*Article*

# Podcasts Created by University Students: A Way to Improve Subject Understanding, Connection with Peers, and Academic Performance

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**Abstract:** The integration of teacher-designed audiovisual tools in education has gained significant prominence, with podcasting emerging as a powerful pedagogical resource. While its benefits in enhancing learning flexibility and knowledge acquisition are well-documented, limited research examines the impact of student-generated podcasts. This study addresses that gap by investigating whether student-produced content enhances learning, improves academic performance, and enriches the classroom environment. A total of 190 students from the Tourism and Pedagogy degrees at the Universidad de La Laguna (Tenerife, Spain) participated by actively engaging in podcast creation as part of their coursework. They subsequently completed a survey assessing various aspects of the activity. Hypothesis testing revealed that student-generated podcasts not only improve academic outcomes but also cultivate a more dynamic and engaging learning experience. Findings suggest that beyond reinforcing subject mastery, podcasting yields intangible educational benefits, fostering deeper engagement and a more enriched classroom atmosphere. These results underscore the pedagogical value of student-driven content creation, positioning podcasting as an innovative instructional strategy that transcends conventional learning paradigms.

**Keywords:** student-created podcasts; learning process; classroom environment; academic achievement

## 1. Introduction

The unprecedented global pandemic of 2020–2021, which confined individuals to their homes for several months, compelled educational systems to adopt mandatory online communication as the sole means of interaction between teachers and students. Within an exceptionally brief timeframe, both groups, who were unprepared for such an abrupt transition, were required to convert face-to-face education into an online format, relying on digital tools they were either unfamiliar with or had limited experience using. Consequently, instructors, most of whom had no prior training in these technologies, had to rapidly acquire the necessary skills and integrate them into their teaching practices, ensuring accessibility for students. Simultaneously, learners, many of whom lacked prior experience with such digital platforms, were compelled to adapt to these tools to assimilate course content and navigate the learning process successfully (Aboagye et al., 2021; Maphalala & Adigun, 2021).

In recent years, the emphasis on higher education has progressively shifted from solely valuing the content transmitted by instructors to recognizing the pedagogical approaches through which such content is delivered. Traditional lecture-based university instruction is

increasingly being replaced by interactive learning environments, where innovative and dynamic teaching methodologies play a central role. Against this backdrop, the COVID-19 pandemic acted as a catalyst, accelerating the search for and implementation of digital educational tools that not only facilitate subject-specific knowledge acquisition but also enhance student engagement and motivation, fostering a more integrative and student-centered learning experience (Slavin, 2012; Ahmad, 2019; Lewis & Price-Howard, 2021; Mendo-Lázaro et al., 2022).

There is no doubt that pedagogical approaches significantly influence students' emotional and cognitive engagement. Extensive research has highlighted the interconnection between educational tools and the development of essential personal and professional competencies, which are critical for students' future careers (Mason, 2019; Ravina-Ripoll et al., 2019). Moreover, studies have established a strong link between a harmonious and cooperative classroom environment and academic performance (López-Pérez & Fernández-Castilla, 2018; Leung et al., 2021). Given these considerations, the selection of teaching methodologies and tools should not be regarded as a mere operational concern but rather as a crucial determinant of student success and overall educational effectiveness.

Podcasting represents a growing digital tool within higher education, increasingly adopted to enhance student engagement and motivation while facilitating knowledge acquisition throughout the university learning process. It is broadly defined as the creation and distribution of audio or video content, enabling users to download and access it at their convenience (Morris & Tomasi, 2017). The term "podcast" originates from a fusion of "iPod", the portable media device launched by Apple on 23 October 2001, and the English word "broadcast", which denotes the transmission or dissemination of content. The Merriam-Webster Dictionary defines a podcast as "a program (whether music or conversation) available in digital format for automatic download over the Internet" (Merriam-Webster Dictionary, 2021). While this definition provides a basic understanding, podcasts possess several distinguishing characteristics: they are audio-based programs, structured as a series of individual episodes, and have no fixed duration or publication frequency.

The integration of podcasting into educational methodologies has been closely linked to the flipped classroom model (Akçayır & Akçayır, 2018; Kalenda & Kočvarová, 2020; Maduka & Nwabianke, 2020), in which instructors provide pre-class content in a self-paced format, allowing students to engage with the material independently before attending classes dedicated to problem-solving and in-depth discussions. Furthermore, podcasting serves as a valuable tool within gamification strategies, where game-based mechanics are employed to enhance learning experiences and engagement (J. J. Lee & Hammer, 2011; Caponetto et al., 2014; Urh et al., 2015; Tan Ai Lin et al., 2018). As part of game-based methodologies, podcasting is also increasingly recognized as an effective instrument for integrating mobile technologies into the learning process (Figueroa, 2020; Sattarov, 2020), facilitating a holistic pedagogical approach that can be seamlessly combined with other instructional activities.

A literature review on the use of podcasts as a teaching tool at the university level, particularly when created by the teacher, enables the classification of its benefits into three categories as follows:

- A mechanism for optimizing academic performance by providing structured, accessible, and pedagogically sound content delivery (M. J. Lee & Chan, 2007; Faser et al., 2008; Fietze, 2010; Walls et al., 2010; Nwosu et al., 2017; Moretti & Morini, 2020; Strelan et al., 2020; S. A. Z. Ahmad et al., 2022; Kelly et al., 2022; Gunderson & Cumming, 2022);
- An effective pedagogical tool for facilitating distance education, offering flexibility in adapting to dynamic and evolving learning environments (Dale, 2007; Merchi, 2015;

García-Peinazo, 2019; Dimock, 2019; Celaya et al., 2019; Smith, 2021; Andersen & Dau, 2021; Andersen & Dau, 2022; Caldwell et al., 2024; Fox & Singer, 2025);

- A strategic instrument for fostering a more engaging classroom environment, enhancing student participation, and ultimately promoting overall well-being and self-efficacy in mastering course content (Edirisingha & Salmon, 2007; Nie et al., 2008; Francom et al., 2011; Baltaci, 2019; Giannetti et al., 2021; Jolley, 2022).

However, it is evident there are several limitations of this digital tool in the classroom. Stöhr et al. (2020) highlight that podcasting may contribute to polarization in academic performance. Frydenberg (2008) points to the possibility of reduced class attendance and the increased workload it imposes on instructors. Gribbins (2007), in a study on the perceived usefulness of podcasting in higher education, found that while students generally consider podcasting a valuable educational tool, they question its actual efficacy in enhancing their academic performance. Similarly, Lonn and Teasley (2009) observed that although students utilize podcasts to review lectures, their impact on improving learning outcomes remains limited.

