



Big Steps, Little Change: A Case Study in French University Teachers' Cognitions in the Context of Pedagogical Innovation

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The rate of failure of French students during their first years at university is substantial, with only 42% graduating in the expected three or 4 years. As a result, French universities have called for a “pedagogical transformation” encouraging innovative teaching practices to improve undergraduate students’ academic success, notably the introduction of blended learning methods. In 2015, teachers from the three marine stations of Sorbonne Université created the online blended learning platform *e-marin’lab* for their marine science programs. In this paper, we investigated the participating teachers’ cognitions with regard to teaching and learning. Despite the success of the project that relied on their substantial voluntary commitment, the teachers demonstrated an adhesion to more traditional views (i.e., directive teacher-student transmission of knowledge is more efficient for students’ learning). Perhaps more paradoxically, our data reveal that the same teachers saw themselves as teaching in a student-oriented way, and that their students’ lack of engagement in class was due to their poor study skills and intrinsic motivation. Among other factors that will be discussed, we believe that these results are influenced by a context that does not provide many teacher training opportunities and that places little importance on teaching in university professors’ career recognition. Finally, the importance of the *e-marin’lab* platform in the context of the SARS-CoV-2 pandemic situation from 2020 and the massive use of distance teaching in marine sciences during national lockdown periods is discussed.

Keywords: marine science courses, blended learning, flipped classroom, higher education pedagogy, teachers’ cognition, teaching practices, SARS-CoV-2 pandemic

INTRODUCTION

Like most degree programs in France, undergraduate marine sciences courses are challenged by the “massification” of the higher educational system. This “massification” of (increased access of high school graduates to) university studies in France beginning in the mid-1960s led to major changes in the organization of the field of higher education (Benhenda and Dufour, 2015). In recent years, a significant rate of failure has been observed in undergraduate students across all disciplines. In France, a student enrolled in a *licence* (Bachelor’s program) is expected to graduate in 3 years; however, in 2018, only 28% of students effectively graduated in 3 years, and 14% graduated in 4 years.

In contrast, almost a third (29%) stopped pursuing their degree before graduating (MESRI, 2019). The origin of this failure is multifactorial, and remains difficult to characterize and evaluate. However, among those factors, pedagogical practices appear to play a pivotal role in the students' academic success (Wells and Edwards, 2013). Moreover, in a French higher education context, Bertrand and Bonnafous (2014) make the following conclusions: “Based on the observation that our higher education system still too often uses models that are increasingly unsuited not only to new training issues, but also to the nature of the student population, it appears necessary to promote new forms of education, learning, and new ways of teaching. It is an educational transformation that must take place. It is one of the keys to the development of higher education, particularly with regard to the objectives of student success” (2014, p. 2, our translation).

In this perspective, one of the major challenges facing higher education institutions is to engage a profound transformation of their teaching and learning methods in order to better favor students' completion of their degrees. In French universities, teaching is often still based on a transmissive model: students remain passively seated before the instructor who delivers knowledge through lectures with limited in-class interactions (Land and Jonassen, 2012). This type of pedagogical approach does not allocate much in-class time to individual students' tutoring and mentoring needs, and after-school work is usually limited to the revision of class notes in preparation for exams.

When looking more specifically at undergraduate programs in experimental sciences, it is true that all programs organize sequences of practical sessions with smaller groups of students (Benson, 2001). In marine sciences, these practical sessions usually occur “in the field” in a marine station and are thus characteristically hands-on experiences for the students. However, these courses are usually still transmissive, as the students are expected to reproduce the teacher's demonstration, as well as directive, as the teacher guides students to the correct answer instead of presenting different possible solutions for students to debate. Additionally, the “massification” of higher education led many French universities to set up practical courses that have to be taught in a strictly identical manner when delivered to different sub-groups of students in the same degree program, disallowing teachers from modifying course content as well as their pedagogical approaches. Over time, some marine science programs have adopted project-based approaches to address global ecological or societal questions relative to ocean sciences (i.e., ocean acidification, overfishing issues, marine pathogens or global warming) which have been relatively successful (Hodder, 2009). However, these practices remain limited, and as a whole, the inflexible aspects of French university teaching limit students' motivation and engagement in their own learning as well as their academic success (Duguet and Morlaix, 2012).

