‘You told the students?’: Experts’ views on design and measurement of active learning in Higher Education

Pedro Isaias[1], Paula Miranda[2] and Sara Pifano[3]

[1]University of New South Wales (UNSW – Sydney), Sydney, Australia
[2]Universidade Aberta–Portuguese Open University, Lisbon, Portugal
[3]Setubal School of Technology, Polytechnic Institute of Setubal, Setúbal, Portugal
[4]ISRLab – Information Society Research Laboratory, Lisbon, Portugal
1pedro.isaias@unsw.edu.au

Abstract. The higher education sector is constantly pivoting towards innovation and adopting new strategies to improve education delivery. Active learning is at the centre of various teaching approaches that focus on the increasing participation of the students in their own learning process. While it is becoming a widespread strategy in higher education, its adoption remains limited and it continues to be surrounded by some uncertainty, in particular at the level of its design and effectiveness. This paper aims to examine the viewpoints of university lecturers with concern to active learning´s design and instructional impact measurement, which were collected in a two-phase research strategy combining an online questionnaire and semi-structured interviews. The findings portray active learning as a valuable teaching strategy and enable the proposition of an assortment of design guidelines, as well as recommendations for measuring the instructional impact of active learning initiatives that can contribute to a more fruitful implementation.

Keywords: Active Learning, Higher Education, Instructional Design, Instructional Impact Measurement, Mixed Method Research

1 INTRODUCTION

There are several studies arguing active learning's capacity to promote learning more effectively in comparison with traditional methods, based solely on transmission of content [1] [2]. In addition, educators and researchers are increasingly sharing their experience with different applications of active learning strategies and supporting technologies, adding to a considerable body of research on the subject [3-6]. Despite the extensive inventory of benefits provided by the literature, some teachers still question its effectiveness, they fear the preparation time involved and the students’ resistance to this method. Moreover, they have some reservations regarding their capacity to cover the entirety of the syllabus [7].

Despite the popularity of active learning and the abundance of research focusing on it, there seems to be a lack of specific studies that address its design and the measurement of its impact. Although some studies do approach these questions, in

terms of design they concern specific subjects [8, 9] or individual activities [10, 11], and in terms of measurement they focus solely on one or two methods [12]. Furthermore, active learning's benefits call for its implementation, but instruction seems to remain mostly focused on teacher-centred practices [13]. This paper examines design guidelines, which can be used transversally in any subject, and a variety of measurement instruments, with the potential to provide a more comprehensive depiction of the impact of active learning. Thus, it intends to answer two main research questions: a) what design strategies can be used to develop active learning in higher education, in order to maximise its effectiveness; b) what measurement instruments can be used to assess active learning's instructional impact.

The paper begins with a brief overview of active learning's design guidelines and measurement instruments to assess its instructional effectiveness. The methods section ensues describing the data collection instruments and prefaces the results section. The paper concludes with a discussion of the most significant results.

2 DESIGNING AND MEASURING ACTIVE LEARNING IN HIGHER EDUCATION

Higher education is concerned with providing students with the competences that they require to address real-world problems and to become skilled professionals and lifelong learners. Active learning emerges in a context of growing student empowerment, of promoting student engagement with their own learning and fomenting student proactivity [14]. Active learning is connected with social-constructivist paradigms and promotes the delivery of content in inquiry-based practices [15].

2.1 Design recommendations

The literature is abundant with recommendations when it comes to active learning design. The studies that were reviewed for this paper seem to focus especially on recommendations that underline the importance of explaining the context, starting early and in a simple manner, planning the learning activities carefully, fostering student participation and measuring the outcomes of active learning.

Given that active learning demands students to be more responsible for the learning process and it represents a significant change in relation to transmission-based instruction, it is important to clarify the context. Explaining the rationale behind the implementation of active learning, identifying and elucidating the structure of the course and the purpose of the learning activities can reduce the students' resistance [7]. When lecturers explain the value of active learning and its requirements, early in the semester, students can more swiftly adhere to it [16]. Lecturers can resort to interactive digital maps and visualization tools, such as online infographics to illustrate the advantages and expectations of active learning as a teaching strategy, helping students to become more informed and less reticent.

In addition, to ease the transition into active learning it is important to start the implementation early in the course and with simple activities that represent lower risk

to the teachers and the learners. This type of activities (for example pause procedure and minute papers) enables the teachers to make only a few changes and gives the students the opportunity to adapt. The activities and the rationale behind them should be clearly explained to students [1]. Using interactive tutorials and simulations can represent an appealing start for the students and using microlearning platforms and assist them to acquire knowledge in a more progressive and manageable manner.

With regards to planning the activities, students welcome active learning activities that have meaning, represent an appropriate challenge [1] and that are unambiguously connected to the learning objectives and assessment, as it is defended by constructive alignment [17]. In order to foster student participation, some best practices include navigating the room and engaging directly with the students, inviting students to ask questions, approaching students who seem disengaged and trying to include them in the activity, and grading the students' participation as a manner to elicit their contribution [7]. Learning Management Systems can be valuable allies in this phase, as they can be used by lecturers to store the classes' planification. In addition, polling and survey tools can be integrated in the class to offer real-time feedback from the students.

Some studies also mention the importance of student reflection, using an adequate space and obtaining feedback. Students' reflection has a fundamental role in the promotion of lifelong learning, and it plays a central part in supporting decision-making [18]. Active learning is improved with reflection [19]. Concerning feedback, teachers can begin by consulting and asking for feedback from colleagues, which can be a useful strategy when designing active learning courses [1]. Feedback can come equally from students, by asking them to provide feedback about how the course is going and addressing their concerns [16]. The physical space is an important aspect of designing active learning courses [20]. There are several examples in the literature that report the conversion of traditional rooms into rooms suitable for active and collaborative learning with the support of technology [21]. Interactive whiteboards and annotation tools can support active learning inside the classroom and to foment reflection, students can be asked to compile e-portfolios with activities featuring relevant content covered in the lectures.