At the university level, literature is not so prolific regarding the possible benefits of podcasts when they are created by the students themselves (Baker et al., 2010). While it is evident that such podcasts require research into the chosen topic, writing a script, recording the podcast, and becoming familiar with this tool, the literature consulted indicates, as benefits of this specific use of the podcast, the following:

- Self-learning related to understanding the technical aspects of podcasts, developing the topic, and expressing oneself orally helps develop other skills (Indahsari, 2020; Singer, 2025);
- The collaborative experience of designing and creating podcasts contributes to the playful aspect of the teaching–learning process, transforming subject content into meaningful knowledge for students, achieving higher levels of motivation for learning, improving the understanding of contents, and developing specific attitudinal competencies, such as autonomy in decision making to generate content (Edirisingha & Salmon, 2007; Carvalho & Aguiar, 2009);
- The creation of the podcast also contributes to the development of social skills and community identity (Alpay & Gulati, 2010; Barquero Cabrero et al., 2022);
- It achieves better educational outcomes (Lazzari, 2009).

Building upon these conclusions and addressing the research gap highlighted by González Enríquez et al. (2023, p. 1), who emphasize that "there has been little research in Spain on the potential of using podcasts when students themselves are responsible for the design and development of their content", this study seeks to explore whether student-created podcasts in higher education can enhance the learning process, foster a more collaborative and engaging classroom environment, and ultimately contribute to improved academic performance.

The literature has explored the use of podcasts in various educational settings, ranging from fully online degree programs (Moretti & Morini, 2020) to language-related courses (Abdous et al., 2012) and, to a lesser extent, comparative analyses across different academic disciplines (Chester et al., 2011). In this context, the present study expands the existing body of research by examining the impact of student-generated podcasts across two distinct university degree programs with markedly different pedagogical and professional frameworks, particularly in terms of the implications of self-directed learning methodologies. The degree programs analyzed are a B.A. in Pedagogy and a B.A. in Tourism.

The empirical study focuses on two university groups within these programs, comprising 89 students from the tourism degree and 101 students from the pedagogy degree. Participants were tasked with creating and broadcasting a podcast, adhering to a set of

predefined criteria. Upon completion of the activity, they were invited to respond to a survey, assessing various aspects of their experience and the educational impact of the podcasting task.

From here, the paper is organized as follows. First, the case study and the hypotheses raised are addressed. Next, statistical analyses of the survey results and their relation to the proposed hypotheses are discussed. Finally, the paper presents the main conclusions derived from the study.

## 2. Material and Methods

### 2.1. Case Study

The present study examines the use of podcasts as a tool for university educational innovation of university students of the B.A. in Pedagogy and B.A. in Tourism at the Universidad de La Laguna (Spain) during the academic year 2023/2024. In both cases, the subjects were economic matters, taught by the same teacher.

It is important to highlight that the selection of the university degree programs for this study was not arbitrary. The tourism program is not directly related to education, whereas the pedagogy program prepares future professionals in the field of teaching. As a result, the familiarity with and application of innovative educational tools may influence pedagogy students differently than those in tourism. Given the distinct professional orientations of these degrees, variations in the impact of educational innovations can be anticipated, as their relevance and perceived utility may differ according to the specific academic and professional context of each discipline.

The development of the podcast was divided into the following phases. Initially, students were divided into groups and given the opportunity to select their own members. The teacher then allocated a 30 min period in which the groups were required to select a topic and then present it to the rest of the class, who could comment on it. Finally, the students were informed about how the podcast script should be made (interview, newscast, debate, etc.). With all these elements assimilated, an initial version of the script was presented by the students to the teacher for comments and feedback.

The next step was to work on the script and the recording. Interestingly, although most of the students can be classified into the so-called Generation Z or I Gen (Gabrielova & Buchko, 2021), they had no previous experience with the use of technical tools for recording and editing images and sound (Turner, 2015). To address this issue, an expert in audiovisual sciences provided students with a comprehensive overview of various recording methods, tools, and techniques to ensure optimal sound quality and presentation.

Given that students were at different stages of their academic studies (pedagogy students were in their first year and tourism students in their fourth year), it was considered appropriate to adapt the podcasting activity accordingly. Differences were introduced in both duration and topic selection. Pedagogy students were assigned a maximum podcast length of seven minutes, while tourism students were allowed up to twelve minutes.

Topic selection was aligned with each degree's curriculum. In pedagogy, students analyzed tables or figures from a practical report as part of their coursework. By contrast, tourism students were given greater flexibility, selecting topics from within the scope of their Tourism Policy subject.

The characteristics of the podcasts also varied by discipline. Pedagogy students, working within a more structured framework, produced podcasts averaging 6 min and 20 s, primarily focusing on data analysis. All were recorded in Spanish, except for one vodcast in English. Tourism students were given greater thematic autonomy and explored topics ranging from sustainable development and tourist destinations to social media influence and fake news. These podcasts averaged 9 min and 15 s, with most recorded in Spanish,

except for two groups that opted for English. Notably, humor was a recurring element, as student laughter was frequently present in all recordings.

*2.2. Research Questions*

We propose examining the effects of the creation of the podcast by students, at two levels of analysis. At the first level, we consider the total group of students.

The aims for the total group of students are the following:

(a)  An analysis of the academic contribution of the activity in terms of understanding and passing the subject;

(b)  An analysis of the contribution to the enhancement of the classroom, in terms of student satisfaction with his/her participation in the activity and the possible improvement of the classroom environment, as well as the relationship between peers and with the teacher. This first level also studied whether there are differentiated effects by gender or age.

The hypotheses formulated at this initial level are presented in Table 1.

**Table 1.** First level hypotheses[1].

| Academic Contribution | |
|---|---|
| H1 | Podcasts help to understand the subject |
| H2 | Podcasts help to pass the subject |
| H3 | Podcasts increase the interest in other topics related to the subject |
| H4 | The contribution of podcasts to passing the subject is independent of the contribution of the podcasts to understanding the subject matter |
| **Contribution to classroom enhancement** | |
| H5 | Podcasts help students get to know their classmates better |
| H6 | Podcasts help students improve their relationships with classmates |
| H7 | Students like the activity of making a podcast |
| H8 | Liking the activity is independent of the perception that it enhances understanding of the subject |
| H9 | Liking the activity is independent of the perception that it helps to pass the subject |
| H10 | Liking the activity is independent of recommending its use |
| H11 | Participation in the podcast activity negatively influences students' perceptions of the teacher who proposed it |
| H12 | Podcasts should be used in other subjects and degrees as a teaching system |

Source: Prepared by authors.

