The Version of Record of this manuscript has been published and is available in *Higher Education Research & Development*, 2024
https://www.tandfonline.com/doi/10.1080/07294360.2024.2366318/

Direct instruction or active learning? The spectrum of first-year university teaching practices

Manuel Bächtold[a,b], Jacqueline Papet[a,b], Dominique Barbe Asensio[a], & Appolinaire Ngoua Ondo[a]

[a]*OTP, SCSIP, University of Montpellier, France*
[b]*LIRDEF, University of Montpellier & University Paul Valéry Montpellier, France*

This study aims to gain a better understanding of the practices of first-year university teachers by considering the distinction between direct instruction and active learning. It is based on the responses of 356 teachers to questions relating to three areas of teaching practice: preparation, implementation and use of digital technology. Principal component analysis reveals a continuous spectrum of varied practices, distinguished by a combination of more or less frequent use of direct instruction and active learning. Cluster analysis was used to identify practice profiles by considering each of the three practice areas separately. This analysis reveals that teachers whose preparation corresponds to active learning methods rely more on teaching resources, but also on their expertise in the subject. The profiles of teaching implementation show a division between direct instruction and active learning methods, with specific profiles associated with either the use of flipped classrooms or serious games. It appears that the teachers who make the most use of digital technology to get their students active are also those who use it most to deliver content. Results also show that the majority of teachers are involved in a transition to active learning, but that half still alternate it with direct instruction.

Keywords: teaching profiles; teaching practices; active learning; technology; higher education

Introduction

In recent years, many international organisations, both political (e.g. UNESCO) and professional (e.g. European Society for Engineering Education), have recommended the use of more active pedagogies in higher education (Hartikainen et al., 2019; Lima et al., 2017). This recommendation is based on a body of research showing that active learning

methods are more effective than direct instruction in promoting student learning, both in the context of science education (Deslauriers et al., 2019; Freeman et al., 2014) and in the humanities and social sciences (Kozanitis & Nenciovici, 2022). Active learning methods are also highlighted because they help to develop higher order and cross-disciplinary skills, such as design, analysis and problem-solving skills, social and communication skills, and critical thinking (Hartikainen et al., 2019; White et al., 2015). The promotion of active learning in higher education is often associated with the promotion of new technologies, particularly digital tools, because they offer new ways of encouraging this type of pedagogy: for example, they allow teachers to implement flipped classroom and hybrid teaching and students to conduct investigations, construct content and take part in collaborative activities (Barak, 2017; Danker, 2015; European Commission, 2014).

However, despite certain instances of pedagogical innovation, this shift towards more active learning methods is still limited (Børte et al., 2023). Several studies highlight a certain inertia in higher education practices, particularly with regard to the use of technology for teaching purposes (Lillejord et al., 2018).

Other quantitative studies give a more mixed picture of the teaching conceptions and practices of university teachers. Only a minority of teachers describe their conceptions and practices as systematically corresponding to direct instruction, while the majority of teachers oscillate in their conceptions and practices between direct instruction and active learning methods (Postareff et al., 2008; Stes et al., 2014). Such “dissonances”, i.e. combinations between direct instruction and active learning methods, were also identified in a qualitative study between different aspects of the same teacher’s teaching practices: between the objectives assigned to teaching, the planning of that teaching, its implementation and the assessment method used (Uiboleht et al., 2016).

The present study aims to deepen these studies to better understand the teaching practices of university teachers: by conducting a quantitative study to identify profiles of teaching practices (like the studies by Postareff et al., 2008 and Stes et al., 2014) and by considering more finely the multiple aspects of teaching practices (like those distinguished in the qualitative study by Uiboleht et al., 2016). Furthermore, in this study, we propose to take into account digital uses in teaching, because these uses constitute an additional means of characterising teaching practices (Barak, 2017).

Direct instruction and active learning: conceptual and empirical background

Definition of direct instruction

Direct instruction is defined as a set of teaching practices that consist of transmitting content to students directly without any detours through activities to be carried out by the students. Direct transmission of content is also described as explicit communication of content (de Jong et al., 2023). Lectures are typically associated with such direct instruction. Some researchers refer to this teaching practice as the "content-centred approach" (Postareff et al., 2008; Uiboleht et al., 2016). Still others describe it as "teacher-centred" or "teacher-led" (Coorey, 2016; Danker, 2015; de Jong et al., 2023). The teacher selects the content and delivers it to the students during the course according to a precise plan that leaves little room for improvised changes (Uiboleht et al., 2016).

This practice of direct instruction is generally associated with a conception of learning according to which students are relatively passive listeners whose task is merely to listen to the teacher, remember the content transmitted and repeat it (Danker, 2015; Postareff & Lindblom-Ylänne, 2008). There is little room for interaction between the teacher and the students, as this is not supposed to promote learning (Postareff & Lindblom-Ylänne, 2008).

In addition, teachers practising direct instruction often emphasise their expertise in the content transmitted rather than their training in pedagogy (Postareff & Lindblom-Ylänne, 2008). In the case of teacher-researchers, they derive this expertise from their research activities. In this way, direct instruction is sometimes linked to the Humboldtian tradition of the university, according to which research and teaching form a unity (Harland, 2016). From this point of view, teaching should ideally be based on research (Børte et al., 2023).

Definition of active learning

Active learning methods are defined in this study as a set of teaching practices that involve students in activities which stimulate their engagement and thus promote learning of the content targeted by the teaching. Researchers sometimes refer to these teaching practices as "learning-centred approaches" (Postareff et al., 2008; Uiboleht et al., 2016) or "student-centred approaches" (Coorey, 2016; Danker, 2015). Active learning methods are all characterised by continuous student participation (Børte et al., 2023).