The development of innovative teaching approaches in France is promoted in a top-down manner, either at a local level by the institutions themselves, at a national level by programs like the

French Ministry of Higher Education's *Initiatives d'Excellence*, or at the European level through various initiatives like Erasmus+ (e.g., in marine sciences, the project *DigitalMarine*). By these means, several groups of pioneer teachers have and continue to experiment with and share ideas for more active and student-centered practices in French universities (Berthiaume and Rege-Colet-Johnson, 2013; Poteaux, 2017). Among the pedagogical methods that are put into practice and are supported by these teachers, the establishment of flipped classrooms has received specific attention.

Flipped classroom pedagogy is defined as “a pedagogical approach in which direct instruction moves from the group learning space to the individual learning space, and the resulting group space is transformed into a dynamic, interactive learning environment where the educator guides students as they apply concepts and engage creatively in the subject matter” (Network, 2014). This pedagogy is practiced at all grade levels in many countries and has gained in popularity with the development of blended courses. The definition of blended learning pedagogy is highly variable and differs between authors, but a commonly-used definition is simply the combination of online and face-to-face instruction (Osguthorpe and Graham, 2003; Bryan and Volchenkova, 2016). This model of teaching gives students time to assimilate course knowledge at home and at their own pace via an online format, usually illustrated with carefully-designed and ergonomic media. In class, the teacher organizes time around students' activity and collaboration instead of centering it on directive/transmissive teaching, for example through interactions and discussions in small groups, or requiring students to work on personal or group projects in order to explore all the facets and limits of learning content through the online course (Gilboy et al., 2015). Through its involvement of students in the learning process and promoting student engagement, blending and flipping a classroom can be considered as active learning practices, the merits of which are largely established concerning learning outcomes and student retention in STEM fields (Prince, 2004; Haak et al., 2011; Chi and Wiley, 2014; Freeman et al., 2014; Lucke et al., 2017).

When considering which pedagogical approaches university teachers choose to use and why, an array of diverse factors comes into play. Borg stipulates that teachers are “active, thinking decision-makers who make instructional choices by drawing on complex, practically-oriented, personalized, and context-sensitive networks of knowledge, thoughts, and beliefs” (Borg, 2003). This phenomenon, to which he refers as *teacher cognition*, is detailed in a complex, dynamic framework showing how these different thoughts, knowledge, and beliefs—about teaching, learning, students, teachers, and the subject matter to name a few – are in constant interaction and evolution (**Supplementary Figure S1**). This framework also suggests that elements such as contextual factors, professional training, teaching experience, and learning experience are key influences in teachers' cognition. Anchored in the mainstream educational literature of the time, and including a set of factors that are common to all teachers, this holistic model is thus applicable to any teaching context.

The dynamic aspect of this framework means that not only are teachers' chosen pedagogical practices directly affected by their beliefs (Woods, 1996; Kalaja and Barcelos, 2003; Song and Looi, 2012), but these practices can in turn shape teachers' beliefs over time (Borg, 2009; Borg and Al-Busaidi, 2012). In recent years, a growing body of research has explored university teacher beliefs with regard to teaching and learning, and in particular with regard to using technology in their teaching (Song and Looi, 2012; Kim et al., 2013; Scott, 2016; Jääskelä et al., 2017; Poteaux, 2017; Trémion, 2019; Guillén-Gámez and Mayorga-Fernández, 2020), progressively uncovering complex cognitions that appear firmly anchored to personal experiences and professional context as well as beliefs and attitudes. Furthermore, when it comes to choosing to implementing active learning practices in the classroom, recent studies have shown that certain obstacles and opportunities can come into play. Teachers' fears of negative student response to such practices are a major barrier to implementation, even though this perceived resistance is in fact overestimated and students report enjoying active learning practices (Andrews et al., 2020). Furthermore, the perceived supports –such as access to teaching resources and encouragement from colleagues– actually has a stronger relationship to instructors' implementation of active learning practices than the perceived barriers–such as student resistance or a lack of time (Bathgate et al., 2019). Current and ongoing research continues to investigate strategies for implementing active learning practices, suggestions for maximizing effectiveness, and the effect of faculty training workshops on these classroom practices (Prince et al., 2020; Carroll et al., 2021).

