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TEACHING SSI: IMPLICATIONS WITH RESPECT TO TEACHERS' PROFESSIONAL IDENTITY

NATHALIE PANISSAL AND NICOLAS HERVÉ

Abstract: Socioscientific issues (SSI) are complex, controversial, uncertain and value-laden issues, encompassing interdisciplinary knowledge for which there is no consensus in the scientific realm of producers of knowledge, and their teaching requires a change in the educational paradigm. Teachers of scientific disciplines are destabilized, as the didactic formats of the SSI field differ from the pedagogical formats of their own disciplinary culture. These different teaching contexts are thus likely to put the teachers' professional identity under stress by subjecting them to new professional dilemmas both in their relationship to the profession and in their relationship to themselves. We analyze how experienced and novice teachers negotiate these difficulties and show how experienced teachers reconcile the different strata of their professional identity (disciplinary and SSI). In particular, they assume their values as a driving force behind their commitment to teaching SSI and they have gradually changed their work context to reduce the risk of teaching. We suggest that the professional development for future teachers should be based on pedagogical guides to make them feel safe in the classroom, it should also include training in ethics to deal with professional dilemmas, as well as interdisciplinary and team work to bring together disciplinary professional identities.

Keywords: professional identity, SSI, novice teachers, experienced teachers.

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5.1 Introduction

Socioscientific issues (SSI) are complex, controversial issues, fraught with uncertainty and values, and involve interdisciplinary knowledge for which there is no consensus in the scientific realm of producers of knowledge. Such issues are debated in society and in the media, and potentially in the classroom when they are taught and can become heated depending on current events (Legardez, 2017). Examples of SSI that are particularly relevant in the French agricultural high schools where we intervene are veganism, the banning of glyphosate in agriculture, or the reappearance of the wolf in the Alps. Encouraging the study of these issues in class is an important aim for science education, as it involves forming critical and emancipated eco-citizens by developing their scientific, humanist and political culture through education.

This perspective requires a shift in educational paradigm, which in part breaks with a strictly disciplinary management of the classroom and of knowledge (Zeidler, 2014). In this context, it is necessary to open up spaces, inside and outside the classroom, to come up with situations that allow learners to construct interdisciplinary, uncertain and complex knowledge, and to foster their empowerment. This challenge necessarily impacts on teachers' professional identity (Zeidler, 2014). This chapter aims to understand how this is affected by the implementation of SSI teaching.

5.2 Teaching SSI: a paradigm shift from traditional teaching practices

Recent works testify to the interest of taking an inquiry approach with students when discussing SSI (Amos & Levinson, 2019; Bencze, 2017; Simonneaux *et al.*, 2017) by mobilizing different pedagogical devices and strategies (Bencze *et al.*, 2020): controversy mapping, debates, stakeholder meetings, public actions, futures scenarios, ethical dilemmas, etc. The promotion of inquiry as the preferred form of schooling consists of enhancing learners' understanding of the complex links between nature of science, scientific and social knowledge, expertise, ethical questioning, and discourses and practices of stakeholders involved in a controversy. It seeks to develop high-level cognitive skills such as critical, ethical or political thinking and is an instrument of empowerment and citizen engagement.

However, although teachers agree with the inclusion of controversial issues in science teaching, few put it into practice (Ekborg *et al.*, 2013; Sadler *et al.*, 2006;

Sund, 2016). Teaching SSI is indeed considered risky and difficult (Bernard & Albert, 2018; Panissal *et al.*, 2016), as goes beyond traditional teaching practices. They feel uncomfortable with this teaching (Sadler *et al.*, 2006) and declare a lack of pedagogical resources (Bryce & Gray, 2004; Sadler *et al.*, 2006; Saunders & Rennie, 2013), and of time with regard to more traditional contents to be taught (Bossér *et al.*, 2015; Cross & Price, 1996; Ekborg *et al.*, 2013).