At the second level, we separately consider the students from each degree who participated in this activity. The objective at this level is to research whether the results of the effects of the activity differ depending on the student's degree.

*2.3. Research Design*

This study adopts a quantitative approach within a quasi-experimental design framework. While the case study defines the target population, the analysis does not focus on specific individuals but rather on variables conceptualized as precise operational constructs and the relationships between them.

Data were collected through a structured, closed-ended questionnaire completed by all students who participated in the podcast activity. Consequently, the dataset accurately represents the population being studied.

Initially, descriptive statistical techniques were employed to summarize participants' responses, offering a preliminary insight into the research questions. However, the principal findings emerge from the application of statistical hypothesis testing procedures.

### 2.4. Data Collection and Participants

To measure the effects of planning, developing, and creating podcasts by university students, a survey was developed and sent to the students to complete electronically. The automated recording of these data enhances their reliability by mitigating potential biases that might arise if data collection were conducted manually by an observer. The records must be considered as derived from a non-random selection of individuals from the population. In fact, all students from both degrees who had participated in the podcast were requested to complete the survey.

In addition to gender, age, and degree, the survey contained statements or items that had to be scored on a Likert scale from 1 to 7 (1 representing total disagreement with the question or statement, 7 representing total agreement). Table 2 shows a summary of the experience and the items finally considered for the study.

**Table 2.** Summary of the experience.

| Degree | Degree in Pedagogy | | Degree in Tourism | |
|---|---|---|---|---|
| Subject | Introduction to Economics | | Tourism policy | |
| Academic year | 1st | | 4th | |
| Number of students | 101 | | 89 | |
| | men (16.83%) | women (83.17%) | men (17.98%) | women (82.02%) |
| Average age | 19.60 years | | 22.15 years | |
| Type of podcast | Induced | | Free | |
| Evaluation or perception (1–7), after making the podcast, of the following statements: | P1. I liked the activity of creating a podcast | | | |
| | P2. Creating the podcast helped me understand the subject | | | |
| | P3. Creating the podcast helped me to get to know my classmates better | | | |
| | P4. Creating the podcast helped me improve my relationship with classmates | | | |
| | P5. Creating the podcast increased my interest in other aspects related to the degree | | | |
| | P6. Creating the podcast will help me pass the subject | | | |
| | P7. Podcasts should be used in other subjects as a teaching system | | | |
| | P8. Creating the podcast has worsened my opinion of the teacher who proposed the activity | | | |

Source: Prepared by authors from survey data.

### 2.5. Data Processing and Statistical Analysis

First, frequency distributions were calculated for each item, with particular emphasis on descriptive statistics, such as the median. This analysis offered initial insights into the research questions.

Second, assuming a certain degree of randomness in individual responses, two hypothesis testing procedures were employed to assess the extent of discrepancy between these preliminary insights and the available data. On the one hand, since many of the first-level hypotheses presented in Table 1 involve high scores on the corresponding item, the median test was applied. Specifically, the null hypothesis tested was that the median value of the given item was greater than or equal to a specified threshold. Considering the discrete nature of the variable capturing responses to each item, the critical regions used for this test are detailed in Appendix A.

Conversely, to examine the existence of relationships between responses to different items, a standard chi-square test of independence was conducted. This test was also applied to compare relative frequency distributions across degree programs and thereby assess second-level hypotheses. Given that for some items involved in the independence test, certain Likert scale response categories had low frequencies, it was necessary to recode these items by grouping some of the original response categories to satisfy the assumptions required for the asymptotic distribution of the test statistic.

## 3. Statistical Analysis of Survey Results

Sending surveys in electronic format resulted in 190 responses, of which 101 (53.15%) came from the pedagogy degree, while 89 (46.85%) belonged to students in tourism. As illustrated in Table 2, the average age of the pedagogy students in this study was almost three years younger than that of the tourism students, coinciding with the three academic year difference that separated the students chosen. By gender, in both degrees, there is a higher prevalence of women among the respondents, a reflection of the distribution by gender that exists among the students enrolled in both degrees.

### 3.1. First Level (190 Students) Results

As indicated, at this level, the objectives were to examine the effects of the podcast activity on the total set of 190 students through the analysis of a) the academic contribution of the activity in terms of learning and passing subjects (H1 to H4); b) the contribution to classroom enhancement in terms of the student satisfaction with their participation in this activity, and possible improvement of the classroom environment in terms of the relationship between peers and with the teacher (H5 to H12).

To enhance the presentation and interpretation of the data, several tables have been devised. Table 3 provides a comprehensive overview of the frequencies and descriptive statistics (median and mode) of all the items that have been analyzed in this study. Table 4 shows the results of the test of the null hypothesis that specifies that the median value is greater than or equal to a given amount.

**Table 3.** Frequencies, median, and mode for items and all students.

| Value | P1 | | P2 | | P3 | | P4 | | P5 | | P6 | | P7 | | P8 (*) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Freq.** | **%** | **Freq.** | **%** | **Freq.** | **%** | **Freq.** | **%** | **Freq.** | **%** | **Freq.** | **%** | **Freq.** | **%** | **Freq.** | **%** |
| 1 | 0 | 0 | 17 | 8.9 | 3 | 1.6 | 2 | 1.1 | 12 | 6.3 | 10 | 5.3 | 3 | 1.6 | 131 | 69.0 |
| 2 | 0 | 0 | 6 | 3.2 | 2 | 1.1 | 3 | 1.6 | 10 | 5.3 | 6 | 3.2 | 8 | 4.2 | 33 | 17.4 |
| 3 | 4 | 2.1 | 16 | 8.4 | 14 | 7.4 | 9 | 4.7 | 20 | 10.5 | 10 | 5.3 | 5 | 2.6 | 13 | 6.8 |
| 4 | 17 | 8.9 | 47 | 24.7 | 17 | 8.9 | 27 | 14.2 | 47 | 24.7 | 28 | 14.7 | 13 | 6.8 | 6 | 3.2 |
| 5 | 26 | 13.7 | 49 | 25.8 | 37 | 19.5 | 33 | 17.4 | 49 | 25.8 | 42 | 22.1 | 32 | 16.8 | 4 | 2.1 |
| 6 | 77 | 40.5 | 37 | 19.5 | 49 | 25.8 | 48 | 25.3 | 33 | 17.4 | 41 | 21.6 | 46 | 24.2 | 1 | 0.7 |
| 7 | 66 | 34.7 | 18 | 9.5 | 68 | 35.8 | 68 | 35.8 | 19 | 10.0 | 53 | 27.8 | 83 | 43.7 | 2 | 0.8 |
| Median | 6 | | 5 | | 6 | | 6 | | 5 | | 5 | | 6 | | 1 | |
| Mode | 6 | | 5 | | 7 | | 7 | | 5 | | 7 | | 7 | | 1 | |

(*) Sole item stated in a negative way. Source: Prepared by authors from survey data.