Outside of the specific context of classroom practices, another key aspect to consider in these cognitions is teachers' professional identity. Van Lankveld et al. (2017) notes that unlike primary and high school teachers, in higher education teachers are obligated to balance their role as teachers with their role as a researcher and/or practitioner. While interactions with students, other teachers, and participation in faculty training programs can contribute to this identity, the broader higher education context can limit it if teaching is not valued or even viewed as a second-class activity (van Lankveld et al., 2017).

In France, studies indicate that a university environment that values research over teaching, a culture of “pedagogical solitude” (meaning a lack of discussion and collaboration) among university teachers, and a national context that provides little to no teacher training for them are substantial obstacles to transforming teaching practices in higher education (Duguet and Morlaix, 2012; Poteaux, 2013; Bertrand and Bonnafous, 2014; Étienne, 2014; Frouillou et al., 2017). Furthermore, while there is substantial literature on teachers' beliefs and pedagogical choices at different educational levels and in various disciplines (Hua, 2009; Markic and Eilks, 2012; Song and Looi, 2012; Díaz Larenas et al., 2013; Kim et al., 2013; Nishimuro and Borg, 2013; Scott, 2016; Jääskelä et al., 2017; Ramnarain and Hlatswayo, 2018; Lee, 2019; Ferguson, 2020), in France there are significantly fewer studies that focus on university teachers' cognition and educational practices (Bécharde, 2001). More recently, studies have emerged that examine university teachers' beliefs and knowledge regarding technology (Poteaux, 2017) and using

technology to flip the classroom (Trémion, 2019). However, in general, questions about French university teaching and university teachers' thoughts, beliefs, and knowledge regarding teaching and learning remain largely unanswered.

While being centrally located in Paris, Sorbonne Université is internationally recognized as a leading institution in marine sciences education and research. Its strength in this domain is mainly due to its three marine stations located in Banyuls-sur-Mer, Villefranche-sur-Mer (both along the Mediterranean Sea), and Roscoff (along Brittany's Atlantic coast). These stations are small campuses where a variety of marine science research projects are carried out, as well as where approximately 3,500 visiting undergraduate or graduate students learn, study, and practice marine sciences each year. Despite the fact that marine science courses are characterized by hands-on experimentation and observation, they are still usually taught in a traditional manner, and their pedagogy does not differ much from the transmissive/directive pedagogical model described above. For example, a course might be organized in the following way: in the field, teachers present the diversity of marine or coastal species; back in the lab, students have to describe and learn the specificities of each species as described in textbooks or in the teacher's lectures. These courses are of great interest to students, especially as mixing field and lab studies solicits more activity and mental engagement on the students' behalf. Nevertheless, the means of teaching and learning ultimately remain more teacher-centered than student-centered.