The term "active learning methods" is used in the plural because it can take different forms, including problem-based teaching, project-based teaching, inquiry-based teaching, flipped classroom and cooperative learning (Bonwell & Eison, 1991; Kozanitis & Nenciovici, 2022). It should be noted that there is some overlap between these teaching methods: project-based teaching and inquiry-based teaching generally involve solving a problem and are often implemented in small groups to encourage cooperation between students (Savery, 2006), or flipped classroom may be associated to cooperative and problem-solving activities (Crouch & Mazur, 2001). In all of these teaching methods, students are required to carry out activities that ultimately aim to make them more cognitively active when discovering or applying the content being taught. As part of the constructivist paradigm of teaching and learning (Bächtold, 2013), active learning

methods assume that this cognitive activity enables students to reconstruct, at least in part, the knowledge they are aiming to acquire, based on their prior conceptions (Barak, 2017; Hartikainen et al., 2019; Uiboleht et al., 2016). Students' observable activities, whether behavioural (e.g. conducting an experiment) or communicative (e.g. debating), are seen as ways of fostering this cognitive activity (Mayer, 2009).

However, some researchers believe that behavioural and social activities are important for their own sake in active learning methods (Kozanitis & Nenciovici, 2022). They offer opportunities to develop skills that are used in this type of activity, including problem-solving, cooperation, communication and critical thinking (Børte et al., 2023; Hartikainen et al., 2019).

In the context of active learning, the role of teachers is to set up student activities, facilitate their discussions (Danker, 2015) and guide them in the construction of knowledge (Hartikainen et al., 2019). They also need to take into account their prior conceptions and various ways of learning (Postareff & Lindblom-Ylänne, 2008). Some researchers argue that active learning methods should not be seen in opposition to direct instruction (de Jong et al., 2023). They do not remove the teacher's role in transmitting knowledge. Student activities and knowledge transmission can be combined and be mutually beneficial: if the transmission precedes the activities, it can provide students with the prior knowledge necessary for the success of the activities, and conversely, the activities can put students in a state of readiness to receive the knowledge transmitted by the teacher during or after these activities (de Jong et al., 2023).

Empirical studies on teaching practices in universities

According to several studies, direct teaching is still dominant in university teaching practices (Børte et al., 2023; Lillejord et al., 2018). This approach to teaching is expressed in the way digital tools are used by teachers, i.e. mainly for the transmission and

management of information and less for the implementation of active learning methods (Barak, 2017; Lillejord et al., 2018).

Changing teaching practices towards more active learning approaches faces a series of obstacles, as shown by a systematic review of the literature (Børte et al., 2023): the layout of the space, the furniture and its location, which separate students from teachers and encourage a transmissive mode of communication; large and diverse groups of students; teachers' workload and lack of time; deeply rooted conceptions of teaching which reduce it to individual practice and do not require in-depth training; lack of skills in the use of digital tools for teaching purposes and the constant evolution of technologies; lack of opportunities for professional development in pedagogy; students' expectations. These obstacles do not all have equal weight. In particular, according to some studies, the potential of digital tools to support active learning methods cannot be realised if teachers continue to adhere to the tradition of direct instruction; instead of challenging this tradition, digital tools can adapt to it (Lillejord et al., 2018).

Other studies give a more nuanced picture of the teaching conceptions and practices of university teachers and show that only a minority of teachers describe their conceptions and practices as systematically corresponding to direct instruction (Postareff et al., 2008; Stes et al., 2014). According to these studies, about half of the teachers have dissonant conceptions and practices of teaching, i.e. that fall alternately under direct instruction and active learning methods. According to Stes et al. (2014), these dissonant approaches are diverse and lie on a continuum of approaches, the two extreme poles of which are systematically direct instruction and systematically active learning methods.

When considering different aspects of the practices of the same teacher (e.g. planning of teaching, implementation of teaching, method of evaluation), we can observe dissonances between these different aspects, or even within the same aspect (e.g.

objectives expressed by the same teacher in planning her or his teaching that fall alternately under direct instruction and active learning methods) (Uiboleht et al., 2016). In the study by Postareff and her colleagues (2008), science teachers were mainly characterised by profiles that were either dissonant or consonant but systematically falling under direct instruction, whereas humanities teachers were mainly characterised by consonant profiles falling under active learning methods. Furthermore, in the same study, it was observed that the majority of teachers with consonant profiles relating to active learning methods had taken part in training courses on teaching methods organised at the university.

The present study

There are still few studies that characterise university teaching practices by distinguishing between direct instruction and active learning methods. Some studies provide quantitative indications of the relative importance of the two types of approach, but do not consider teaching practices in detail (Postareff et al., 2008; Stes et al., 2014). Conversely, one study explored these practices in detail but with a very limited number of teachers (Uiboleht et al., 2016). In the present study, we combine the two methodologies, quantitative and fine-grained, with the aim of better characterising the pedagogical practices of university teachers. In addition, we consider digital uses because they form part of teaching practices and are therefore a means of characterising them (Barak, 2017). The aim of the study is to identify profiles of practices by considering a set of specific aspects that fall under three different areas of these practices: the preparation of teaching, the implementation of teaching and the use of digital tools for teaching.

This study focuses on the first year of university teaching which presents a significant challenge for academic success, with higher dropout and failure risks (Fokkens-Bruinsma et al., 2021). Beyond choosing the right academic path, students

undergo a complex transition from high school, involving changes in their social and learning environments and requiring a shift in thinking and understanding (De Clercq et al., 2017). The implementation of active learning in the first year seems to be of paramount importance to support first-year students in this transition.