Several factors help to explain the reluctance of teachers to further engage in this teaching. Firstly, traditional teacher-centered pedagogical methods are unsuitable for teaching SSI (Bernard & Albert, 2018; Zeidler, 2014). Indeed, inquiry articulated with specific approaches relies on student-centered teaching strategies that allow students to express their views and opinions. The responsibility given to students in the construction of knowledge and problems is not a familiar practice for teachers (Bossér *et al.*, 2015; Pedretti *et al.*, 2008; Saunders & Rennie, 2013) and students (Zeidler *et al.*, 2011), which may lead teachers to doubt their ability to manage such situations. Moreover, the knowledge at stake when teaching SSI is different from the scientific knowledge of traditional teaching: it is to some extent uncertain, interdisciplinary, controversial in certain respects, and imbued with values, which distances the teacher from his or her expertise in the disciplinary knowledge to be taught (Panissal & Vieu, 2018; Pedretti *et al.*, 2008). Teaching SSI also has a transformative aim, which engages teachers and students beyond a pedagogical relationship of the transmission of knowledge. The challenge is to promote, through scientific education, a critical citizenship aimed at social eco-justice (Bencze *et al.*, 2020). This commitment beyond mere transmission can be uncomfortable for teachers who question the stance to be adopted, both in expressing their own point of view (the "disclosure dilemma" according to Journell, 2011), and the limit they place between neutrality, impartiality and indoctrination. Pedretti *et al.* (2008) also showed in the context of STSE teaching that a non-traditional teaching model could isolate novice teachers from a professional community, because they did not share certain professional standards. Thus, in discussing ways to resolve these different tensions, Pedretti *et al.* (2008) emphasized the importance of cultivating a "science teacher" identity in teacher training that is able to integrate new teaching norms and practices.

In this chapter we want to explore the question of teachers' professional identity in the face of the educational paradigm shift required by teaching SSI.

5.3 Teachers' professional identity: a psychosocial approach

Professional identity is seen as a conceptual framework for understanding teachers' professional development beyond their mastery of professional knowledge or skills. It simultaneously illuminates the role played by the social contexts of practice and the biographical or social characteristics of teachers (Avraamidou, 2014, 2016). The formation of professional identity "is a process of practical knowledge-building

characterized by an ongoing integration of what is individually and collectively seen as relevant to teaching" (Beijaard *et al.*, 2004, p. 123). It is about how teachers integrate influences, and negotiate with various tensions and contradictions that emerge from their practices (Beauchamp & Thomas, 2009). Professional identity is considered important because it is often associated in research with teachers' agency. It encompasses their representation of their profession, their motivation to practice it, the ideal images they form of the management of work situations and their assessment of what they have to change or stabilize in their practices, all of which are levers that enable them to transform the way in which they practice the profession (Beauchamp & Thomas, 2009; Beijaard *et al.*, 2004; Schutz *et al.*, 2018). This is why more and more teacher training curricula include modules supporting the construction of teachers' professional identity (Schutz *et al.*, 2018).

There are various ways of defining professional identity, but there is a consensus that it is a dynamic process of self-construction that is constantly evolving from the beginning to the end of a career (Avraamidou, 2016; Beauchamp & Thomas, 2009; Beijaard *et al.*, 2004). It is formed and developed through the unique experiences of teachers have in their professional context, which is why moments of tension or the exposure of contradictions are important (Schutz *et al.*, 2018). These critical events testify to the subject's work on identity, which is carried out through mechanisms of doubt, exploration or experimentation with a view to finding consonance. These tensions or conflicts can be explained by the diversity of interrelated sub-identities, which reinforce or oppose each other depending on the context, and which constitute professional identity (Avraamidou, 2016; Beauchamp & Thomas, 2009; Beijaard *et al.*, 2004). Professional identity is therefore not a property attached to a person: it is above all a process reflecting the complexity of the relationships that a teacher builds over time with his or her professional environment.