To encourage the development of active learning pedagogies in marine stations, the authors of this paper created a project named *e-marin'lab* with the intention of setting up an online educational platform to encourage blended learning approaches and the use of flipped classrooms at Sorbonne Université. The project's objective was to respond to the university's need for (and a growing interest in) new approaches to teaching and learning. Aware of the difficulty of establishing innovative pedagogical projects (Van Driel et al., 2001), the principal investigators (two teachers in marine sciences at Sorbonne Université) gathered a team of teachers interested in experimenting with these active teaching approaches. After 3 years of running the project, and to contribute to evaluating these educational approaches in marine sciences, we sought to learn more about the participants' teacher cognitions following their experience with alternative pedagogies. Within this context, our research questions were the following: did the teachers' voluntary involvement with *e-marin'lab* have any bearing on, or was conditioned by, how they see teaching, learning, and the roles of teachers and students in these processes? Could these types of pedagogical projects be the key to developing teaching practices and beliefs on an institutional level? Through our investigation, we hoped to gain a greater understanding into how these marine science teachers engaging in blended learning approaches in a French university context perceive the teaching and learning process in their classes, and if their thoughts, beliefs, and knowledge align more with flipped/blended or transmissive/directive pedagogical models.

MATERIALS AND METHODS

Project Context

Raphaël Lami, Associate Professor in Marine Microbiology, and Yves Desdevises, Professor in Marine Parasitology and Evolution of Marine Organisms, both employed by Sorbonne Université, conceived and led the *e-marin'lab* project. *E-marin'lab* was funded from 2015 to 2017 by the university to support the development of blended learning in marine sciences. The primary goals of this project were to transform on-site courses with a blended approach to favor students' motivation and engagement in classrooms, as well as to support the development of active learning practices at the university. *E-marin'lab* was particularly important in the university marine station context as most students come from the main campus in Paris and sometimes from other universities for short periods of 1–6 weeks at a time. Thus, learning the basic concepts of their marine biology courses at home before traveling to a marine station would help students' learning efficiency and increase their activity in class, as less time would be dedicated to lectures.

A total of 12 university teachers participated in the *e-marin'lab* project on an entirely voluntary basis. In order to create the online learning materials for the blended courses, two educational engineers and a web designer were recruited to accompany the teachers in their courses' transformation. The team collaborated with teachers to redefine learning outcomes, choose appropriate media formats, create video and animation storyboards, and generally apply pedagogical alignment principles to the courses, in addition to providing assistance (technical support, personalized advice) to both teachers and students after the courses were created. They also elaborated and distributed satisfaction questionnaires to students.

The final result of the project was an online platform with thematic modules corresponding to different courses or topics, each containing a series of lecture videos that are still active and used in coursework at Sorbonne Université today. Considering the project's success (over 30 courses flipped, national "PEPS" teaching prize awarded to the *e-marin'lab* team in 2017, online learning material used in multiple other courses) that was mainly based on the unfailing commitment of a few dedicated teachers we wanted to evaluate whether their teacher cognition was oriented more toward newer flipped/blended pedagogies or traditional transmissive/directive ones. We hypothesized that the educators involved in *e-marin'lab* would have beliefs and attitudes more favorable to newer pedagogies than traditional ones, based on their participation in the project.

Research Methodology

For this case study, we conducted a total of 12 semi-structured interviews with nearly all the participating teachers in order to gain an understanding into their teacher cognition post-*e-marin'lab*. All steps of our methodology were established and supervised by an international specialist in Education Sciences research (Dr. Nicole Rege-Colet, see acknowledgments section) (Berthiaume and Rege-Colet, 2013). The methodology of our semi-structured interviews followed

previously published described and described ones (Drever, 1995; Longhurst, 2003). A total of 17 questions (**Supplementary Table S1**) were elaborated by the investigators with the objective of learning about the teachers' attitudes, thoughts, beliefs, and knowledge about learning, teaching, and pedagogies of higher education. During the interviews, which lasted around 45 min and were conducted entirely in French, the questions were asked in the same order to all the teachers, and their responses were audio-recorded, and subsequently transcribed for analysis. All teachers involved had permanent positions at Sorbonne Université, with a total of 10 working in one of the university marine stations (Roscoff, Banyuls-sur-Mer, Villefranche-sur-Mer), and two working on the main campus in Paris. Among the interviewed teachers, nine as men, and three as women, all with at least a minimum of 5 years of teaching experience at the university.