The research questions addressed can be formulated as follows:

- RQ1 : What are the different profiles in terms of teaching practices in the first year of university?
- RQ2 : To what extent are these profiles consonant or dissonant in terms of direct instruction or active learning methods?

Materials and methods

Participants

The participants in this study were 356 teachers at a university in France, the University of Montpellier. Of these teachers, 44.7% were women and 55.3% men. 25.8% had less than 7 years of teaching experience, 35.1% between 7 and 18 years and 39.1% more than 18 years. 74.7% were permanent teachers and 25.3% temporary teachers. They were teaching in 10 different faculties, mainly in science and technology: Economics (10 teachers), Education (47), Engineer (7), Law and political science (9), Management (18), Physical activity sciences and sport (18), Science (108), 3 faculties of Technology (139).

Data collection and analyses

Instrument

Data on teaching practices were collected by means of a questionnaire administered by email. To allow teachers to respond accurately, we asked them to consider a course given in a first-year training programme. The questionnaire consisted of 56 items (for the

complete questionnaire, see Supplemental materials A). Teachers were asked to respond on a 7-point Likert scale (note: for some questions, the scale was 3 points; to standardise the presentation of the results, the 3-point scales were converted to 7-point scales). The questions were developed by three researchers, two of whom are also lecturers in different faculties at the university. To ensure the content validity of the questions, i.e. that they were relevant in the context of this university and that their meaning was well understood, cognitive interviews were conducted with two members of the pedagogy training service, two members of the digital pedagogy training service and five teachers from different faculties at the university.

The questions were designed to provide a detailed characterisation of teaching practices in three different areas: preparation of teaching, implementation of teaching and use of digital tools for teaching. Some items have been developed to characterise practices as direct instruction (e.g. “In this course, the concepts and content to be learned are first explained in lectures and then applied by the students in practical work sessions”). To better understand how these questions were formulated, it should be remembered that the study was conducted in a French university where courses are structured as “Cours Magistral” (CM) and “Travaux Dirigés” (TD), which can be translated as “lectures” and “practical sessions”. While this structure may favor direct instruction, it does not prevent teachers from using active learning methods in CM and/or TD. Other items were intended to characterise practices of active learning methods (e.g. “During my practical work sessions, I use one (or more) of the following teaching methods: project-based teaching [...]”). And other items were also included, which correspond to important aspects of teaching practice, but which do not directly relate to either of these two approaches (e.g. “To prepare my teaching, I discussed the objectives of the course with my colleagues who teach in this course”). The items related to digital tools were aimed at understanding their

importance and uses in teaching. Assuming that each use may correspond to a different type of digital tool, we understood the term "digital tools" in a broad sense and considered them in the questionnaire (see Supplementary Material A) to be very diverse (e.g. digital presentation tools, quizzes and voting to run a session, peer assessment, or digital collaborative wall).

Given that the questionnaire is original and was designed to be adapted to the university context, an Exploratory Factor Analysis (EFA) was carried out to construct the measures on the basis of the questionnaire items. The variables were structured according to 9 factors in order to optimise a set of indices (i.e., % de variance = 0,55, RMSEA = 0,053, BIC = 3987) while ensuring the relevance of the factors constructed. For measures including several items, reliability was checked by calculating McDonald's omega, all ranging from .69 to .97. The 18 measures used in the study are described in Table 1.

Table 1. The aspects of teaching practices considered in the study.

Aspects of teaching practices	Description
Teaching preparation	
Expertise (1 item)	Preparation based on expertise in the discipline
Textbooks (1 item)	Use of university textbooks
History_epistemology (1 item)	Taking account of the history or epistemology of the discipline
National_framework (1 item)	Use of a national reference framework of knowledge and/or skills
University_framework (1 item)	Use of a reference framework of knowledge and/or skills internal to the university
Content_adaptation (2 items, ω = .69)	Taking into account students' difficulties with the subject and restructuring knowledge to adapt it to students
Sharing_colleagues (7 items, ω = .93)	Preparation based on discussions with colleagues (on objectives, content, student profiles, teaching methods, materials and/or assessment methods)
Teaching_resources (1 item)	Preparation based on teaching resources (books, articles, documents, online videos and/or training courses)
Teaching implementation	
Transmission_application (2 items, ω = .76)	The content is first delivered by the teacher and then applied by the students in practical sessions.
Students_activities (7 items, ω = .88)	During practical sessions, students carry out activities to discover new content, cooperate with other students, identify and question their erroneous conceptions, develop their critical thinking skills, their autonomy and/or their reflexivity about their learning.
Active_learning (6 items, ω = .76)	During practical sessions, one or more of the following teaching methods are used: problem-based teaching, project-based teaching, inquiry-based teaching, cooperative learning and/or an interdisciplinary approach
Flipped_teaching (1 item)	During practical sessions, the flipped classroom method is used.
Serious_games (1 item)	During practical sessions, students learn through serious games
Benefits_active_learning (10 items, ω = .97)	The implementation of active learning methods promotes the learning of key concepts, helps students to link different types of knowledge, develops their ability to cooperate, their critical thinking skills, their autonomy, their ability to reflect on their learning, their motivation, their self-confidence and their interaction with each other and/or with the teacher
Technology for teaching	
Technology_teaching (1 item)	The importance of digital tools in the teaching process
Technology_transmission (5 items, ω = .91)	Digital tools are used to transmit course content, additional resources and/or information to students, to help students at a distance and/or to motivate them more
Technology_activities (4 items, ω = .79)	Digital tools are used to enable students to work together, debate, assess and/or receive digital training
Technology_production (1 item)	Digital tools are used to enable students to produce new content

Clustering

In order to identify profiles of practices, the statistical analyses were carried out in two stages: a Principal Component Analysis (PCA), which reduces the number of variables on the basis of their correlations and projects the individuals onto a geometric space consisting of several decorrelated factors; then a clustering method, which separates the individuals into several groups according to their distance in the different factorial planes. This method was first applied to all the data, then separately for each of the three practice areas. Several clustering methods (CAH, DBSCAN, K-means and PAM) were compared in order to optimise the creation of groups (using Connectivity, Dunn and Silhouette indices) while keeping a reasonable number of individuals in each group.