The psychosocial model developed by Gohier *et al.* (2001) makes a distinction between several dimensions in these relationships, which are called "relationships with":

The relationship with oneself concerns self-reflection, the affirmation of one's uniqueness, and the qualities of introspection and distancing oneself.

Relationships with the profession, which are broken down into:

- *Relationship with responsibilities*: these are ethical or deontological rules, the concern for the quality of work, the responsibility towards the pupils, the parents and society.
- *Relationship with social institutions*: refers to the mandate that the teacher has from society to form citizens in accordance with its aims, and it also constitutes his or her possibility to redefine this mandate in return.
- *Relationship with learners*: this is the pedagogical relationship in its intellectual and affective dimensions, the educational or learning aims for the student, the teaching models.
- *Relationship with work*: this is a teacher's disciplinary, didactic and pedagogical knowledge of the learning process.

- *Relationship with colleagues* refers to the teamwork, belonging to the group, participation in the life of the institution, social or trade union involvement.

This model will later serve as a theoretical framework for constructing indices of professional identity in relation to SSI teaching.

5.4 What are the differences and similarities in the professional identity of novice and experienced teachers of SSI?

Most research addresses teachers' professional identity in a general way, without making it specific to the content they teach (Schutz *et al.*, 2018). However, since the knowledge to be taught involves subject-specific knowledge and methods, it is also necessary to understand how professional identity is formed in relation to a particular area of knowledge.

We have seen that the teaching of SSI is partly at odds with traditional forms of science teaching, and therefore constitutes a set of contexts likely to put teachers' professional identities under stress, and to pose professional dilemmas for them. How do teachers resolve these contradictions and reconcile the different dimensions or sub-identities that constitute their professional identity?

It is these mechanisms that we wish to identify, to better understand how teaching practice can integrate the educational management of SSI.

In this chapter, we choose to compare the professional identity of novice and experienced SSI teachers to identify the structuring and stabilizing elements.

The professional identity of novice teachers is constructed through conflicts and tensions in the organization of work spaces and temporalities, in the expression of different representations of the profession (e.g. between what they experience at their placement and in the training school), in the articulation of what they are, what they would like to be and what different institutional stakeholders expect of them (Beijaard *et al.*, 2004; Izadinia, 2013; Pillen *et al.*, 2013). It is possible to hypothesize that the professional identity of experienced teachers is based on their ability to find answers to dilemmas and contradictions and to stabilize a professional identity that allows them to articulate what is traditional disciplinary teaching and what is SSI teaching.

The aim of this work is therefore to identify the tensions, and the strategies for circumventing or engaging with SSI teaching in the professional identity of teachers who are at different stages of professional development, questioning and under construction for novice teachers, stabilized for experienced SSI teachers.

5.5 Methodology

Two research approaches allow us to document the link between professional identity and the teaching of SSI:

- A focus group of 12 volunteer teachers from several disciplines undergoing initial training in agricultural education. During their year of training, these teachers experimented with the teaching of SSI related to agroecology, and at the end of this experiment, they were invited to participate in a focus group. The focus group interview guide covers their motivation in choosing an SSI, the interests and difficulties they may have found in teaching, how it was received by the pupils and colleagues, and an explanation and justification of the approaches used.
- Three individual partially directed interviews with three experienced volunteer teachers (more than 25 years of practice). The aim is to deepen the results highlighted in the focus group. Aline is a computer science teacher in an IUT (University Institute of Technology) and trains computer scientists and programmers (students aged 18-20). Florent is a French teacher in secondary school (students aged 12-15) and Léon is an agronomy teacher in a BTS (Brevet de Technicien Supérieur) in an agricultural high school (students aged 18-20) and trains future farmers. All three teachers have been involved in collaborative research on SSI teaching with science education researchers for at least three years. The interview guide focuses on the description and justification of the pedagogical approaches used, the interest and difficulties they have in teaching SSI, and it aims to cover the different aspects of the relationships with. The interviews were conducted by a researcher and lasted one hour.