2.2 Methods for evaluating active learning's effectiveness

Concerns about active learning's effectiveness [7], place an emphasis on the importance of evaluating its impact. Self-reporting instruments are useful to obtain information on the views of different stakeholders, but they are limited in scope, and they can only assess a restricted number of factors. Additionally, observation-based instruments are valuable [22], but they can sometimes miss important cues.

In the literature, comparative studies assess the effectiveness of active learning in comparison with the conventional lecture format, in some cases using student performance [23]. Some authors report having used a combination of methods, such as surveys and students' final grades, paired with demographics [24]

There are also other tools such as the Active Learning scale in the Australasian Survey of Student Engagement (AUSSE) with 11 items to measure active learning [12] and observational tools such as the Active-Learning Inventory Tool [22]. When active

learning is supported by technology there is equally the possibility of using the technology itself to obtain data on students engagement and other metrics. Clickstream data, for example, can provide insight into students' use of resources, but the information it provides is limited [25]. Given the advantages and disadvantages of each method portrayed in the literature, this paper posits that each method on its own is insufficient to provide the width of data to comprehensively understand if an active learning initiative has been effective and argues that it is important to resort to more than one method to assess how the students perceived the experience, and what impact it had on the concrete learning performance and attainment of learning objectives. With this respect, technology can play an important role in gathering insight, learning analytics platforms can be used, as well as online survey services and digital peer and self-assessment tools.

3 MATERIALS & METHODS

This paper is based on a mixed method research approach [26] using an online questionnaire [27] and semi-structured interviews [28] to address its two main research questions: a) what design strategies can be used to develop active learning in higher education, in order to maximise its effectiveness; b) what measurement instruments can be used to assess active learning's instructional impact. Research Ethics Committee approval was sought for this research.

3.1 Data collection instruments

The questionnaire had three main parts: a) demographic questions about the respondents; b) questions concerning the definition, learning activities, design and measurement of active learning; and c) Likert scale questions regarding design guidelines, including measurement. There was a question at the end asking the respondents if they would be interested in participating in a subsequent interview. After the pilot and the necessary adjustments deriving from it, the final version of the questionnaire was distributed via email invitation, on the SurveyMonkey platform. The semi-structured interviews' script was designed following a preliminary analysis of the results of the questionnaire and it was directed at exploring its key conclusions. The script was divided into two sections: a) questions pertaining to definition, learning activities, design and measurement; and b) questions concerning some of the answers that the respondents had provided in the questionnaire. Depending on the availability of the interviewees, the interviews were conducted via Skype and email.

3.2 Sample and subsample

The questionnaire's sample of respondents was the result of convenience and purposive sampling [29], in the sense that they were selected due to their expertise and their accessibility to the researchers. They were selected from a population of university lecturers, from several subjects and various countries. The interviews were conducted

with a subsample of the questionnaire's respondents, who at the end of the questionnaire volunteered their contact information to be part of a subsequent interview. From this population of volunteers, a sample was selected via theoretical sampling [30], based on their answers in the Likert scale questions. This sampling technique was used to select respondents who had, in the questionnaire, used either a neutral score (neither agree nor disagree), a disagreement score (totally disagree or disagree), or a "I don't know" reply. Since the items in the Likert scale questions were supported by previous literature as per section 2, it was more valuable to examine this type of responses, for the insight it could provide.

3.3 Data analysis

The data deriving from the questionnaire was analysed in SPSS 21, where a preliminary analysis based on descriptive statistics was conducted. Following this analysis, the Likert scale questions were further examined by resorting to a factor analysis also in SPSS 21. The results of the questionnaire were then used as the basis for the analysis of the data provided by the interviews. The scripts and transcripts of the interviews were introduced in Aplasia 9 where they were coded using the main subjects that emerged in the questionnaire and explored for any additional themes.

4 RESULTS

Due to the volume and coverage of the data collected in the online questionnaire and the semi-structured interviews, this paper will focus, as per its research questions, solely on the data concerning design and measurement. Focusing only on these sections of both data collection instruments, will enable a more in-depth and reflective analysis of the results. Hence, although the questionnaire and interviews are part of a larger study, for the purpose of this paper, this section will present the data pertaining exclusively to design and measurement. The online questionnaire received 338 valid responses, and 12 semi-structured interviews were conducted.

4.1 Participants

The majority of the participants, 71%, was between the age of 41 to 60 years old. Only 1% was under 30 years old, 19% was between 30 and 40 and a small percentage (9%) was over 60. Circa 61% were female participants and 39% were male. The questionnaire was completed by respondents from 62 countries, such as Spain, Portugal, Turkey, Romania, United States and Russia. Most participants were professors (31%) or associate professors (32%), while lecturers and senior lecturers were accounted by 14% each. Other positions included tutors and assistant and adjunct professors. When directly citing their contribution, to safeguard their anonymity, codes will be used (R#1-R#338). With regards to the interviews, in total, 105 respondents volunteered in the questionnaire, but due to a limitation of resources relating mainly to time, 64 were contacted to participate in the interviews. From the 22 respondents who

responded affirmatively, 12 completed the interview. For the purpose of maintaining their anonymity they are referred in the paper as I#11-I#22.

4.2 Active learning design roadmap for maximising effectiveness

In the questionnaire, the respondents were asked to select the strategies that they have used to ensure an effective design (**Error! Reference source not found.**).