Interview transcripts were then examined through previous published methodologies (De Hosson et al., 2014; Schmidt, 2004) and their analysis relied on the tools based on the principles of grounded theory. The transcripts were thus inductively coded separately by three authors of this paper ("triple-coded"), using a grid specifically designed for the project (**Supplementary Table S2**). Teachers' beliefs, thoughts, and knowledge about teaching related to nine major categories were investigated within and across the interviews. It is noteworthy that in this methodology, teachers' responses to the different questions were not "divided" or "classified" according to the topics or items, allowing the investigators to have a more nuanced view of the complexity of the teachers' cognitions. For example, teachers can affirm in the same interview (or even the same response) that they play a very transmissive role while trying to adopt a posture of accompaniment with their students. These categories are presented in the results section of this article. Lastly, while we recognize the limited scope of a study based on what teachers say (reported practices, for example) and not what they do (observed practices) (Kane et al., 2002), our primary objective was to understand what teachers think and believe about teaching and learning.

RESULTS

Our analyses of teachers' responses yielded interesting results that will be presented in the following thematic categories: the role of teachers and teaching objectives, teacher's beliefs about and approaches to teaching, and the role of students in their own learning and students' learning strategies.

Roles of Teachers and Teaching Objectives

Our analysis first looked at how the interviewees perceived their roles as teachers and the objectives of teaching. When discussing teachers' roles, responses classified in the categories "transmitter of knowledge" and "mentor/advisor" appeared frequently, illustrated by the following extracts (our translations):

Teacher 01—"My role is to transmit knowledge";

Teacher 03—"I consider that (...) it is up to me to transmit this knowledge to them";

Teacher 04—“My role as a teacher is first and foremost to transmit knowledge”;

Responses classified in the categories “facilitator”, “didactic teacher”, and “facilitator of activity/interactivity” were less frequently mentioned. We observed that overall, the teachers attributed more importance to transmitting knowledge than facilitating students’ learning in the interviews, with very few references made to facilitating classroom activity and interaction. These responses indicate that the teachers’ cognitions remain anchored in a more classic, directive model that does not lend itself to allowing students a greater role in their own learning.

When explaining what they believe the objectives of teaching are, the majority of teachers’ responses were categorized as “transmit knowledge”, with a few categorized as “develop critical thinking”, and “favor employability”, and references to objectives classified as “maintain open-mindedness”, “aid in students’ professional orientation”, and “educate future citizens” appeared rarely. While teachers saw themselves as directive transmitters of knowledge, they also positioned themselves as being in a guiding role and a source of support for students, particularly with regard to their professional orientation and the question of student employability. Nevertheless, despite these contradictions, it appears from this analysis that traditional pedagogical approaches are evoked more frequently than non-traditional ones, and knowledge transmission is prioritized above all other teaching responsibilities.

In spite of this preoccupation with knowledge transmission, in the same interviews we sometimes noted contradictory beliefs expressed:

Teacher 04—“I think that like many teachers, we put a funnel in the student’s mouth or ears, and then we open the tap. It’s a bit of a way of operating that is recurrent at universities in France. It’s a concern”;

Teacher 01—“There is a virtual wall between the teacher and the student, and the teacher has too big a role. This is something that should be changed.”

In these extracts, we can observe a recognition of the predominance of the teacher in the learning process, of the lack of space made for student activity and implication in the acquisition of knowledge in the class. This indicates that while the teachers adhere to a classic model of teaching and learning, they feel that it isn’t right and should change. This begs the question of what, according to them, is preventing this change and allowing students a greater role in their learning, especially since they have used their own agency to participate in an alternative pedagogical model.

Teachers’ Beliefs About and Approaches to Teaching

We then looked at how the teachers perceive their own teaching in the classroom. When asked about how they themselves approach teaching, responses were more often categorized as a “directive approach” than a “non-directive approach”:

Teacher 10—“The teacher has to lead the group and instill something, it’s up to the teacher to impart knowledge.”