**Table 4.** Non-parametric median tests. Statistical values.

| Hypothesis | Null Hypothesis | Result |
|---|---|---|
| H1 | Median value of P2 is equal to or greater than 5 | 104 |
| | Median value of P2 is equal to or greater than 6 | 55 (**) |
| H2 | Median value of P6 is equal to or greater than 6 | 94 |
| H3 | Median value of P5 is equal to or greater than 5 | 101 |
| | Median value of P5 is equal to or greater than 6 | 52 (**) |
| H5 | Median value of P3 is equal to or greater than 6 | 117 |
| H6 | Median value of P4 is equal to or greater than 6 | 116 |
| H7 | Median value of P1 is equal to or greater than 6 | 143 |
| H11 | Median value of P8 is equal to or greater than 2 | 59 (**) |
| H12 | Median value of P7 is equal to or greater than 6 | 129 |

Appendix A shows the procedure used to test for a hypothesis of the type "median value of item is equal to or greater than…" through an exact critical region where the test statistic follows a Binomial distribution, or an approximate one, where the test statistic follows a Normal distribution, and where the test statistic is defined as the number of observations greater than or equal to the minimum value of the median in the null hypothesis. (**) Null hypothesis is rejected at a 95% confidence level. In the absence of any indication, it is understood that the null hypothesis has not been rejected. Results obtained from IBM SPSS Statistics Version 29.0.1.0 (171). Source: Prepared by authors.

The results obtained for each of the hypotheses presented in Table 1 will now be discussed in light of the data in Tables 3–5, depending on the case. Specifically, Table 4 is referenced when the hypothesis pertains to a single item, while Table 5 is used when the hypothesis examines the independence between items.

**Table 5.** Independence Test. Pearson chi-square statistic values.

| Hypothesis | Null Hypothesis | Result |
|---|---|---|
| H4 | P6 and P2 are independent | 15.441 (***) |
| H8 | P1 and P2 are independent | 29.196 (***) |
| H9 | P1 and P6 are independent | 25.330 (***) |
| H10 | P1 and P7 are independent | 61.738 (***) |

Independence tests between recoded items. (***) Null hypothesis is rejected at a 99% confidence level. Results obtained from IBM SPSS Statistics Version 29.0.1.0 (171). Source: Prepared by authors.

(a) Hypotheses H1 to H4: review the possible academic contributions of using a podcast created by students.

**Hypothesis 1 (H1).** *Podcasts help to understand the subject (P2).*

This first hypothesis asks whether the podcasting activity has helped students to understand the subject better. The frequency distribution of P2 indicates that creating podcasts has helped students understand the subject matter, given that 80% of the evaluations are concentrated in scores 4 to 7. Although P2 has a median value and mode value equal to 5, 54.8% of the students gave a score equal to or greater than 5 to P2. The findings of the investigation conducted on the median of P2 do not permit the rejection of the hypothesis that the median is greater than or equal to 5 at a 95% confidence level. However, the null hypothesis that the median is greater than or equal to 6 is rejected. Nevertheless, these results lend support to the proposition that the podcast assists students in comprehending the subject matter about which they created the podcast.

**Hypothesis 2 (H2).** *Podcasts help to pass subjects (P6).*

The second hypothesis posits the question of whether engagement in the creation of podcasts, a student-centered activity, contributes to successful academic performance in studies. It has been observed that the students place a high value on this component, with 86.2% of evaluations falling within the 4 to 7 range on a scale of 1 to 7. The median value of P6 is 5, and its mode value is equal to 5. The results of the test of the median of P6 do not allow us to reject that the median is greater than or equal to 6 at a 95% confidence level, a hypothesis that is supported by the observation that 49.4% of students rate this item with a score of 6 or 7.

**Hypothesis 3 (H3).** *Podcasts increase interest in other topics related to the subject (P5).*

This activity could encourage students to be interested in other topics not considered in the podcast but related to the subject, which can result in better learning and, ultimately, passing the subject. Thus, 53.2% gave P5 a score of 5 or higher, causing its median and mode to coincide at 5 points, and it is rejected at the 95% confidence level that its median is greater than 6 (with a test statistic value equal to 52) but it cannot be rejected that its median value is equal to or greater than 5.

Once it is established that this activity supports strict academic objectives, such as facilitating subject matter comprehension and contributing to academic success, it becomes relevant to examine whether the podcast's impact on passing the subject operates independently of its contribution to understanding the subject content. However, before presenting the results related to this proposition (H4), methodological clarification is warranted. As noted by Agresti (2012), among others, when testing the hypothesis of independence between two variables or items, the expected frequency in all cells of the contingency table must be a minimum of 5.

Given that this assumption was not met in several of the analyzed items, they were recoded. They are presented in their final form in Appendix B. Table 5 reports the Pearson chi-square statistic values for the independence tests conducted in this study, where the null hypothesis posits that the relative frequency distribution of one variable remains unchanged regardless of the value of the other.

**Hypothesis 4 (H4).** *The contribution of the podcasts to passing the subject (P6) is independent of the contribution of the podcasts to understanding the subject matter (P2).*

The null hypothesis of independence between P2 and P6 is rejected at the 99% confidence level. Although not explicitly included for the sake of clarity, the cross-tabulation of the recoded items reveals that the conditioned relative frequency distribution of one item varies depending on the score of the other. Specifically, higher scores in one item correspond to a greater proportion of students assigning higher scores to the other item. These distributional differences substantiate the rejection of the independence hypothesis at the 99% confidence level. Moreover, the Spearman correlation coefficient (0.220) between understanding and passing the subject suggests a low but statistically significant positive association in the context of the podcasting activity.

(b)     Hypotheses H5 to H12: review of the possible contribution of the activity to the improvement of the classroom environment.

**Hypothesis 5 (H5).** *Podcasts help students get to know their classmates better (P3).*

The frequency distribution of P3 shows that the podcasts help the students to get to know their classmates better, which has an impact on the general atmosphere of the class; 81.1% of responses scored 5 or higher. In fact, its median value was 6, and its modal value was 7. Thus, when testing at the 95% confidence level, if the median is greater than or equal to 6, H5 could not be rejected.

**Hypothesis 6 (H6).** *Podcasts help students improve their relationship with classmates (P4).*

Creating a podcast about a degree subject seems to have benefited the students by improving their relationships with their classmates. In fact, its modal value was 7, although the median was 6. There were 116 of the 190 students that gave this item a score of 6 or 7, so it is not surprising that the null hypothesis that its median is equal to or greater than 6 could not be rejected at the 95% confidence level.