Table 1. Design strategies

Design strategies	Percentage
Ask for feedback from students	80%
Carefully plan the activities that will be used	62%
Promote student reflection	60%
Foster student participation	60%
Start the implementation of active learning at the beginning of the course	55%
Engage the students through explaining why active learning will be used in the classroom	53%
Measure the outcomes of your active learning experience	43%
Start with simple activities	41%
Ensure the space facilitates active learning	30%
Ask for feedback from colleagues	19%
Other	2%

Asking students for feedback was the most valued design strategy. The participants were asked in an optional open question to identify what other design best practices they would recommend. A total of 123 responses were given, which can be divided into three clusters:

- Activities and tools –games, interactive pools, modelling technologies, argumentation, video discussions, mind mapping, log book entries, text analysis, quizzes, jigsaw reading;
- Best practices - addressing the students' interests, using authentic case studies and evaluation, co-teaching, creating a community of learning, and the adaptation of methods to the course, topic and students' readiness;
- Teaching methodologies – flipped classroom, project-based learning, inquiry-based learning, problem-based learning and cooperative learning.

With respect to the interviews, the participants were asked to compile five main design principles (**Error! Reference source not found.**).

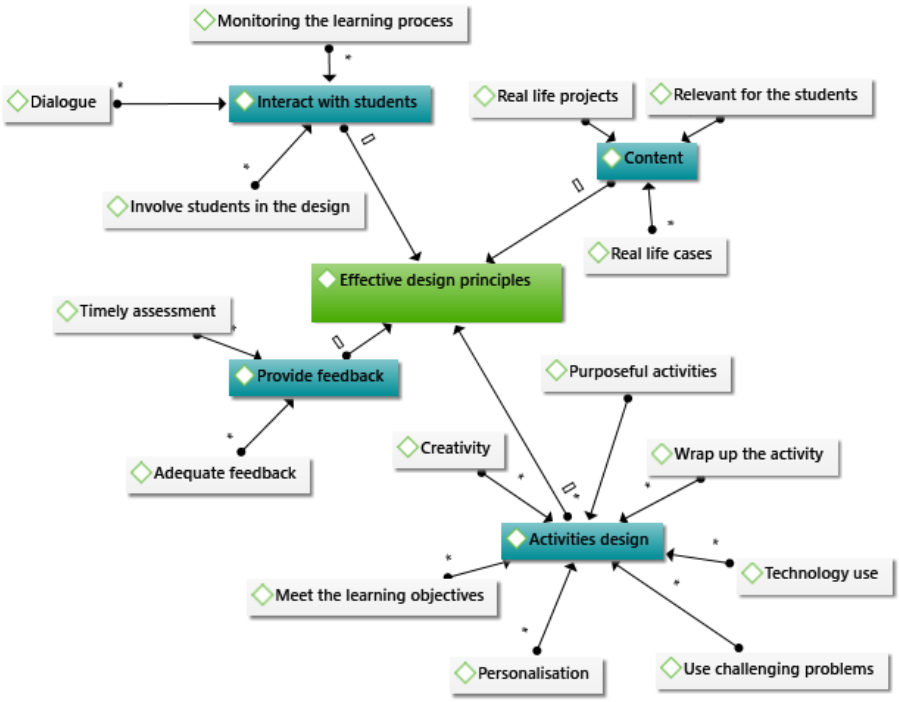

Fig. 1. Network map for the code effective design principles, in the interviews (generated in Aplasia 9)

There is a predominance of sub-codes concerning the design of the learning activities, which the interviewees placed at the centre of their design efforts. According to them, learning activities, in the context of active learning design need to be: purposeful in the sense that they are directed at a specific problem; personalised to suit student's individually; supported by technology deployment; compatible with the learning objectives that were set in the course; designed creatively; inclusive of complex problems to challenge the students; and subject to a wrap-up upon completion. With reference to content, it is required to use real life projects and cases and it needs to be based on subjects that are relevant for the students. Interacting with the students include the promotion of dialogue, increasing communication; the monitoring of the learning process while it is happening in the classroom; and the improvement of the students' involvement. Involving the students in the process seems to be key to a successful implementation, as I#19 describes "a lot of my colleagues arrive to me and say 'I tried to do active learning or flip the class activity, and it fail.' And the first thing I ask them, 'you told the students that they had to work a little bit more, or in a different way?' – 'Yes, more or less', but at the end of the day, the answer is no". Finally, concerning the provision of feedback the participants determined that it should be appropriate to the activity and offered in a timely manner.

The questionnaire explored effective design further through a set of Likert scale questions where the respondents were asked to manifest their agreement or disagreement level toward statements pertaining to several guidelines for active learning effective design and where they could add any comment. The first group of guidelines is explaining the context (**Error! Reference source not found.**).

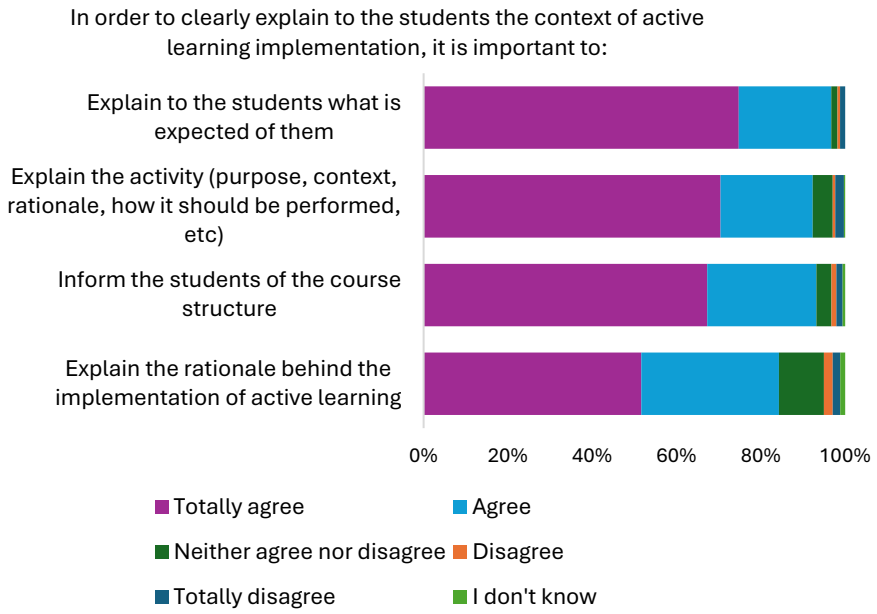

Fig. 2. Statements pertaining to the explanation of context

The respondents' total agreement levels (totally agree and agree scores) were above 80% for the items related to the need to explain the context, with the first item receiving 96% of total agreement. Comments left by the respondents highlighted the importance of informing the students of what is expected of them and of the benefits of active learning, as one respondent added "If students are not informed of what they have to do and why, they are naturally reluctant" (R#46).