Teacher 11—“Acquiring knowledge, that’s what we do now on the other hand, we help (the student) rather little to develop their skills, whether oral or practical, the content taught at the university remains very theoretical.”

Paradoxically, when asked about how teaching should be oriented, many responses were categorized as “student-and skills-centered” with fewer categorized as “teacher-and knowledge-centered”. While these teachers have realized the importance of developing student-centered teaching methods, they described their teaching practices as very directive, again showing conflicting cognitions about the role of teachers and students.

The Role of Students in Their Learning and Students’ Learning Strategies

Teachers were also asked about what they consider to be students’ role in their own learning and the strategies they adopt. Their responses were coded in the following categories: “passively receiving knowledge”, “engaging in learning”, “being mature and displaying agency in their learning”, “answering questions”, and “reflexively engaging in learning”. A majority of the teachers’ responses were classed in the first category, with very few in the last category. The question of why students have developed inefficient and passive ways of learning was linked to students’ lack of “tools” to learn (Teacher 05—“*They don’t know how to take notes anymore, that much is clear, it’s catastrophic*”), as well as to their intrinsic motivation, by many teachers. The teachers noted that students have strong intuitions and beliefs that these learning strategies are not efficient, but they ultimately lack the methodological tools and skills to improve them.

They stressed the importance of using multimedia resources, which they perceived as more attractive to the current generation of students and which would motivate them to learn. They also stressed that intrinsic motivation is the most important element for students to remain committed to learning in their courses:

Teacher 07—“Nothing is done without will and passion”;

Teacher 08—“I would say that learning requires motivation and if the thing has not been presented with a potential utility and they don’t really see the connection, what can they do with it, the interest disappears and therefore learning is impossible”.

In this second extract, we can see the connection made between perceived utility of learned content and student motivation. Whether the perceived role of teachers as transmitters of knowledge includes a responsibility, or not, to show or explain the utility of the content in order to motivate the students, was not investigated in these interviews but would merit further investigation.

We also analyzed teachers’ responses concerning how students learn. Their responses were categorized as “in-depth learning” (meaning regularly revisiting material learned during class, retaining knowledge), “surface learning” (meaning “cramming” for exams, retaining little knowledge over time), and “passive learning” (for example, sitting in lectures without

active note-taking). Teachers lamented their students' very passive attitude toward learning, complaining that the students no longer take notes, and generally do not exercise their agency as active learners:

Teacher 11—"If a student doesn't take notes, I'll point out that they don't take notes because for me it's inconceivable, but if they tell me that they listen better like that and that they'll work on it afterwards, I trust them"; Teacher 04—"It is necessary (...) that the students are not only passive".

In general, teachers recognized that their students often approach learning in ways that are not very effective. Altogether, these results showed that teachers held strong beliefs about how their students learn and should be learning in order to succeed in their studies. It is interesting to note that there did not seem to be an explicit connection made in the interview responses between how students learn and how courses are taught; the students clearly lack methodological tools, motivation, and the ability to learn more efficiently, but this is an inherent issue with students and not directly due to transmissive and directive pedagogical approaches.

DISCUSSION

E-marin'lab is an innovative pedagogical project destined to set up blended classroom pedagogies in marine science programs at Sorbonne Université. The purpose of our study was to investigate the teachers' cognition as a reflexive component of the project, an exercise made all the more interesting by the fact that university professors are not necessarily asked or required to do such reflexive activities with regard to their teaching. Creating *e-marin'lab* required an enormous investment on the behalf of the volunteer teachers who participated, giving substantial amounts of their time and effort to conceive and create the online learning content, even while they were accompanied by educational engineers. The principal investigators thus expected to see cognitions in their interviews that did not align with the usual directive transmissive model usually present in French higher education.