The focus group and individual interviews were audio recorded, fully transcribed and anonymized. They were then processed by means of a content analysis (Krippendorff, 2004). Responses were divided according to the categories predefined by the Gohier *et al.* (2001) model of “relationships with”. Table 5.1 presents the criteria for collecting and analyzing data from the semi-structured interviews and focus groups, and examples from the data illustrate the categorization made.

Table 5.1: Coding guide for data processing

Relationship with...	Criteria	Examples from the data
oneself	values, beliefs, identity, skills, goals	<i>"I am personally involved in this"</i>
responsibilities	missions, implications of actions	<i>"words that may shock us and have the opposite effect of what we are looking for on the class"</i>

social institutions	institutional position, prescriptions, administration	"That's what interested me (...) we get out of the institutional discourse to develop critical thinking"
learners	educational relationship	"they told me that they were really happy to be able to talk about current issues (...) to give their opinion"
work	knowledge, pedagogy, didactics, learning theories	"I was afraid that I might not have the knowledge"
colleagues	teamwork, collegiality	"the teaching team, the colleagues on whom I relied, let me down"

5.6 Results

In line with our methodological choices, we describe the results for the focus group by focusing on collective dynamics. On the other hand, for the individual interviews focused on experienced teachers, we illustrate them more individually.

5.6.1 *The professional identity of novice teachers as seen through the lens of their "relationship with..."*

The relationship with self: Teachers all expressed an attachment to the chosen SSI, with comments such as "it's an important issue, so if it's important, it's because it affects us". This attachment may be linked to social issues or to personal commitment (for example one teacher stated "I have quite a few connections with the vegan community"). They did not report any tensions in this relationship, but rather emphasized their support and stated that they implemented SSI teaching because it was an opportunity to strengthen their self, values, beliefs and ideals.

The relationship with responsibilities: Teachers differentiate their responsibilities according to the SSI taught and their relevance. For the SSI prescribed by the institution, they feel tensions because while prescription reassures in terms of the stance and discourse to be adopted, it leads at the same time to "political correctness", which limits the emancipatory scope of the educational act. When the SSI evokes strong reactions, they stress the importance of dealing with emotions, but they also fear being overwhelmed by what some students can say ("they risk shocking us and may have the opposite effect on the group as a whole"). This concern

raises the question of freedom of expression and the acceptance of the student's word.

The relationship with social institutions: Tensions expressed by novice teachers relate to their professional ethical positioning. Most of them mentioned the impression they had of transgressing the institutional framework when they discussed SSI in class. They had to deal with two tensions: the fear of censure from the head teacher or parents ("I know that when I came up with the topic, the head teacher and colleagues were scared to death"), and the fear of guiding pupils' thinking towards the point of view that they themselves considered desirable.

The relationship with learners: It is a certain transmission approach that is put forward pedagogically: the socio-constructivist model of learning is the implicit reference in their description of the situations experienced by the pupils. Assuming a different stance, a shared risk, leads to an interesting pedagogical relationship, according to the teachers: "they told me that they were really happy to be able to talk about topical issues (...) to be able to give their opinion". Tensions also arose: if the pupils are given freedom, how can they accept words that deny the values of living together? We find here the same tension of freedom of expression already observed during the analysis of the relationship with responsibility.

The relationship with work: The possibility of having several disciplines work together, and the inclusion of this subject in the school curricula weighs heavily on the teachers' representations. In most cases, the SSI chosen by teachers is not explicitly included in the curriculum, which calls for innovation. Studying it at school is a question of linking institutional constraints on student training with teachers' desire to make schoolwork open to the broader social world. In this report, novice teachers mention another model of transmission in an educational framework and the difficulties it causes. For example, they report concerns about mastering the knowledge involved ("I was afraid I wouldn't necessarily have the knowledge"). There is a tension with the usual teaching practices of their discipline, and the disciplinary culture is seen as a hindrance ("we are far too compartmentalized in our disciplines"). The teachers also stated that "it is less the stance of teacher, it is really the stance of a facilitator" that they adopt.