Results

Descriptive analyses

The results show that certain reported teaching practices are more or less present among the teachers, which is reflected in the means of the variables above or below 4, the intermediate value on the Likert scale of 1– 7 (the means and standard deviations of all the variables are given in Supplemental materials B). With regard to teacher preparation, the most common teaching practices were (in decreasing order):

- relying on one's expertise in the field;
- adapting content to students;
- relying on a university reference framework;
- exchanging with colleagues;
- and relying on academic textbooks.

The least common preparation practices were (in increasing order):

- using a national reference framework;

- and taking into account the history or epistemology of the discipline.

With regard to the implementation of teaching, the most common practices were (in decreasing order):

- transmitting content first before asking students to apply it;
- and getting students to discover new content, cooperate, etc.

The least common practices were (in increasing order):

- implementing serious games;
- then flipped classroom;
- and active pedagogy.

When it came to the use of digital tools for teaching, the most common teaching practice was:

- transmitting content.

The least common practices were (in increasing order):

- allowing students to work together, debate, etc.;
- and making them produce new content.

A set of significant correlations can be observed (see Supplemental materials B). In particular, Transmission_application is moderately correlated with Expertise. Active_learning is moderately correlated with Teaching_resources, with University_framework and with History_epistemology. Transmission_application is negatively correlated with Active_learning, but rather weakly. Active_learning is strongly correlated with Students_activities, as well as with the various uses of digital tools, including Technology_activities, Technology_production, and Technology_transmission. Transmission_application is negatively correlated with both Technology_production (moderate correlation) and Technology_activities (weak correlation).

Profiles of teaching practices

A PCA was performed on all the variables. The variables that contribute most to dimension 1 (explaining 25% of the variance) are:

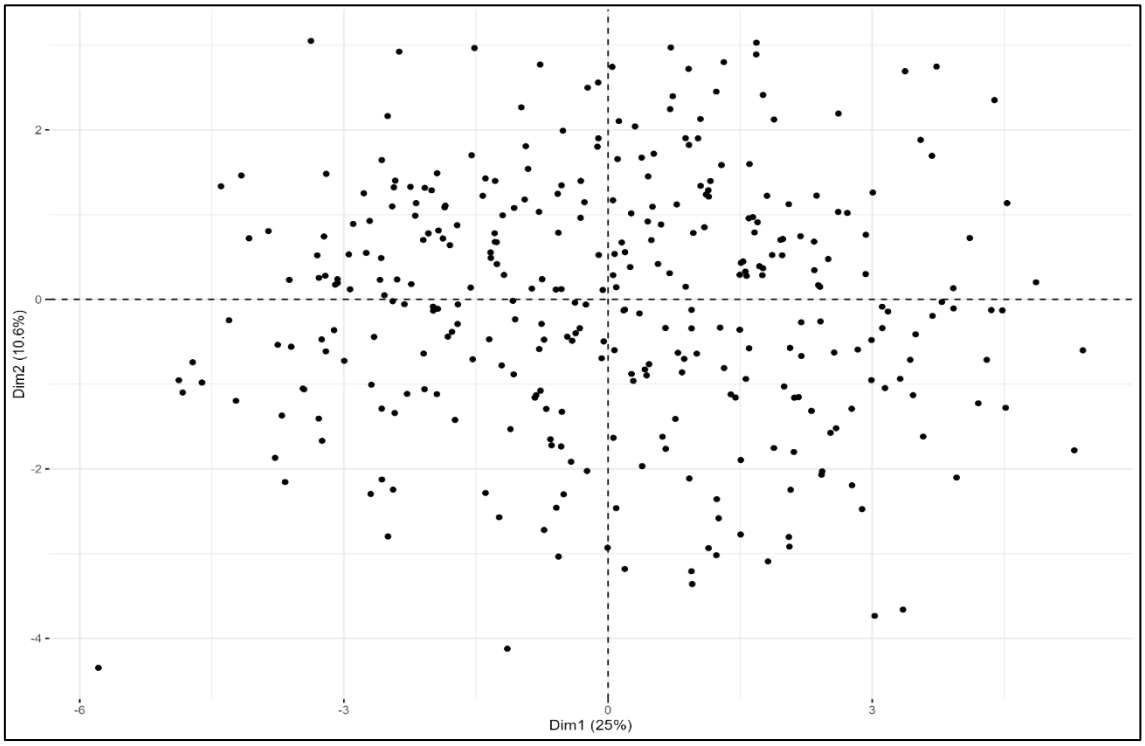
- the four variables associated with the use of technology;
- Active_learning;
- Benefits_active_learning;
- and Teaching_resources.

The variables contributing most to dimension 2 (explaining 11% of the variance) are :

- Expertise;
- Transmission_application;
- Textbooks;
- Content_adaptation;
- and National_framework.