The analysis of the interviews did not support our hypothesis that teachers involved in the *e-marin'lab* project would have cognitions favorable to blended/flipped pedagogies, and provided a very different picture of teachers' cognition. The most notable finding of our study was the observation of a recurrent and contradictory discourse that would occasionally align itself with student-centered and active pedagogies, but was ultimately dominated by an adherence to a traditional directive/transmissive model. Indeed, a vast majority of the interviewed teachers see their main role as a teacher to be a directive transmitter of knowledge, which they consider to be their primary responsibility. At the same time, they believe their teaching approaches to be student-centered, and that their students' passivity and lack of study skills are due to a lack of motivation on their behalf and constitute a substantial obstacle to

developing their intrinsic motivation and in-depth learning. Few studies have looked at teachers' cognition about teaching and learning in French higher education, with virtually none in marine sciences, making comparison with other studies difficult. However, if we consider studies that analyze teachers' representations of teaching and learning, there is ample evidence that these kinds of contradictory postures, beliefs, attitudes are common (Cornet, 2015; Warren, 2015; Reynolds, 2018; Cong-Lem, 2019).

The theoretical framework of teachers' cognition proposed by Borg (2003) offers an interesting perspective to interpret these cognitions. As previously mentioned, this framework considers 1) teachers' own experience as students, 2) their professional coursework or teacher training, 3) the contextual factors in which they teach, and 4) their classroom practices and experience. We believe that in our case study, teacher training (or the lack thereof) and contextual factors are key components to explain these observed paradoxical cognitions. In French universities, teacher training has only been mandatory since 2017 and applies uniquely to newly-recruited teachers. This training remains limited to 32 h the first year after teachers' recruitment, followed by 32 h over the course of the following 5 years (French legislation, Décret n° 2017-854—9 mai 2017; Arrêté du 8 février 2018). Considering our observations, this policy seems minimal and notably ignores already-employed teachers, their participation in any kind of professional development for teaching being therefore purely voluntary and/or based on the availability of opportunities to do so. Without a means to directly influence teachers' cognitions through training, for some, their beliefs about teaching and learning may never evolve, which constitutes a serious obstacle to improving their pedagogy (Aylwin, 1997; Stenberg, 2011). There is also reason to doubt that teachers' positioning and beliefs on pedagogy are not reflected in their reported classroom practices, representing a lack of alignment between what they believe they do and what they actually do (Kane et al., 2002). Professional development opportunities for teachers appear central to better aligning such practices and beliefs (Simmons et al., 1999; Supovitz and Turner, 2000; Kang and Wallace, 2005), and such a connection has shown to directly impact students' way of learning and engagement with their learning (Roth and Weinstock, 2013), as well as web-based learning strategies (Tsai et al., 2011). When considering what these opportunities could look like, existing professional development programs provide ample inspiration. A program based on the "neuroscience of learning" (Schwartz et al., 2019) could be an interesting solution for university professors who highly value scientific research. Another example of a multi-year faculty development program for STEM university teachers concluded that these programs should include modeling a variety of pedagogies, adopting realistic expectations for faculty change, institutionalizing development to make it sustainable, being transparent about known barriers and aligning existing supports to them, and helping faculty develop strategies for transparency with students about these pedagogies (Borda et al., 2020). Yet another solution that could account for both new and experienced professors is the

development of communities of practice (Wenger, 1998) to confront the existing culture of pedagogical solitude. In any case, these opportunities must be conceived in a way that not only appeals to the teachers but is also accorded value by their institutions (Dennin et al., 2017).

When considering contextual factors affecting teachers' cognitions in French universities, the role of the administration has also been identified to explain inconsistencies between teachers' practices and beliefs in some previously published studies (Mansour, 2009, 2013). The evaluation of teachers in French universities, as well as their career progression, is mostly linked to the quality of their scientific research, while their investment in teaching remains secondary (Bertrand and Bonnafous, 2014). It is true that at Sorbonne Université (the employer of the interviewed teachers) as well as in some other French universities, the involvement in innovative teaching is now more considered in career progression and the attribution of financial bonuses. Nevertheless, the weight of these activities in the teacher's career as a whole still remains limited, and as a consequence, from a purely career development point of view, once their mandatory teaching service is accomplished, it is more advantageous to be involved in research activities rather than developing new skills, share thoughts and engage a reflexive approach about teaching practices. Thus, limiting in-class interactions with students and promoting purely transmissive teaching allows them to spend less time working on teaching and more time working on activities that will be consequential for them professionally.