The relationship with colleagues: Teaching an SSI is perceived as fundamentally interdisciplinary and requires teamwork on a project scale ("it is interesting that there is a more comprehensive project, and that it is a joint project with different disciplines"). In fact, the tensions mentioned relate to the difficulty of carrying out collective work to ensure the consistency of the educational situation in the face of the host of viewpoints among teachers and the willingness (or lack thereof) of certain team members to take educational risks. They fear having to deal with the weakening of relations within the teaching team.

5.6.2 *The professional identity of experienced teachers as seen through their “relationship with...”*

The relationship with self: Leon and Aline's commitment to teaching SSI is based on the personal values they attribute to environmental conservation, and they both feel a consistency between their personal and professional identity. Florent describes himself as someone who is primarily concerned with his own well-being, so his investment in SSI is driven by his personal pleasure and intellectual stimulation, above an interest in the students learning.

The relationship with responsibilities: Teachers defined their responsibilities less in terms of the transmission of disciplinary knowledge than in terms of their aim to develop cross-curricular skills in pupils. For example, Aline, as a computer science teacher, is particularly concerned with training future computer scientists and programmers who are sensitive to the ethical issues of their future profession. Similarly, Léon believes that his responsibility as an agronomy teacher is to train students to think critically about the impact of agricultural practices on health and the environment. This is also the critical thinking that drives Florent when teaching SSI to his pupils.

The relationship with social institutions: The teachers interviewed have different attitudes towards institutions, but they do not feel any tension. Aline teaches at the university, where curricula are flexible and allow her to easily integrate SSI. Her institution seems to be sensitive to her experimentation as it has asked her to present it at the national level. Léon allowed himself to deviate from the curriculum ("I always gave myself permission to teach it, even if it wasn't in the curriculum"), and Florent felt that his discipline offered more flexibility to work towards SSI than disciplines with more specific curricula such as science or history-geography.

The relationship with learners: Aline and Léon teach in vocational courses (IT and agriculture) and they spend about 10 hours per week with the students with whom they teach SSI. They are aware that the introduction of SSI into their classes questions the practices of the professional sector, which is why they are careful to be benevolent and tolerant of students' reactions. The importance of shared time and the challenge of professionalization are seen by Aline and Léon as elements that give them confidence and legitimacy to tackle SSI in the classroom. Florent's situation is different: he has fewer hours per week (4.5 hours) and his students are younger. He sees SSI mainly as a way of motivating students and he favors an investigative approach ("let them do their own research, build their own opinions"). He uses assessment to ensure the continued involvement of students throughout the course.

The relationship with work: Teaching SSI is seen as a source of professional development for Leon and Aline. Controversies in agroecology are central to Leon: "I enjoy debate and controversy. I find it enriching. It makes me confront my certainties, my convictions, and shows me the limits of my own knowledge". It was current events that made Aline aware of the need to connect technical knowledge to

the challenges facing society. Indeed, teaching SSI on IT with her students allows her to address the ethical issues of their future profession. The importance she gives to the responsibility of computer scientists or programmers means that she has been happy to invest in a field (ethics) that is far removed from her skills (computer science): "it's something that doesn't scare me at all". For Florent, it is the attraction of interdisciplinary that pushes him towards SSI: "I like many things when I tackle these issues. It is often a question of acquiring scientific knowledge and reflective points of view that lead to ethical questions". He also points out that the pedagogy adapted to teaching SSI is time-consuming, which causes a certain tension with the curriculum to be completed. He says he adapts by accelerating some parts so that he can address SSI.