In the interviews, explaining her response of "neither agree nor disagree" in the item "explaining the rationale behind the implementation of active learning", I#16 said that her students already know that "doing" is required in statistics, so there is no need to explain the pedagogical choice. Also, one interviewee, who had selected the option "neither agree nor disagree" in the item "explain the activity", justified it by arguing that if the students "are actively engaged in the development of the learning programme, explaining the details mentioned above is irrelevant. Moreover, going over such details BEFORE the activity might "spoil" the "surprise" aspect of the lesson (which can be a motivational element)" (I#20).

The second set of design guidelines, posits that it is important to start early and simple (**Error! Reference source not found.**)

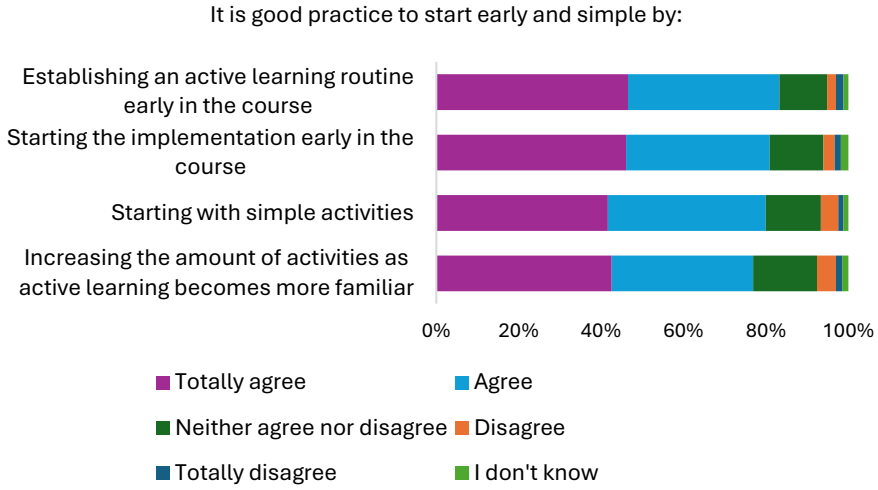

Fig. 3. Statements concerning an early and simple start

The total agreement percentage concerning an early and simple start were higher than 80%, with the difference that they gathered more neutral and disagreement ratings. The comments added by the participants clarified that it depends mainly on the learning goals. In addition, the interviews provided some insight into these results (Table 2).

Table 2 Explanation of responses to starting early and simple items

Item	Response	Reasons for response
Starting with simple activities	Neutral (I#11)	Depends on the level of the students. With master students or more experienced students, for example, it is possible to start with complex activities.
	Disagreement (I#16)	Starting early is important, but it doesn't necessarily mean that the activities need to be simple. They need to be challenging and relevant.
Increase of the amount of activities as active learning becomes more familiar	Neutral (I#19)	It depends on the situation, but there can be an increase in intensity rather than in number.
	Disagreement (I#16)	"Starting activities should be the same as the activities that are going to be used throughout the entirety of the

course, to ensure a similar structure between the weeks" (I#16).

The third group of guidelines, regarding the need to carefully plan the activities, gathered similar agreement in the questionnaire (**Error! Reference source not found.**).

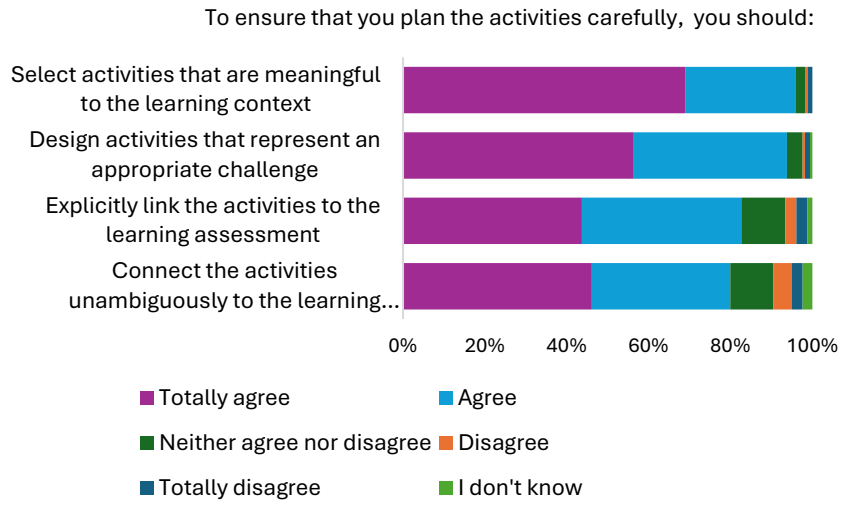

Fig. 4. Items related to carefully planning the activities

All statements had a high level of total agreement with 80% or over. The selection of activities that are meaningful to the learning context even reached 96% of total agreement scores. In the comments, one respondent added a different perspective, contrary to connecting the activities to assessment, "this frees me up as a teacher to focus on the students' learning, not their grades. Likewise, by being separated from assessment, students are given the opportunity to experiment and try new things. When tied to assessment, students understandably become more narrowly focused and risk averse." (R#108). In the interviews, I#18 argued that he had selected the option "neither agree nor disagree" in the item "explicitly link the activities to the learning assessment" because "there are certain learning outcomes that cannot really (and effectively) be measured. That is why I would go (mainly) for learner feedback as it provides indications of the achievement of these "invisible" outcomes. "(I#18).