The values of these contributions are given in Supplemental materials C. Dimension 1 may be associated more with active learning methods, and dimension 2 more with direct instruction. The projection of the teachers onto the factorial plane composed of these two dimensions is shown in Figure 1. It can be seen that the teachers are distributed continuously on this plane. The various clustering methods used do not allow us to form clearly separated groups.

Figure 1. Plot of the teachers on the two first dimensions of the PCA.



However, by considering the variables relating to teaching preparation, three groups could be distinguished by applying the Hierarchical Ascendant Classification (HAC) method (Table 2). The teachers in G_prep_1 were those who adapted the content least to the students and who based their teaching least on academic textbooks and on the history or epistemology of the discipline. Those in G_prep_2 rely the least on university or national reference frameworks. Those in G_prep_3 rely the most on teaching resources and academic textbooks, adapt the content to the students and base it most on the history or epistemology of the discipline. We can thus see that the approach of G_prep_3 teachers is more in line with active learning methods, insofar as they adapt the content most to the students, and contrasts with that of G_prep_1.

Table 2. Groups of teaching preparation practices identified with an HAC.

Group	**Variables characterising the group** (in decreasing order of importance)	**Mean of the group**	**Mean of the whole sample**
G_prep_1 *N* = 123	Content_adaptation (lower mean)	4.83	5.75
	Textbooks (lower mean)	3.02	4.45
	History_epistemology (lower mean)	2.00	3.19
	Expertise (lower mean)	5.1	5.82
	Teaching_resources (lower mean)	2.84	3.97
	University_framework (higher mean)	5.37	4.77
G_prep_2 *N* = 81	University_framework (lower mean)	1.65	4.77
	National_framework (lower mean)	1.75	3.12
	Teaching_resources (lower mean)	2.91	3.97
G_prep_3 *N* = 152	Teaching_resources (higher mean)	5.44	3.97
	Textbooks (higher mean)	5.64	4.45
	Content_adaptation (higher mean)	6.45	5.75
	University_framework (higher mean)	5.95	4.77
	History_epistemology (higher mean)	4.13	3.19
	National_framework (higher mean)	4.09	3.12
	Expertise (higher mean)	6.39	5.83

Note. For each group, the variables are listed in decreasing order of their importance in characterising the group, according to the comparison test between the mean of the group and the mean of the whole sample.

By considering the variables relating to the implementation of teaching, four groups could be distinguished by applying the Density-based Spatial Clustering of Applications with Noise (DBSCAN) method (Table 3). The teachers in G_impl_1, who represented 51.4% of all teachers, were those who implemented the least flipped classroom and active learning methods. G_impl_2 teachers were the ones who implemented the flipped classroom the most. Those in G_impl_3 were those who saw the most benefit in implementing active learning methods. Those in G_impl_4 are the ones who make the most use of serious games and active learning methods. We can thus observe that the approach of the teachers in G_impl_1 is least concerned with active learning methods and, in this sense, contrasts with those of the other three groups. G_impl_1 was also associated with an average Transmission_application (M = 5.51) that was significantly higher than the average for all teachers (M = 4.96). Although this

variable is not the most characteristic of G_impl_1, this data confirms that the approach of this group is most closely related to direct instruction.

Table 3. Groups of teaching implementation practices identified with a DBSCAN.

Group	**Variables characterising the group** (in decreasing order of importance)	**Mean of the group**	**Mean of the whole sample**
G_impl_1 *N* = 183	Flipped_teaching (lower mean)	1.12	2.46
	Serious_games (lower mean)	1.00	1.80
	Benefits_active_learning (lower mean)	4.05	4.79
	Active_learning (lower mean)	1.62	3.47
	Students_activities (lower mean)	4.43	4.83
G_impl_2 *N* = 96	Flipped_teaching (higher mean)	4.39	2.46
	Serious_games (lower mean)	1.00	1.80
	Benefits_active_learning (higher mean)	5.38	4.79
G_impl_3 *N* = 59	Serious_games (higher mean)	4.00	1.80
	Benefits_active_learning (higher mean)	5.79	4.79
	Active_learning (higher mean)	4.15	3.47
G_impl_4 *N* = 18	Serious_games (higher mean)	7.00	1.80
	Active_learning (higher mean)	5.26	3.47
	Flipped_teaching (higher mean)	4.00	2.46

Note. For each group, the variables are listed in decreasing order of their importance in characterising the group, according to the comparison test between the mean of the group and the mean of the whole sample.

By considering the variables relating to the use of digital tools for teaching, three groups could be distinguished by also applying the DBSCAN method (Table 4). The teachers in G_tech_1 make the least use of digital tools. Those in G_tech_2 make the most use of digital tools, both to get students to carry out activities and to transmit content. Those in G_tech_3 use digital tools mainly to transmit content. The approach of the teachers in G_tech_2 is therefore more in line with active learning methods and that of the teachers in G_tech_3 more in line with direct instruction.

Table 4. Groups of technology for teaching practices identified with a DBSCAN.

Group	**Variables characterising the group** (in decreasing order of importance)	**Mean of the group**	**Mean of the whole sample**
G_tech_1 *N* = 80	Technology_transmission (lower mean)	1.01	4,32
	Technology_teaching (lower mean)	1.00	3,99
	Technology_activities (lower mean)	1.00	2,88
	Technology_production (lower mean)	1.00	3,12
G_tech_2 *N* = 171	Technology_production (higher mean)	5.36	3,12
	Technology_activities (higher mean)	4.13	2,88
	Technology_transmission (higher mean)	5.52	4,32
	Technology_teaching (higher mean)	5.07	3,99
G_tech_3 *N* = 105	Technology_production (lower mean)	1.1	3,12
	Technology_activities (lower mean)	2.29	2,88
	Technology_transmission (higher mean)	4.86	4,32

Note. For each group, the variables are listed in decreasing order of their importance in characterising the group, according to the comparison test between the mean of the group and the mean of the whole sample.