**Hypothesis 7 (H7).** *Students like the activity of making a podcast (P1).*

This hypothesis evaluates the students' degree of satisfaction with creating a podcast. The activity is based on the teachers' conviction that it would be well received by the students, but it was unknown whether this really was the case for the participating students. The median and mode values were equal to 6, and the results of the tests on the median of P1 do not allow us to reject that the median is greater than or equal to 6, which is supported by the fact that 143 students rated this item with a value greater than 6. For all these reasons, it can be concluded that the acceptance of the activity by participating students is high.

**Hypothesis 8 (H8).** *Liking the activity is independent of the perception that it enhances understanding of the subject (P1 and P2).*

The cross-tabulation between these two recoded items reveals differences in the distribution of conditioned relative frequencies, and such differences explain why the hypothesis of independence is rejected at the 99% confidence level.

**Hypothesis 9 (H9).** *Liking the activity is independent of the perception that it helps to pass the subject (P1 and P6).*

The cross-tabulation between P1 and P6, when recoded, reveals that the conditioned relative frequency of one item varies as the score of the other changes, which explains the rejection of the independence hypothesis at the 99% confidence level.

**Hypothesis 10 (H10).** *Liking the activity is independent of recommending its use (P1 and P7).*

The cross-tabulation between these items, when they are recoded, shows that the conditioned relative frequency of one of the items changes when the other's score changes, which accounts for the rejection of the independence hypothesis at the 99% confidence level. It is clear, however, that they recommend its use.

**Hypothesis 11 (H11).** *Participation in the podcast activity negatively influences students' perception of the teacher who proposed it (P8).*

A critical question that we, as university teachers, must consider is whether proposing an activity that encroaches on students' free time could negatively influence their perceptions of the instructors who introduce it. Notably, Item P8 was the only statement framed in a negative manner. This intentional modification aimed to prompt students to reflect more

carefully on their response regarding their perception of the instructor, ensuring that this response was distinct from the rest of the questionnaire. Consequently, the measurement scale for this item must be interpreted inversely compared to the other items: a score of 1 indicates that engaging in the activity does not negatively affect the student's perceptions of the teacher, whereas a score of 7 signifies a substantial deterioration in that perception. The null hypothesis stating that "the median value of P8 is equal to or greater than 2" is rejected at the 95% confidence level. In fact, 86.4% of responses fall within the range of 1 to 2, suggesting that participation in this activity does not negatively impact students' perceptions of their teacher.

**Hypothesis 12 (H12).** *Podcasts should be used in other subjects and degrees as a teaching system (P7).*

This final hypothesis examines whether, after completing the activity and reflecting on its perceived value, students believe it should be implemented in other degrees. Recommending an activity for use in additional subjects is arguably one of the most direct indicators that a newly introduced classroom tool has achieved its intended impact. The frequency distribution of P7 suggests that students would endorse incorporating this activity into other subjects. Specifically, 84.7% of responses fall within the 5 to 7 range, with a median of 6 and a mode of 7. Given these results, it is unsurprising that the statistical tests for the median of P7 do not provide sufficient evidence to reject the hypothesis that the median is greater than or equal to 6 (test statistic = 129).

*3.2. Second Level (Students by Degree) Results*

The second level of analysis seeks to evaluate the 12 previously stated hypotheses, now examining potential differences in results based on the degree of the students participating in the podcasting activity. The distinct student profiles of these degree programs suggest that the acceptance of a teaching tool may vary considerably depending on the professional orientation of the field. Specifically, in a program such as pedagogy, where knowledge transmission is a fundamental component of professional training, the adoption of such an activity might differ significantly from that in tourism, where students' future careers are largely unrelated to education.

Again, three tables show the results at this level. Table 6 contains the frequencies, mode, and median for each item by degree, although it should be noted that the results of the independence tests that provide answers to the hypotheses raised have been carried out on the recoded items and are shown in Appendix B.

These results of independence testing are shown in Table 7 (independence tests between items P1 to P8 and the degree) and Table 8 (independence tests between P1 with P2, P6, P7, and P2 with P6 for one degree and the other).

As observed, median values of items P1 to P8 for the two degrees were very similar. In fact, the corresponding independence tests suggest that the distribution of relative frequencies for items P2 to P8 does not change when the degree changes. However, such a hypothesis is rejected in the case of P1 (Table 7).

**Hypothesis (H1S).** *The contribution of this activity to understanding the subject matter is independent of the degree (P2 and degree).*

**Table 6.** Frequencies, mode, and median for items by degree.

| Value | P1 | | | | P2 | | | | P3 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Tourism | | Pedagogy | | Tourism | | Pedagogy | | Tourism | | Pedagogy | |
| | Freq. | % | Freq. | % | Freq. | % | Freq. | % | Freq. | % | Freq. | % |
| 1 | 0 | 0 | 0 | 0 | 14 | 15.7 | 3 | 3.0 | 3 | 3.4 | 0 | 0 |
| 2 | 0 | 0 | 0 | 0 | 2 | 2.2 | 4 | 4.0 | 1 | 1.1 | 1 | 1.0 |
| 3 | 1 | 1.1 | 3 | 3.0 | 6 | 6.7 | 10 | 9.9 | 6 | 6.7 | 8 | 7.9 |
| 4 | 7 | 7.9 | 10 | 9.9 | 24 | 27.0 | 23 | 22.8 | 10 | 11.2 | 7 | 6.9 |
| 5 | 4 | 4.5 | 22 | 21.8 | 22 | 24.7 | 27 | 26.7 | 14 | 15.7 | 23 | 22.8 |
| 6 | 42 | 47.2 | 35 | 34.7 | 15 | 16.9 | 22 | 21.8 | 25 | 28.1 | 24 | 23.8 |
| 7 | 35 | 39.3 | 31 | 30.7 | 6 | 6.7 | 12 | 11.9 | 30 | 33.7 | 38 | 37.6 |
| Median | 6 | | 6 | | 4 | | 5 | | 6 | | 6 | |
| Mode | 6 | | 6 | | 4 | | 5 | | 7 | | 7 | |