The set of guidelines that follows concerns the promotion of student participation (**Error! Reference source not found.**).

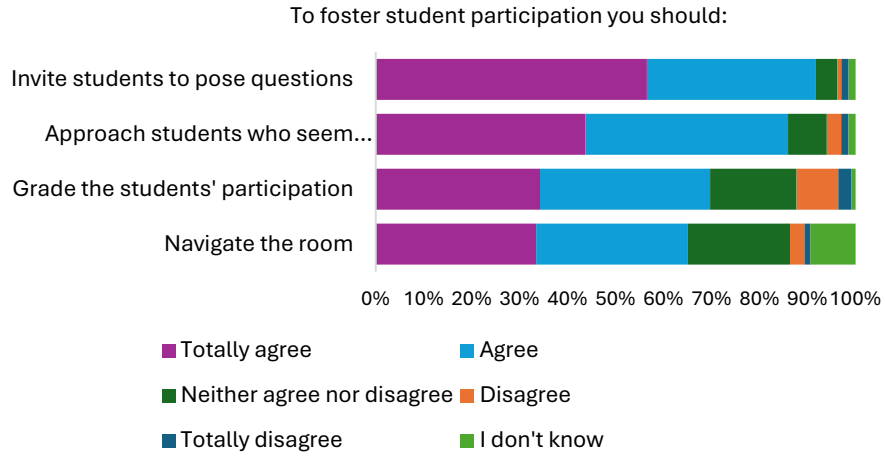

Fig. 5. Student participation items

The items associated with this guideline had different levels of total agreement. The first two items had 86% and over of total agreement. Grading the students' participation had the agreement of 70% of the sample, but 18% of neutral scores, while navigating the room had 65% of total agreement and 21% of neutral scores. The comment section was used mainly to suggest other forms of engaging the students, namely activity design, getting to know them and their interests better, defining their role and encouraging them to share their ideas. **Error! Reference source not found.** shows some of the reasons behind the respondents' answers, which became evident during the interviews.

Table 3. Items pertaining to student participation discussed in the interviews

Item	Response	Reasons for response
Navigate the room	Neutral (I#14)	It will not in itself engage students, but it is good to maintain them alert.
Approach students who seem disengaged	Neutral (I#20)	It is unrealistic to approach large numbers of students.
Grade the students' participation	Neutral (I#19)	Grading participation isn't always the solution. It depends on the context and on the content.
	Disagree (I#18, I#20)	"I strive for the opposite: peer learning and healthy collaboration" I#20.
		It can "force participation just to get a good grade, not because learners are truly participating." (I#18).

Design guidelines pertaining to measurement will be analysed in the next sub-section (4.3). The last question combined several recommendations. The six items connect essentially to student reflection, learning space and feedback (**Error! Reference source not found.**).

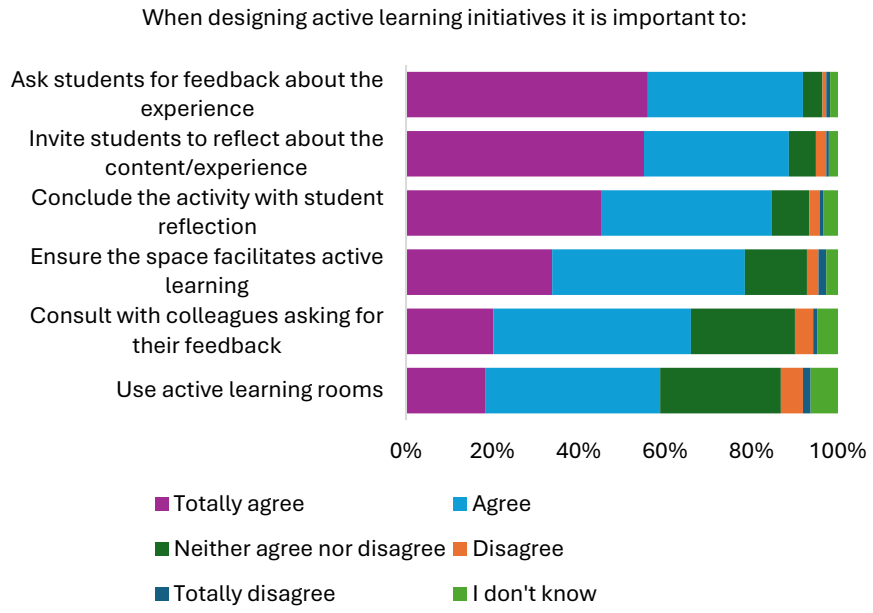

Fig. 6. Other guidelines for active learning design

Consulting with colleagues and using active learning rooms gathered only 66% and 59% of agreement respectively. In the comments, one participant said that although the space does facilitate active learning, the absence of it should not be an impediment. Another respondent highlighted the value of studying the literature, similar implementation cases and the experiences of others. The interviews provided data on all items pertaining to this question (**Error! Reference source not found.**).

Table 4. Interviewees' responses to various design guidelines

Item	Response	Reasons for response
Consult with colleagues asking for their feedback	Neutral (I#11, I#20)	Some teachers do not have the time to spare, and academic competition can hinder its usefulness.
		It is dependent on experience, but it is not crucial.

	Disagreement (I#12)	Some teachers aren't interested in new ideas.
Ask students for feedback about the experience"	Neutral (I#12, I#14)	Despite the neutral rating, student feedback would be welcomed.
		Can be used only if there is any free time.
Use active learning rooms	Neutral (I#18, I#19, I#20)	With massification it is important to be creative and use the resources that are available.
		It can have an important role in planning, but there is no need to create special rooms.
		Although it can be a problem, it is more often "an excuse not to do active learning (…) Spaces, if you are creative, are not a problem. That is not the key point" (I#19).
	Disagreement (I#14)	Active learning does not require a specific facility.
Ensure the space facilitates active learning	Neutral (I#19, I#20)	Massification requires teachers to use what they have
		The room is not essential
	Disagreement (I#14)	Active learning needs to be "more mental than manual/physical."(I#14)
Invite students to reflect about the content/experience	Neutral (I#12, I#16)	Would rather invite students to reflect
		It can sometimes be useful, but it is not always required.
Conclude the activity with student reflection	Disagreement (I#16)	It is important to have some type of "wrap-up (whether it be reflection or a discussion), (…) reflection felt too narrow of a term to use." (I#16).