This lack of training, time, and incentives to improve higher education pedagogy is not unique to the French context; a few authors (Brownell and Tanner, 2012) have discussed identical issues in Life Sciences university teaching in the United States, indicating that our results may not be a unique or singular occurrence. While the two contexts are quite different, studies from both countries have called for increased teacher training opportunities to confront new challenges or long-existing ones, as well as changes to institutional policies to allow for the creation of an environment that values and promotes improvement in undergraduate teaching (Bertrand and Bonnafous, 2014; Dennin et al., 2017; van Lankveld et al., 2017). In some American universities, implementing curricular changes from the *Vision and Change* report has led to tangible results and improvements (Auerbach and Schussler, 2017a, 2017b; Wienhold and Branchaw, 2018). Another possible axis for improvement is for marine science faculty to organize change themselves, as academic departments have been proven highly effective units of instituting change in higher education (Fisher and Henderson, 2018).

The development of the *e-marin'lab* platform started in 2015, years before the SARS-CoV-2 pandemic. In many countries, the pandemic led many universities to shift to entirely online learning, at least during the different lockdowns. In France, Sorbonne Université courses were taught almost entirely online during the three lockdown periods, even if a few practicals were taught on-site in between the most critical situations. On one hand, the *e-marin'lab* platform was greatly helpful during the

lockdowns, and the previous experiences of teachers involved in the project with on-line tools was very useful. On the other hand, many colleagues now avoid any kind of online teaching because of its (forced and rushed) over-use during the pandemic, which generated caricatural discussions about online teaching. Blended-learning approaches are not designed to replace on-site teaching, but unfortunately such beliefs conflating blended learning with online teaching have remained firmly stuck in the teaching community. This shows us that, despite the crash course in adapting to different modalities of teaching that was collectively experienced, professional development including training on the use of modern pedagogies is still essential in the post-pandemic period.

Having an insight into what teachers believe about teaching and learning is an important first step to developing and improving teacher training opportunities and educational policy more generally (Fives and Gill, 2014). Our results reinforce the importance of developing an educational policy in France that strongly supports not only initial training for teachers recruited at the university level, but also increased professional development opportunities for experienced teachers, since teaching approaches are constantly evolving with social practices and the sharing of new SoTL research (Felten, 2013). The number of pedagogical support centers and instructional designers to accompany teachers in French universities has grown exponentially since the SARS-Cov-2 crisis (Peraya, 2021), and we believe that their continued investment is essential and should be broadly reinforced to institute lasting, coherent change - a true "pedagogical transformation". French universities should also modify their criteria of teachers' evaluation and career progression if they want them to take time to better accompany their students, to improve their pedagogical skills, and to share new teaching practices. Lastly, pedagogical change in higher education will require a team effort, not only by teaching departments to develop their own plans of action and group visions of desired change, but as well as university administrators to put professional development on equal footing with research activities.

FINAL REMARKS

This paper investigated teacher cognitions about teaching, learning, and the roles of teachers and students in the context of a project to implement flipped classroom practices at a French university. Our investigation found that the observed cognitions adhered more to a classic directive and transmissive vision of teaching and learning, meaning the teachers' voluntary involvement with an innovative pedagogical project was not necessarily linked to beliefs favoring student-centered approaches. These findings also highlight the importance of and need for institutional support and accompaniment in transforming higher education pedagogy in France, as individual initiatives alone are not enough to affect deeply-rooted beliefs about teaching and learning.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

RL, SG conducted the research, RL, SG, HF, and YD analyzed the data and wrote the manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/feduc.2021.765771/full#supplementary-material>

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