program's output will be or which alternative would correct a specific error. Another example is providing an optimization scenario and asking the student to choose the alternative with the most efficient implementation in terms of computational complexity. These strategies allow for assessing student understanding without relying on essay-style responses. The assessment tools should also consider the diverse characteristics of students, as certain practices may favor specific skills in some learners (Bitencourt et al., 2013, p. 219).

The use of contextualized questions can also make assessments more relevant to students' professional daily lives. For example, instead of just asking what the concept of normalization in databases is, one could present a set of tables and ask the student to select the option that represents the correctly normalized version. Similarly, in a test about data structures, a question could present a search problem and ask the student to choose the best structure to solve it efficiently. This type of question evaluates the ability to apply technical knowledge practically, without requiring essay-style answers.

Another crucial point in the creation of automated tests is ensuring the clarity and precision of the questions. Ambiguous statements can lead to different interpretations and compromise the validity of the assessment. To avoid this problem, it is recommended to review all questions, test their comprehension with a pilot group, and ensure that the alternatives are well-defined, with no room for doubt. Additionally, whenever possible, use standardized examples and avoid informal expressions that could cause confusion among students.

The exam review should also consider the progression of question difficulty. A well-structured assessment activity should start with simpler questions that test basic knowledge and gradually advance to more complex challenges that require detailed analysis. This balance ensures that students not only have the opportunity to demonstrate their knowledge but are also encouraged to apply what they have learned progressively. *"Thus, the assessment should be comprehensive, allowing the student to recognize their difficulties and recover, while also considering this recovery when evaluating them again."* (Bitencourt et al., 2013, p. 219). *[Translated by the author]*.

In addition to measuring student performance, a well-planned assessment can provide valuable data on the effectiveness of the course's curriculum. If many students struggle with a particular type of question, it may indicate that the corresponding topic was not addressed clearly or that the teaching material did not offer sufficient support for learning. This type of analysis allows teachers to identify gaps in teaching and make adjustments to lesson planning, ensuring that the course is aligned with students' needs.

Similarly, overall performance in assessments can serve as an indicator for updating content and teaching methodologies. If an entire class finds certain topics too easy, it may suggest that the assessment is underestimating the students' level of knowledge or that more advanced content needs to be included to appropriately challenge them.

> This [quantitative] information is important and should indeed be considered in the evaluation of content planning, lessons, and the virtual teaching-learning environment. (Bitencourt et al., 2013, p. 219). *[Translated by the author]*.

This continuous monitoring allows the course to evolve dynamically, ensuring that assessments are not only a tool for measurement but also a means of improving teaching and enhancing the learning experience for students.

5 Conclusion

The analysis conducted in this study demonstrates that the use of Fink's Taxonomy, the Learning Goals Inventory (LGI), and Learning Assessment Techniques (LAT) enables the construction of assessments more aligned with educational objectives and students' needs. By applying these models to a specific course in the program, in this case, the Introduction to Artificial Intelligence track, we were able to restructure the objective question, making it more dynamic and consistent with the expected competencies.

The results suggest that by replacing purely objective assessments with activities structured based on learning domains, it is possible to offer a more engaging and effective experience for students. The selection of techniques such as Sequence Chains, Case Study, and What's the Problem? allowed for a more contextualized approach, closer to the professional reality.

As a contribution to programs using distance education, we suggest the study and use of these methodologies, or similar ones, in the process of building and designing assessment activities to enhance their assessment practices. The integration of rubrics, automated feedback, and activities that encourage the application of knowledge are key strategies to ensure that students develop real and applicable competencies in their field of practice.

Thus, this study contributes to the discussion on improving assessments in distance education, pointing out ways to make the process more dynamic, effective, and aligned with the contemporary demands of distance education.

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