For the three clustering analyses, the values of the tests for comparison of means and the *p*-values are given in Supplemental material C.

The gender of the teachers, their years of teaching experience, their professional status, their faculty and whether or not they had received training in pedagogy were analysed as additional variables in each of these classifications. Several significant differences were identified:

- women were over-represented in G_prep_3 and G_impl_3 (which are consistent with active learning), while men were over-represented in G_impl_1 (which is not consistent with active learning);
- teachers with 0–3 years of teaching experience are over-represented in G_prep_1 (not consistent with active learning), under-represented in G_prep_3 (consistent with active learning) and over-represented in G_impl_3 (not consistent with active learning),while those with 4 to 6 years of teaching experience are over-represented in G_impl_4 (consistent with active learning) and under-represented in G_impl_1 (not consistent with active learning);

- teachers with permanent teaching status are over-represented in G_impl_1 (not consistent with active learning) and under-represented in G_impl_4 (consistent with active learning), while the opposite is true for those with temporary status;
- science faculty teachers are under-represented in G_prep_3 (not consistent with active learning); teachers from the faculties of science, sports science, law and political science are over-represented in G_impl_1 (not consistent with active learning); teachers in the faculty of management are over-represented in G_impl_2 (consistent with active learning); teachers from the faculty of education are over-represented in G_tech_2 (consistent with active learning) and under-represented in G_tech 3 (not consistent with active learning), while the reverse is true for teachers from the faculty of science;
- finally, teachers who relied on pedagogical training are over-represented in G_prep_3 (consistent with active learning) and under-represented in G_prep_1 (not consistent with active learning), they are over-represented in G_impl_3 (consistent with active learning) and under-represented in G_impl_1 (not consistent with active learning), and over-represented in G_tech_2 (consistent with active learning).

Consonances and dissonances

Let us now examine the extent to which teachers' practices are consonant or dissonant (Postareff et al., 2008; Stes et al., 2014; Uiboleht et al., 2016). A teacher's practices are considered here to be consonant if the three aspects under study (i.e. preparation of teaching, implementation of teaching and use of digital tools for teaching) are either all based on direct instruction or all based on active learning methods. They are considered dissonant if some aspects are based on direct instruction and others on active learning. The approaches of groups G_prep_1, G_impl_1 and G_tech_3 are most strongly based

on direct instruction and/or least on active learning methods, while the approaches of groups G_prep_3, G_impl 2, G_impl_3, G_impl_4 and G_tech_2 are most strongly based on active learning methods. Based on the contingency tables (see Supplemental Materials 3), 21 teachers belong simultaneously to groups G_prep_1, G_impl_1 and G_tech_3. In other words, 5.9% of the teachers had consonant practices that systematically corresponded to direct instruction. Similarly, there were 61 teachers belonging simultaneously to groups G_prep_3, G_impl 2 or G_impl_3 or G_impl_4 and G_tech_2. In other words, 17.1% of teachers had consonant practices that systematically corresponded to active learning methods.

Conversely, teachers belonging to these two sets of groups, for example G_prep_3 and G_impl_1, corresponded to a dissonance in practices. There were 175 cases of dissonance between the preparation of teaching and/or the implementation and/or use of digital technology, representing 49.2% of teachers.

Finally, there are 99 teachers (27.8%) who belong solely to groups whose approach is not clearly associated with direct instruction or active learning methods.

Discussion

The spectrum of first-year teaching practices

This study aims to gain a better understanding of teaching practices in the first year of university. It builds on previous studies (Postareff et al., 2008; Stes et al., 2014; Uiboleht et al., 2016) and seeks to deepen them using a methodology that is both quantitative and fine-grained. The results are based on the responses of 356 teachers to questions covering many aspects of their teaching practices in training programmes at 10 different faculties. The PCA carried out with all variables shows that the practices reported by teachers are diverse but cannot be divided into clearly distinct groups. There is a continuous spectrum

of practices. Within this spectrum, practices are characterised and distinguished by a combination of more or less frequent use of active learning methods (associated with the Active_learning variable, which contributes to dimension 1 of the PCA) and more or less frequent use of direct instruction (associated with the Transmission_application variable, which contributes to dimension 2 of the PCA). These two approaches, theoretically antagonistic, turn out not to be mutually exclusive in practice (the Active_learning and Transmission_application variables being negatively correlated but weakly so). This result confirms what was suggested in the qualitative study by Uiboleht and colleagues (2016).

However, profiles of practices have been identified by considering each of the three areas separately: preparation of teaching, its implementation and the use of digital technology for teaching. One of the three profiles relating to the preparation of teaching can be associated with active learning methods insofar as it is characterised by a great effort to adapt content to students, taking account of their difficulties. We note that the adaptation work of teachers in this profile is based on teaching resources and on the epistemology or history of the subject, as might be expected, but also on their expertise in the field. This result contradicts a previous study which found that it was the teachers practising direct instruction who emphasised their expertise in the field (Postareff & Lindblom-Ylänne, 2008). According to our study, it is the teachers whose preparation is most closely related to active learning methods who most satisfy the Humboldtian ideal of coherence between teaching and research (Børte et al., 2023; Harland, 2016).