| Value | P4 | | | | P5 | | | | P6 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Tourism | | Pedagogy | | Tourism | | Pedagogy | | Tourism | | Pedagogy | |
| | Freq. | % | Freq. | % | Freq. | % | Freq. | % | Freq. | % | Freq. | % |
| 1 | 1 | 1.1 | 1 | 1.0 | 7 | 7.9 | 5 | 5.0 | 8 | 9.0 | 2 | 2.0 |
| 2 | 2 | 2.2 | 1 | 1.0 | 3 | 3.4 | 7 | 6.9 | 2 | 2.2 | 4 | 4.0 |
| 3 | 2 | 2.2 | 7 | 6.9 | 7 | 7.9 | 13 | 12.9 | 3 | 3.4 | 7 | 6.9 |
| 4 | 11 | 12.4 | 16 | 15.8 | 22 | 24.7 | 25 | 24.8 | 12 | 13.5 | 16 | 15.8 |
| 5 | 15 | 16.9 | 18 | 17.8 | 26 | 28.2 | 23 | 22.8 | 20 | 22.5 | 22 | 21.8 |
| 6 | 28 | 31.5 | 20 | 19.8 | 17 | 19.1 | 16 | 15.8 | 21 | 23.6 | 20 | 19.8 |
| 7 | 30 | 33.7 | 38 | 37.6 | 7 | 7.9 | 12 | 11.9 | 23 | 25.8 | 30 | 29.7 |
| Median | 6 | | 6 | | 5 | | 5 | | 5 | | 5 | |
| Mode | 7 | | 7 | | 5 | | 4 | | 7 | | 7 | |

| Value | P7 | | | | P8 | | | |
|---|---|---|---|---|---|---|---|---|
| | Tourism | | Pedagogy | | Tourism | | Pedagogy | |
| | Freq. | % | Freq. | % | Freq. | % | Freq. | % |
| 1 | 2 | 2.2 | 1 | 1.0 | 64 | 71.9 | 67 | 66.3 |
| 2 | 4 | 4.5 | 4 | 4.0 | 14 | 15.7 | 19 | 18.8 |
| 3 | 1 | 1.1 | 4 | 4.0 | 7 | 7.9 | 6 | 5.9 |
| 4 | 6 | 6.7 | 7 | 6.9 | 2 | 2.2 | 4 | 4.0 |
| 5 | 11 | 12.4 | 21 | 20.8 | 2 | 2.2 | 2 | 2.0 |
| 6 | 24 | 27.0 | 22 | 21.8 | 0 | 0 | 1 | 1.0 |
| 7 | 41 | 46.1 | 42 | 41.6 | 0 | 0 | 2 | 2.0 |
| Median | 6 | | 6 | | 1 | | 1 | |
| Mode | 7 | | 7 | | 1 | | 1 | |

Source: Prepared from survey data.

**Table 7.** Independence test. Pearson chi-square statistic values by degree. Hypotheses: H1S, H2S, H3S, H5S, H6S, H7S, H11S, H12S.

| Hypothesis | Null Hypothesis | Result |
|---|---|---|
| H1S | P2 and degree are independent | 3.257 |
| H2S | P6 and degree are independent | 0.477 |
| H3S | P5 and degree are independent | 1.097 |
| H5S | P3 and degree are independent | 0.548 |
| H6S | P4 and degree are independent | 3.476 |
| H7S | P1 and degree are independent | 11.422 (***) |
| H11S | P8 and degree are independent | 0.687 |
| H12S | P7 and degree are independent | 2.120 |

Results obtained from IBM SPSS Statistics Version 29.0.1.0 (171). Interpretation: The hypotheses remain the same as those presented in Tables 4 and 5 but are now applied to an analysis by degree, corresponding to the second level of analysis. Consequently, the notation includes an 'S' to distinguish these hypotheses. (***) Null hypothesis is rejected at the 99% confidence level. If nothing is indicated, the null hypothesis is not rejected. Source: Prepared by authors.

**Table 8.** Independence test. Pearson chi-square statistic values by degree. Hypotheses: H4S, H8S, H9S, H10S.

| Hypothesis (*) | Null Hypothesis | Result | |
|---|---|---|---|
| | | Tourism | Pedagogy |
| H4S | P6 and P2 are independent | 2.364 | 16.550 (***) |
| H8S | P1 and P2 are independent | 13.775 (***) | 21.711 (***) |
| H9S | P1 and P6 are independent | 8.182 (*) | 29.238 (***) |
| H10S | P1 and P7 are independent | 8.663 (*) | 38.008 (***) |

Results obtained from IBM SPSS Statistics Version 29.0.1.0 (171). Interpretation: The hypotheses in Table 8 remain the same as those presented in Tables 4 and 5 but are now applied to the analysis by degree, corresponding to the second level of analysis. Consequently, the notation includes an 'S' to distinguish these hypotheses. (*) Null hypothesis is rejected at the 90% confidence level. (***) Null hypothesis is rejected at the 99% confidence level. Source: Prepared by authors.

Observing that the median and mode of P2 in pedagogy is 5 and in tourism is 4, it could be said that pedagogy students agree more with the statement than tourism students. However, when this item is recoded, the observed differences in the relative frequencies of this item according to degree do not seem sufficient to conclude that the podcast contributes to understanding the subject matter in one degree more than in the other.

**Hypothesis (H2S).** *The contribution of this activity to passing the subject is independent of the degree (P6 and degree).*

Considering the conditioned relative frequencies of P6, which has been recorded, by degree, it follows that there is not sufficient evidence to conclude that the podcast contributes more significantly to passing the subject in one degree than in the other.

**Hypothesis (H3S).** *The contribution of this activity to increase interest in other topics related to the subject is independent of the degree (P5 and degree).*

Regarding P5, this contribution was higher in Tourism than in Pedagogy. However, when P5 is recoded, differences in the relative frequencies of this item according to the degree do not seem sufficient to conclude that the podcasts contribute to increasing interest

in other subjects related to one degree more than in the other. So, the independence hypothesis between this type of contribution and the degree is not rejected.

**Hypothesis (H4S).** *The contribution of the podcast to passing a subject (P6) is independent of the contribution of the podcast to understanding the subject matter (P2) by degree.*

In this case, the observed differences in the frequencies of these two items, once recoded, support the conclusion that passing the subject and understanding the subject matter yield different results by degree. Specifically, the null hypothesis is not rejected for tourism students, whereas it is rejected for pedagogy students. This indicates that, for pedagogy students, the relationship between the podcast's contribution to passing the subject and its role in fostering subject-matter comprehension is more clearly established than for tourism students.

**Hypothesis (H5S).** *The contribution of this activity to getting to know classmates better is independent of the degree (P3 and degree).*

The median value is 7, and the mode value is 7 in both degrees, but the percentage of students who gave this item a value equal to or greater than 5 was 77.5% in tourism and 84.2% in pedagogy. When P3 is recoded, the frequencies in relative frequencies observed in the recoded values of this item according to the degree do not seem sufficient to conclude that the podcast contributes to getting to know classmates better in one degree than in the other.