4.3 Measurement instruments to assess active learning's instructional impact

In the interviews, the university lecturers were asked about the benefits of evaluating the effectiveness of active learning. They were unanimous in defending the importance of measuring their experiences, mainly because the data that they collect assists them to determine if their work is being successful, it offers feedback about the students' views, and it can be used to further perfect the design of prospective active learning initiatives. According to the interviewees, evaluation methods can, similarly, be used to evaluate the performance of both students and teachers; to determine if the learning strategy is meeting the learning objectives, both in general to the course and in particular to the activity; and to determine the aspects that are working and those that are just inefficient and result in superficial learning, In addition it serves as a motivation, as stated by I#18 "seeing that these methods are effective, motivates teachers/lecturers to invest more in developing such learning programmes".

In the questionnaire, the participants were asked to list the methods that they have used (**Error! Reference source not found.**).

Table 5. Evaluation methods to assess active learning's effectiveness

Evaluation methods	Percentage
Learning outcomes measurements (i.e. grades of exams, tests or assignments)	77%
Observation	59%
Student surveys	56%
Number of assignments/activities completed	40%
Student interviews	34%
Student focus groups	24%
Data analytics from technology deployment	21%
Other	6%
I do not assess the effectiveness of my active learning initiatives	2%

The majority of the participants reported using students' learning outcomes, such as their grades in exams and assignments, relying on observation and using students' surveys. Only an exceedingly small percentage of respondents (2%) claimed not to assess the effectiveness of the active learning initiatives. Some participants added other methods to the list in the questionnaire, including analysis of the quality of interventions, attendance and dropout rates, open feedback sessions, and teacher reflections. A frequency and mean analysis of the number of options selected by the respondents showed that on average each respondent selected 3 evaluation instruments (mean = 3.21) and that only 9% of the respondents selected just one method.

The interviews also included a question to list specific instruments, which half of the participants responded by identifying only one method. Similarly to the results in the questionnaire, 7 interviewees identified some type of learning outcomes measurement, such as formative and/or summative tests and assessment obtained from projects, portfolios or essays. In addition, observations and students' surveys were mentioned by 4 interviewees each. One of the university lecturers reported using all three methods combined. I#14, who mentioned only learning outcomes, argued: "I don't use any specific instrument for active learning effectiveness measurement as I can't spend teaching hours for it". Observation, in its turn, was described as being more sensitive by I#15, and student surveys were defended by I#18 as "a true reflection of what the learners "get" from the learning experience".

In the questionnaire, measurement of active learning' outcomes was equally included as a design guideline in the Likert scale questions (**Error! Reference source not found.**).

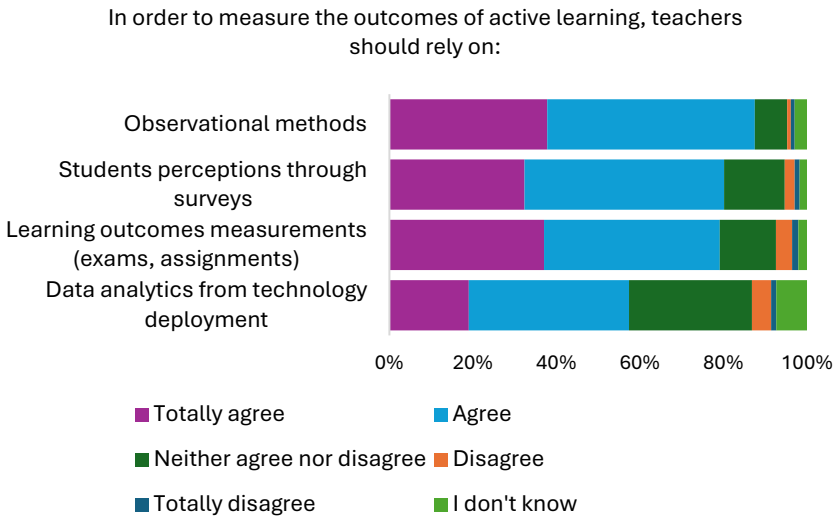

Fig. 7. Items for measuring the outcomes of active learning

Most measurement instruments had total agreement levels of 79% or higher, with the exception of data analytics, which reached just 57% of total agreement rates. This item also had 29% of neutral responses, which is substantially high. The comments offered by the respondents pertained to data analytics from technology, with one respondent stating that it is "questionable whether the right data could be collected, analysed and interpreted correctly" (R#57). With concern to student surveys one participant argued that he has "observed oftentimes that students' perceptions through survey are not honestly evaluated by students" (R#205). Also, exam results, one respondent argued, provide incomplete data, being necessary to observe the behaviour of the students. **Error! Reference source not found.** illustrates some of the arguments behind the selection of neutral scores to the measurement items.

Table 6. Examination of responses to measurement items in the interviews

Item	Response	Reasons for response
Data analytics from technology deployment	Neutral (I#11, I#14, I#18, I#20)	Prefer formative learning
		Prefer student feedback questionnaires/interviews, as they provide insight into what the students obtained
		No experience with data analytics
		Teachers can extract the data themselves and analyse it
	I don't know (I#16)	Didn't understand what it meant

Students' perceptions through surveys	Neutral (I#14)	They only provide an estimation and do not have a direct link to actual knowledge

Finally, the interviewees were asked to identify the challenges associated with measuring active learning and they all voiced different concerns. According to the respondents the challenges pertaining to measurement concern the need for platform readiness, difficulty in preserving student representativeness, student excessively positive feedback, survey design bias, evaluation bias in observational methods, subjectiveness of evaluation, lack of time to develop adequate instruments and complexity of qualitative data analysis.