Regarding the way in which teaching is implemented, the results show that the practices of half the teachers relate more to direct instruction, while the practices of the other half relate more to active learning methods. The results also shed new and finer light on active learning practices by isolating two specific profiles: one characterised by

greater use of the flipped classroom, and another characterised by greater use of serious games. There are therefore different trends among teachers in the use of active learning methods.

One of the original features of our study is that it includes teaching practices linked to digital technology. The data obtained enable us to identify a profile of practices in which teachers use digital technology essentially to transmit content. This result confirms the conclusion of Lillejord and colleagues (2018) from a systematic review of the literature: although digital tools have the potential to support active pedagogies, they can be used without actualising this potential and adapting to the tradition of direct instruction. In addition, the profiles identified lead us to rule out a binary representation of teaching practices associated with digital technology, one that would oppose teachers using digital technology for direct instruction to teachers using it for active learning methods. In fact, it appears that the teachers who make the most use of digital technology to get students active are also those who use it the most to transmit content. This result highlights the multiple and non-exclusive uses of digital technology for teaching.

Furthermore, the results highlight personal characteristics of teachers that are predictive of the practice of active learning methods: female gender, teaching experience of between 4 and 6 years, temporary status and having undergone teacher training. The result concerning the influence of gender is in agreement with a previous study (Stes et al., 2014), but in disagreement with another study (Postareff et al., 2008) which showed no significant difference between genders. The latter study also showed no significant difference according to teaching experience, unlike our study. The various studies therefore do not robustly establish the role of these two factors. On the other hand, the observed role of teacher training corroborates the findings of a previous study (Postareff et al., 2008).

This study also shows that teaching practices depend on the faculty. However, the results do not lead us to distinguish, on the one hand, humanities faculties, which would be more associated with active learning methods and, on the other, science faculties, which would be more associated with direct instruction, as in two previous studies (Postareff et al., 2008; Stes et al., 2014). In order to understand the links observed between faculties and teaching practices, parameters other than disciplines should probably be taken into account, such as the number and diversity of students trained in each faculty, the facilities available and the resources allocated to teacher training and support.

Consonances and dissonances between teaching practices

The results of the study confirm those obtained by Postareff et al. (2008) and show that teachers whose practices are all systematically based on direct instruction are in the minority, representing less than 10% of teachers. According to what the teachers declare, a majority of them often or sometimes use active learning methods. These results qualify the very negative assessment by Børte and her colleagues (2023) that there has been no clear shift towards such pedagogies.

However, the results also show that half of the teachers have dissonant teaching practices. This proportion corresponds to that found in two previous studies (Postareff et al., 2008; Stes et al., 2014). Unlike these two studies, the present study includes digital uses. The results obtained show some consonance between digital uses and other aspects of teaching practices, but also some dissonance. Consequently, digital uses are not a simple reflection of teaching practices. They constitute a full aspect of these practices that deserves to be taken into account in the studies.

What are the reasons for the dissonances? They could be due in part to inadequate training in pedagogy. This is suggested by the relationship between training and active learning methods revealed in a previous study (Postareff et al., 2008) and confirmed in

the present study. It was found that teachers who relied on pedagogical training were over-represented in the groups consistent with active learning, not only in terms of teaching preparation, but also in terms of teaching implementation and the use of digital tools for teaching. Dissonances could also be linked to teachers' lack of reflexivity about their practices (Postareff et al., 2008), that is, they may not have taken the time to analyse how they teach and become aware of the potential discrepancies between the way they prepare their teaching, the way they implement it and/or the way they use digital tools to support their teaching. In some cases of dissonance, teachers may be in a transition phase from direct teaching to active learning methods (Postareff et al., 2008), in the sense that they have begun to integrate elements of active learning into part of their teaching, and in another part continue to do what they did before, possibly practicing direct instruction. Constraints linked to the teaching context, such as the variable number of students, is another possible explanation (Uiboleht et al., 2016). It is conceivable, for example, that a teacher seeking to implement active learning methods might fall back on direct instruction when faced with a very large number of students in one of their courses. Finally, some teachers may prioritise their research and lack the interest to systematically develop active learning methods (Postareff et al., 2008), because they feel that it requires too much effort and time.

Educational implications

The results of this study indicate that a very large proportion of teachers are engaged, to varying degrees, in a transition towards active learning methods. Among teachers who are in the process of making this transition, different trends can be observed, with teachers making more use of flipped classrooms or more use of serious games. As these approaches are not mutually exclusive, it may be possible to support teachers with pedagogical training to allow them to gradually expand their range of teaching methods.

The results suggest that preparation practices aimed at adapting content to students and their difficulties involve both a highly specialised mastery of the subject matter (i.e. that acquired through research), its epistemological analysis and the use of teaching resources. As a result, high quality teaching requires multiple skills, investment and possibly assistance. Although digital technology is not always used to support active teaching methods, the results also suggest that the implementation of digital tools in teaching is a possible subject for training and reflection on teaching practices. This study points to a number of ways in which teachers can be supported in their transition to active learning: by giving them more time and opportunities to reflect on their teaching practices, in particular on the alignment between the different aspects of their teaching; and by giving them more time and opportunities for pedagogical training to discover and experiment with a variety of new teaching methods.

Limitations and future directions of research

There are several limitations to the results obtained. The teaching practices described are those reported by teachers, and moreover by voluntary teachers, which may have an impact on the level of the means of the variables considered. Nonetheless, the biases associated with this procedure may have little impact on the differences observed between teachers, particularly in terms of profiles. Furthermore, the measures used in this study are based on original items created to fit the university context. To guarantee their validity, we carried out an AFE and checked McDonald's omega. In order to confirm the validity of the measures, further studies should be carried out in the context of other universities. In addition, the results obtained must be put into perspective because of the greater proportion of teachers from science and technology faculties in the sample. Finally, they relate only to teaching practices in the first year of a French university. The French university system is characterised by early specialisation in specific subjects from

the start of studies. Further research could be carried out in the higher years and in other countries.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Ethics statement

The study received formal approval of the Research Ethics Committee of the University of Montpellier (number UM 2023-035).