**Hypothesis (H6S).** *The contribution of this activity to improving the relationship between classmates is independent of the degree (P4 and degree).*

Reviewing the frequencies given to P4, we can see that 33.7% of tourism students and 37.6% of pedagogy students awarded it a 7. The percentage of students who are quite/very/totally in agreement with the statement (values 5, 6, and 7) represents 82.1% of the responses in the tourism degree, and in pedagogy, it reaches 75.2%. However, the distribution of relative frequencies of P4, once recoded, does not seem to change according to the degree. So, the test statistic for the independence between the contribution of this activity to improving the relationship between classmates and the degree does not allow for the rejection of the null hypothesis of independence.

**Hypothesis (H7S).** *Liking the activity of creating a podcast is independent of the degree (P1 and degree).*

In both degrees, the mode and median of P1 were equal to 6, but when P1 is recoded, the hypothesis of independence with a 99% confidence level is rejected; that is, the distribution of relative frequencies of P1 changes with the degree.

**Hypothesis (H8S).** *Liking the activity is independent of feeling that it helps to understand the subject matter (P1 and P2).*

In this case, the differences in the relative frequencies of these items, according to degree, seem sufficient to conclude that there is a relationship between liking the activity and feeling that it helps to understand the subject matter in both degrees.

**Hypothesis (H9S).** *Liking the activity is independent of the perception that it helps to pass the subject (P1 and P6).*

For both university degrees, the results suggest that the differences in the relative frequencies of these items are sufficient to conclude the existence of a relationship between liking the activity and perceiving it as helpful for passing subjects.

**Hypothesis (H10S).** *Liking the activity is independent of recommending its use (P1 and P7).*

The differences in the relative frequencies of these items seem sufficient to conclude that there is a relationship between liking the activity and recommending its use in both degrees.

**Hypothesis (H11S).** *Participation in the podcast activity negatively influences students' perception of the teacher who proposed it (P8) is independent of the degree (P8 and degree).*

When P8 is recoded, the null hypothesis that this item and the degree are independent is not rejected. This is especially interesting because the different subjects in both degrees had the same teacher.

**Hypothesis (H12S).** *Recommending this activity in other subjects is independent of the degree (P7 and degree).*

In both degrees, the observed differences in the relative frequencies of this item according to the degree do not seem sufficient to conclude that the recommendation of using this activity in other subjects is higher in one degree than in the other, so the null hypothesis that this item and the degree are independent is not rejected.

## 4. Discussion

This study addresses a critical gap in research on podcasting in higher education, particularly when this tool is designed and developed by students. As noted by González Enríquez et al. (2023), there is a significant lack of studies of this nature within the Spanish context, highlighting the need for further research into its potential and pedagogical implications. So, our primary objective was to evaluate the effectiveness of this approach in enhancing subject-matter comprehension, improving pass rates, and fostering a more interactive and collaborative learning environment. The study participants were drawn from two distinct academic disciplines: Pedagogy, a program centered on teaching and educational methodologies, and Tourism, where podcast creation was incorporated as a self-directed learning task within the broader curriculum. Upon completing the podcasting activity, students provided feedback through a structured survey, assessing their level of agreement with various statements related to their experience.

The findings provide compelling evidence that student-created podcasts serve as an effective pedagogical tool in higher education, simultaneously reinforcing subject-matter comprehension, enhancing academic performance, and fostering a more engaging and interactive classroom dynamic—an increasingly recognized contributor to student success. These results align with existing literature, demonstrating that active student involvement in content creation promotes deeper learning in line with the observations made by Lazzari (2009), Carvalho and Aguiar (2009), and Fietze (2010). It also enhances academic performance, consistent with the claims put forward by S. A. Z. S. A. Z. Ahmad et al. (2022), Kelly et al. (2022), and Gunderson and Cumming (2022), among others. There is greater critical engagement and essential academic skills, such as research, structured narrative development, and the articulation of complex ideas, echoing the insights provided by Alpay and Gulati (2010). Unlike teacher-produced instructional materials, student-generated podcasts encourage active participation, positioning learners as co-creators of

knowledge rather than passive recipients. Moreover, the absence of significant differences in learning outcomes between disciplines underscores the adaptability of this approach, highlighting its potential as a versatile and scalable instructional strategy applicable across diverse academic programs.

Another noteworthy finding is that students' perceptions of their instructors remained unchanged following their participation in this activity, corroborating Vermote et al. (2020), who emphasize the pivotal role of educators in shaping student motivation. Additionally, the overwhelmingly positive student reception, as evidenced by their strong recommendation for implementing this approach in other courses, reinforces Nicholas (2020, p. 2), who argues that "in-class work has become a critical component for Generation Z learning, as opposed to just listening to lectures".

These results contribute to the ongoing discourse on the necessity of adapting teaching methodologies to the evolving characteristics of new student cohorts and the pedagogical challenges associated with instructional design in contemporary higher education (Shorey et al., 2021). The integration of student-generated podcasts into university curricula represents a pedagogically sound, flexible, and engaging strategy that aligns with the learning preferences of today's students while promoting deep comprehension, critical thinking, and active participation.

## 5. Conclusions

This study employed a two-tiered analytical approach. The first level examined the impact of the podcasting activity across the entire sample of 190 students, assessing its academic effects on learning and academic performance (H1–H4). Its influence on the classroom environment, including student satisfaction, peer relationships, and student–teacher interactions, was also analyzed (H5–H12). The second level analyzed disciplinary differences to determine whether the effectiveness of the activity varied by field of study.

Findings from the 12 tested hypotheses provide strong evidence of the academic benefits of student-generated podcasts. The activity enhances content comprehension, fosters deeper engagement with course materials, and contributes to a more positive classroom atmosphere, a factor closely linked to academic success. Students strongly associate the podcast's role in facilitating learning with an increased likelihood of passing the subject.

Moreover, participants reported high satisfaction with the podcasting experience, attributing their enjoyment to improved understanding and greater academic success. The activity also strengthens peer relationships without altering the perceptions of the teacher. Its impact is largely independent of gender and age, except in its perceived contribution to passing the subject, which was more pronounced among female students.

From a disciplinary perspective, no significant differences emerged between pedagogy and tourism students in their overall perceptions. However, pedagogy students identified a direct link between podcasting and academic success, a relationship not observed among tourism students. This divergence may reflect the pedagogical training of future educators, who are inherently more attuned to the instructional value of such tools.

### 5.1. Theoretical Implications

The positive outcomes observed in this study align with active learning theory, which posits that interactive and participatory approaches enhance knowledge retention and comprehension. The process of constructing knowledge through podcast creation situates this activity within the framework of constructivist learning theories, particularly following the principles outlined by Funa and Talaue (2021). These include the teacher's role as a

facilitator and students' self-regulation in the development of learning materials, both of which were evident in this study.