4.4 Factor analysis of design guidelines

The Likert scale questions were further analysed through a factor analysis. To determine the factorability of the items, The Kaiser-Meyer-Olkin test resulted in 0.908, above the recommended 0.5 value [31]. In addition, the Bartlett's test of sphericity had a 0.00 value signifying that the data is not normally distributed, it is skew and since it is lower than 0.05 [31] it is significant. Both tests confirmed the appropriateness of conducting a factor analysis. This adequacy was further confirmed by the communalities table, which displayed values above 0.3, attesting the items common variance. Factor analysis was selected due to its ability to provide a summary of the data in a manner that simplifies the interpretation and understanding of relationships and patterns. It can reorganise variables, narrowing them into clusters established on their common variance [32]. Factor analysis was performed using principal axis factoring extraction technique, since it is the best option for data which is not normally distributed [33] and direct noblemen rotation, due to an assumed correlation between the items [33]. Based on the items' eigenvalues (>1) and on a visual examination of the scree plot, five components were extracted. In examining the pattern mix and the items factor loadings, it was possible to detect the items that were associated with each factor, enabling their characterisation. The items associated with factor 1 pertained mostly to learning activities, factor 2 to reflection and feedback, factor 3 to measurement, factor 4 to space and factor 1 to early implementation. These five components do summarise the overall findings in the sense that both respondents and interviewees emphasised the centrality of learning activities in terms of their design and of informing the students about their context and rationale; argued the significance of student reflection and feedback as an approach to improve design; and defended the deployment of several measurement instruments as an important design strategy. In addition, they were supportive of the idea of using active learning rooms, but characterised the guidelines pertaining to it as dispensable, and promoted the idea of a timely implementation, rooted early in the routine of the course.

5 DISCUSSION

This paper intended to contribute to active learning research by focusing on design and measurement guidelines, to assist the development of more effective learning experiences in higher education. The results offered a panoply of guidelines and recommendations in term of design and measurement that can provide teachers, across multiple subjects, with a structure to enhance their courses whether they are just starting to implement active learning or are more experienced.

Responding to the first research question, on a preliminary approach to design guidelines, in the questionnaires, the overall results underlined the importance of obtaining feedback from the students, carefully planning the learning activities, student reflection, starting early and explaining the rationale behind active learning's use. The interviews echoed the centrality of the learning activities and of the students' role. A preliminary analysis of the Likert scale items frequencies confirmed the central design themes that emerged from previous research. Explaining the context as argued by Tharayil, Borrego [7] received a sound support by the respondents, with high agreement levels and with comments and interviewees reiterating the importance of keeping the students informed. Starting early and in a simple manner defended by previous research [1, 16], received a high percentage of agreement, which was more pronounced in terms of starting early rather than in a simple manner. Planning the learning activities judiciously as theorised in the literature [1, 17], gathered the agreement of an expressive majority of the respondents, while fostering student participation, as advocated by Tharayil, Borrego [7] was defended by the participants, but with more restraint in terms of navigating the room and grading participation.

As per the literature [18, 19], overall the respondents underlined the importance of student reflection and, in line, with previous studies [16], an overwhelming majority of the participants were in agreement with asking students for feedback, but contrary to what [1] defended they were much less inclined to do so in relation to colleagues. Finally, the items pertaining to space registered a lower level of agreement. Although the literature argues for the value of rooms designed to facilitate active learning [20, 21] and the majority of the respondents also agrees, it was deemed as nonessential by some respondents and interviewees. In response to the second research question, the instruments for measuring the outcomes of active learning inventoried in previous studies [12] had the support of the majority of the respondents in the Likert scale questions, but with varying degrees. The instrument that gathered less agreement was data analytics, while observational methods, student surveys and exams and assignments were more popular. It equally became evident that the best approach to a more comprehensive measurement is the use of several methods, each providing data about an aspect of the experience. A further examination of the Likert scale items, using factor analysis enabled the reduction of these items down to five components, which were defined as learning activities, reflection and feedback, measurement, active learning spaces and early implementation.

6 CONCLUSION

As it is true for any teaching approach, active learning's pedagogical value is greatly dependent on the outcomes that stem from its adoption. This becomes even more relevant for strategies that require considerable effort and time. Although this research set out to provide a comprehensive and general set of guidelines for design and measurement, it became evident that even the most straightforward practices were not a one-size-fits-all solution. The findings show that some of the best practices that teachers can use to guide the implementation of active learning depend on a variety of factors to be successful. Nonetheless, and recognising that these guidelines cannot be universalised, they do seem to constitute the pillar, as per the respondents and interviewees, of a more effective implementation and measurement.

The main limitations of this study pertain to the samples, both in the questionnaire due to the lack of probability sampling and in the interviews due to a low number of interviewees. The fact that the interviewees were volunteers can also introduce some bias, as it speaks to a specific type of respondent. Since not all the items of the guidelines were covered by the interviews, limited insight was obtained about the reasons behind the agreement and disagreement with certain items. Further research can focus on case studies of active learning implementation to examine the strategies that are used in its design and to assess its instructional impact. Moreover, given that there is still some teacher resistance to active learning, it would be important to its advancement, to examine the reasons behind this opposition. It is fundamental to examine the viewpoints of university lecturers and to study their experiences. The more active learning pioneers and adopters share their experience, more knowledge will be accessible to teachers to judge if this teaching approach is suitable for their courses and more data will be available to guide a more successful implementation.