References

Bächtold, M. (2013). What do students "construct" according to constructivism in science education? *Research in Science Education, 43*(6), 2477–2496.

Barak, M. (2017). Cloud pedagogy: Utilizing web-based technologies for the promotion of social constructivist learning in science teacher preparation courses. *Journal of Science Education and Technology, 26*(5), 459–469.

Bonwell, C. & Eison, J. (1991). *Active learning: Creating excitement in the classroom*. ASHE-ERIC Higher Education Report No. 1, The George Washington University.

Børte, K., Nesje, K., & Lillejord, S. (2023). Barriers to student active learning in higher education. *Teaching in Higher Education, 28*(3), 597–615.

Coorey, J. (2016). Active learning methods and technology: Strategies for design education. *International Journal of Art & Design Education, 35*(3), 337–347.

Crouch, C., & Mazur, E. (2001). Peer instruction: Ten years of experience and results. *American Association of Physics Teachers, 69*(9), 970–977.

De Jong, T., Lazonder, A., Chinn, C., Fischer, F., Gobert, J., Hmelo-Silver, C., Koedinger, K., Krajcik, J., Kyza, E., Linn, M., Pedaste, M., Scheiter, K., & Zacharia,

Z. (2023). Let's talk evidence: The case for combining inquiry-based and direct instruction. *Educational Research Review, 39*, 100536.

Deslauriers, L., McCarty, L., Miller, K., Callaghan, K., & Kestin, G. (2019). Measuring actual learning versus feeling of learning in response to being actively engaged in the classroom. *Proceedings of the National Academy of Sciences (PNAS), 116*(39), 19251-19257

Danker, B. (2015). Using flipped classroom approach to explore deep learning in large classrooms. *IAFOR Journal of Education, 3*(1), 171–186.

De Clercq, M., Galand, B., & Frenay, M. (2017). Transition from high school to university: A person-centered approach to academic achievement. *European Journal of Psychology of Education*, *32*(1), 39–59.

European Commission (2014). *Report to the EU Commission on new modes of learning and teaching in higher education*. http://ec.europa.eu/dgs/education_culture/repository/education/library/reports/modernisation-universities_en.pdf

Fokkens-Bruinsma, M., Vermue, C., Deinum, J-F., & Rooij, E. (2021). First-year academic achievement: The role of academic self-efficacy, self-regulated learning and beyond classroom engagement. *Assessment and Evaluation in Higher Education*, *46*(7), 1115–1126.

Freeman, S., Eddy, S., McDonough, M., Smith, M., Okoroafor, N., Jordt, H., & Wenderoth, M. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences (PNAS)*, *111*(23), 8410–8415.

Harland, T. (2016). Teaching to enhance research. *Higher Education Research & Development*, *35*(3), 461–472.

Hartikainen, S., Rintala, H., Pylväs, L., & Nokelainen, P. (2019). The concept of active learning and the measurement of learning outcomes: A review of research in engineering higher education. *Education Sciences, 9*(4), 276.

Kozanitis, A., & Nenciovici, L. (2022). Effect of active learning versus traditional lecturing on the learning achievement of college students in humanities and social sciences: A meta-analysis. *Higher Education,* https://doi.org/10.1007/s10734-022-00977-8

Lillejord, S., Børte, K., Nesje, K., & Ruud, E. (2018). Learning and teaching with technology in higher education: A systematic review. *Online report:* www.kunnskapssenter.no.

Lima, R., Andersson, P., & Saalman, E. (2017). Active learning in engineering education: A (re)introduction. *European Journal of Engineering Education, 42*, 1–4.

Mayer, R. (2009). Constructivism as a theory of learning versus constructivism as a prescription for instruction. In S. Tobias and T. Duffy (Eds.), *Constructivist instruction: Success or failure?* (pp. 184–200). Routledge.

Postareff, L., Katajavouri, N., Lindblom-Ylänne, S., & Trigwell, K. (2008). Consonance and dissonance in descriptions of teaching of university teachers. *Studies in Higher Education, 33*(1), 49–61.

Postareff, L., & Lindblom-Ylänne, S. (2008). Variation in teachers' descriptions of teaching: Broadening the understanding of teaching in higher education." *Learning and Instruction, 18*(2), 109–120.

Savery, J. (2006). Overview of problem-based learning: Definitions and distinctions. *The Interdisciplinary Journal of Problem-Based Learning, 1*(1), 9–20.

Stes, A., & Van Petegem, P. (2014). Profiling approaches to teaching in higher education: A cluster-analytic study. *Studies in Higher Education, 39*(4), 644–658.

Uiboleht, K., Karm, M., & Postareff, L. (2016). How do university teachers combine different approaches to teaching in a specific course? A qualitative multicase study. *Teaching in Higher Education*, *21*(7), 854–869.

White, P., Larson, I., Styles, K., Yuriev, E., Evans, D., Rangachari, P., Short, J., Exintaris, B., Malone, D., Davie, B., Eise, N., Mc Namara, K., & Naidu, S. (2015). Adopting an active learning approach to teaching in a research-intensive higher education context transformed staff teaching attitudes and behaviours. *Higher Education Research & Development*, *35*(3), 619–633.