Moreover, the cognitive structuring required for podcast production supports the principles of Cognitive Load Theory (CLT) (Sweller, 1988). The task requires processing and simplifying content to focus on core concepts; it provides a structured yet creative form of engagement that mitigates cognitive overload while reinforcing understanding. These findings further substantiate the pedagogical utility of student-generated podcasts as an effective instructional strategy.

### 5.2. Practical Implications

The findings of this study hold significant practical implications for higher education institutions. Student-generated podcasts emerge as a cost-effective and versatile pedagogical tool applicable across diverse disciplines, fostering both engagement and academic performance. This potential is further amplified by recent advances in artificial intelligence, which have substantially reduced the time, effort, and technical expertise required for podcast creation.

Beyond enhancing subject-matter comprehension, podcasts actively promote the development of essential 21st-century skills, including teamwork, communication, and critical thinking, while also equipping students with the digital competencies necessary to navigate an evolving labor market where technological proficiency is increasingly valued. Moreover, our findings suggest that the benefits of podcast creation extend across disciplines, irrespective of their distinct academic orientations. The broad, positive impact observed across different fields of study underscores the potential of podcasts as a universally applicable instructional strategy in higher education. Furthermore, the integration of artificial intelligence into podcast production has made this tool even more accessible, lowering costs and minimizing the effort required to create high-quality educational content. This technological advance enhances the feasibility of implementing podcast-based learning strategies on a larger scale, further reinforcing their pedagogical value.

An additional implication of this study is the demonstration that adapting pedagogical approaches to align with students' learning preferences not only enhances educational outcomes and assessment processes but also contributes to a more favorable perception of teachers and greater student satisfaction.

### 5.3. Limitations and Future Research

Given the contextual constraints of this study, namely, data collected from only two undergraduate degree programs, the generalizability of the findings remains inherently restricted, and conclusions should be interpreted as exploratory. To derive more robust and widely applicable insights, future research should replicate this study with a larger and more diverse student sample across multiple academic disciplines. Additionally, further studies should seek to validate these findings by examining the correlation between students' subjective evaluations and their final degree grades, thereby providing a more objective measure of podcasting's impact on academic performance. Such an approach would allow for a more comprehensive assessment of the pedagogical effectiveness of student-generated podcasts as a supplementary instructional tool in higher education.

# Appendix A

*Non-Parametric Test on the Median for Each Item*

Let X be a discrete random variable whose range is $R_X : \{1, 2, 3, 4, 5, 6, 7\}$ and let $\{X_1, X_2, \ldots X_n\}$ be a random sample of this random variable. We wish to test the null hypothesis that indicates that the median of this random variable is greater than or equal to $m_0$ against the alternative hypothesis that indicates that the median is less than $m_0$, that is,

$$H_0 : Me_X \geq m_0 \text{ against } H_1 : Me_X < m_0$$

To test this, another random variable $Y$ can be defined such that

$$Y = \begin{cases} 1, if\ X \geq m_0 \\ 0,\ if\ X < m_0 \end{cases}$$

So, Y is $B(p)$. If from the original random sample, the random sample $\{Y_1, Y_2, \ldots Y_n\}$ is defined as

$$Y_i = \begin{cases} 1, if\ X_i \geq m_0 \\ 0,\ if\ X_i < m_0 \end{cases}$$

This random sample can be used to carry out the following test (equivalent to the previous one)

$$H_0 : p \geq \frac{1}{2} \text{ against } H_1 : p < \frac{1}{2}$$

A suitable critical region for the above contrast is the following:

$$C : \left\{ (y_1, y_2, \ldots, y_n) / \sum_{i=1}^{n} y_i \leq k \right\}$$

and, to carry out the test with a probability of type I error equal to $\alpha$, the value of the constant k can be determined considering that

$$\alpha = \underset{p \geq 0.5}{\text{Sup}}\, P\left( \sum_{i=1}^{n} y_i \leq k / p \right) = P\left( \sum_{i=1}^{n} y_i \leq k / p = \frac{1}{2} \right)$$

and considering that the sample statistic $\sum_{i=1}^{n} y_i$ is $B\left(n, \frac{1}{2}\right)$ because it counts the number of sample observations greater than or equal to $m_0$.

If the sample is large enough, an approximate critical region can also be used, taking into account that the asymptotic behavior of the sample statistic $\overline{Y} = \frac{\sum_{i=1}^{n} y_i}{n}$ can approach a Normal distribution. An approximate critical region for the above test is the following:

$$C : \{(y_1, y_2, \ldots, y_n) / \overline{y} \leq k\}$$

and, to carry out the test with a probability of type I error equal to $\alpha$, the value of the constant k can be determined considering that

$$\alpha = \sup_{p \geq 0.5} P(\overline{y} \leq k / p) = P\left(\overline{y} \leq k / p = \frac{1}{2}\right)$$

So, considering that the sample statistic $\overline{Y}/p = 0.5$ has an asymptotic Normal distribution, a critical region with a probability of type I error approximately equal to $\alpha$ is the following

$$C : \left\{ (y_1, y_2, \ldots, y_n) / \frac{\overline{y} - 0.5}{\sqrt{\frac{0.5 * 0.5}{n}}} \leq z_\alpha \right\}$$

## Appendix B

*Recoding of Original Items*

**Table A1.** Initial and final coding.

| Item | Name | Initial → Final | Initial → Final | Initial → Final |
|------|------|-----------------|-----------------|-----------------|
| P1 | P1R | 1–5 → 1 | 6 → 2 | 7 → 3 |
| P2 | P2R | 1–4 → 1 | 5 → 2 | 6–7 → 3 |
| P3 | P3R | 1–5 → 1 | 6 → 2 | 7 → 3 |
| P4 | P4R | 1–5 → 1 | 6 → 2 | 7 → 3 |
| P5 | P5R | 1–4 → 1 | 5 → 2 | 6–7 → 3 |
| P6 | P6R | 1–4 → 1 | 5–6 → 2 | 7 → 3 |
| P7 | P7R | 1–5 → 1 | 6 → 2 | 7 → 3 |
| P8 | P8R | 1 → 1 | 2 → 2 | 3–7 → 3 |

Source: Prepared by authors.

## Notes

[1] It is worth highlighting that the analysis carried out at the first level was also performed to check whether students' gender or age affected the results. The results do not change, except in the case of gender when regarding the contribution of podcasts to passing the subject: female students value the contribution podcasts make to passing higher than male students.

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