7 REFERENCES

1. Brame, C. and C.A. Director, *Active learning.* Vanderbilt University Center for Teaching, 2016.
2. Kozanitis, A. and L. Nenciovici, *Effect of active learning versus traditional lecturing on the learning achievement of college students in humanities and social sciences: A meta-analysis.* Higher Education, 2023. **86**(6): p. 1377-1394.
3. Isaias, P. Flipping Your Classroom: A Methodology for Successful Flipped Classrooms. in *IADIS International Conference Cognition and Exploratory Learning in Digital* (ed. Demetrios G. Sampson, D. I. and P. I.) (International Association for Development of the Information Society., Budapest, Hungary, 2018).
4. Isaias McKimmie B. Bakharia A. & Zornig J., P. Flipping the Classroom Effectively: Evaluation Results from a Course at The University of Queensland. in *EdMedia+ Innovate Learning* 1864–1873 (Association for the Advancement of Computing in Education (AACE)., 2018).

5. Nordmann, E., et al., *Lights, camera, active! appreciation of active learning predicts positive attitudes towards lecture capture.* Higher Education, 2021.
6. Velde, R.v.d., et al., *'The idea is nice… but not for me': First-year students' readiness for large-scale 'flipped lectures'—what (de)motivates them?* Higher Education, 2020.
7. Tharayil, S., et al., *Strategies to mitigate student resistance to active learning.* Int J STEM Educ, 2018. **5**(1): p. 7.
8. Sandrone, S., et al., *Active learning in psychiatry education: current practices and future perspectives.* Frontiers in psychiatry, 2020. **11**.
9. Borda, E., et al., *Initial implementation of active learning strategies in large, lecture STEM courses: lessons learned from a multi-institutional, interdisciplinary STEM faculty development program.* International Journal of STEM Education, 2020. **7**(1): p. 4.
10. Campbell, L.O., S. Heller, and L. Pulse, *Student-created video: An active learning approach in online environments.* Interactive Learning Environments, 2020: p. 1-10.
11. Kannan, V., et al., *Flip & Pair – a strategy to augment a blended course with active-learning components: effects on engagement and learning.* Smart Learning Environments, 2020. **7**(1): p. 34.
12. Carr, R., S. Palmer, and P. Hagel, *Active learning: The importance of developing a comprehensive measure.* Active Learning in Higher Education, 2015. **16**(3): p. 173-186.
13. Børte, K., K. Nesje, and S. Lillejord, *Barriers to student active learning in higher education.* Teaching in Higher Education, 2023. **28**(3): p. 597-615.
14. Faustino, P. and D. Simões, *The Contribution of the Technology Acceptance Model for an Active Teaching and Learning Process in Higher Education: A Bibliometric Analysis*, in *Handbook of Research on Digital Learning*. 2020, IGI Global. p. 242-261.
15. Reilly, C. and T.C. Reeves, *Refining active learning design principles through design-based research.* Active Learning in Higher Education, 2024. **25**(1): p. 81-100.
16. Deslauriers, L., et al., *Measuring actual learning versus feeling of learning in response to being actively engaged in the classroom.* Proceedings of the National Academy of Sciences, 2019. **116**(39): p. 19251-19257.
17. Hailikari, T., et al., *Student perspectives on how different elements of constructive alignment support active learning.* Active Learning in Higher Education, 2021: p. 1469787421989160.
18. López-Cuello, J., S. Uitdewilligen, and A. Sambeth, *Triggers and conducive factors for reflection in university students: a focus group study.* Reflective Practice, 2024: p. 1-15.
19. Van den Beemt, A., et al., *Remote labs in higher engineering education: engaging students with active learning pedagogy.* Journal of Computing in Higher Education, 2023. **35**(2): p. 320-340.
20. Park, E.L. and B.K. Choi, *Transformation of classroom spaces: traditional versus active learning classroom in colleges.* Higher Education, 2014. **68**(5): p. 749-771.

21. Rands, M.L. and A.M. Gansemer-Topf, *The room itself is active: How classroom design impacts student engagement.* Journal of Learning Spaces, 2017. **6**(1): p. 26.
22. Van Amburgh, J.A., et al., *A Tool for Measuring Active Learning in the Classroom.* American Journal of Pharmaceutical Education, 2007. **71**(5): p. 85.
23. Freeman, S., et al., *Active learning increases student performance in science, engineering, and mathematics.* Proceedings of the National Academy of Sciences, 2014. **111**(23): p. 8410-8415.
24. Duran, P.A., et al., *Student attitudes and achievement in active learning calculus.* International Journal of Mathematical Education in Science and Technology, 2024. **55**(3): p. 759-780.
25. Seo, K., et al., *Active learning with online video: The impact of learning context on engagement.* Computers & Education, 2021. **165**: p. 104132.
26. Creswell, J.W. and J.D. Creswell, *Research design: Qualitative, quantitative, and mixed methods approaches*. 5th ed. 2018, Los Angeles: Sage.
27. Wright, K.B., *Researching Internet-based populations: Advantages and disadvantages of online survey research, online questionnaire authoring software packages, and web survey services.* Journal of computer-mediated communication, 2005. **10**(3): p. JCMC1034.
28. Dicicco-Bloom, B. and B.F. Crabtree, *The qualitative research interview.* Medical Education, 2006. **40**(4): p. 314-21.
29. Lavrakas, P.J., ed. *Encyclopedia of Survey Research Methods*. 2008, Sage Publications: Thousand Oaks, California.
30. Robinson, O.C., *Sampling in interview-based qualitative research: A theoretical and practical guide.* Qualitative research in psychology, 2014. **11**(1): p. 25-41.
31. Field, A., *Discovering statistics using IBM SPSS statistics*. 4th ed. 2013: Sage.
32. Yong, A.G. and S. Pearce, *A beginner's guide to factor analysis: Focusing on exploratory factor analysis.* Tutorials in quantitative methods for psychology, 2013. **9**(2): p. 79-94.
33. Costello, A.B. and J. Osborne, *Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis.* Practical assessment, research, and evaluation, 2005. **10**(1): p. 7.