The relationship with colleagues: Aline and Léon emphasized the importance of working on ISS as a team, to aim for complementarity of skills and expertise (for Aline), but also because SSI makes it possible to weld a teaching team together (for Léon). However, they both testify to the fact that relations within the teaching team have not always been easy, because it is traditional to compartmentalize disciplines and to take a strictly scientific and technical approach to teaching science. Thus Aline was gradually able to unite a larger number of colleagues in her experiment. Some SSI helped to unlock collective work, because they made sense to the whole teaching team. Collective work is a strong constraint for Florent, who prefers to join forces colleagues only occasionally, in areas where he considers himself to lack competence.

5.7 Discussion

We now look at the difficulties and tensions expressed by the group of novice teachers to try to understand how the three experienced teachers responded to them.

5.7.1 Tensions of beginning teachers

Through the analysis of the different *relationships with* and more particularly the relationship with work, we find the results observed in literature in the field concerning the epistemological and pedagogical difficulties encountered by teachers in integrating SSI into their practices (Chen & Xiao, 2021). The interdisciplinary and uncertain nature of SSI destabilizes the professional identity of the novice teacher based on the mastery of stabilized disciplinary contents. Risk-taking associated with the fear of "not having the knowledge" anaesthetizes their desire to engage in this type of teaching at the beginning of their career unless they are supported.

The tensions expressed in the relationship with colleagues lie at the very heart of the problem of identity, i.e. the dialectic for an individual to simultaneously differentiate him/herself in a group while assimilating into it. Addressing SSI in the classroom can put the teacher at risk of falling out of step with his or her disciplinary group, which is extremely costly because socialization is essential when it comes to constructing oneself as a professional (Pedretti *et al.*, 2008). This defensive position also refers to the ambiguous position of social institutions, as they recognize the value of SSI but remain cautious and may censor the study of particularly acute questions. The discomfort expressed by novice teachers is thus an ethical dilemma, that of a three-unknown equation in which they must decide what is acceptable to them (their personal ethics), with others (their peers), in just institutions (society's educational values).

5.7.2 Responses from experienced teachers

The analysis of the relationship with work and the relationship with institutions shows that the three experienced teachers have overcome the fear of failing to master knowledge. It is true that Aline (a computer scientist) is interested in knowledge that lies outside the remit of her discipline (ethics), but she is not disqualified by her colleagues or by her institution. She builds her legitimacy and her identity as an SSI teacher by relying on the educational challenge of training responsible professional computer scientists and programmers. The exercise in identity is easier for Léon, who can rely on his speciality, agronomy, and on the need to train critical farmers. His assertion of his disciplinary identity allows him to go outside the curriculum to teach organic farming, for example. The task is more difficult for Florent who has been unable to build an SSI identity but an innovative teacher identity. It can be assumed that the generalist teaching of secondary school does not facilitate this work, especially as his subject (French) is further removed from socioscientific issues. He is required to pass the test of double legitimization: the authorization to talk about scientific knowledge and the authorization to study controversies and uncertainties. The example of Aline and Léon shows us that teaching in professionally oriented courses allows teachers to find more space to carry out projects related to SSI. Thus, the exercise for a novice teacher will be more or less within his or her reach depending on the subject he or she teaches, the SSI, and the vocational or technical stream in which he or she works. Teachers who are more distant from the professional world and from the SSI-related knowledge to be taught will take more risks and will need more support.

Analysis of the relationship with colleagues and, more broadly, with educational partners gives an indication of the strategies developed by experienced teachers. For example, Florent, to overcome his difficulties, systematically called on outside contributors or colleagues from another discipline for content in which he felt he lacked

competence. Aline and Léon emphasized the importance of interdisciplinary for working on SSI in the classroom.

The curriculum is not an obstacle as it is for novice teachers. Their mastery of the subject taught and their expertise in managing a school year enabled them to adjust their teaching progression, either by accelerating certain parts of the curriculum to have time to study an SSI (Florent), or by reformulating it (Aline and Léon). These results confirm the strategies identified in previous studies (Chen & Xiao, 2021).

The analysis of the relationship with the institution and with colleagues shows how Aline and Léon have consolidated their SSI identity as a strong feature of their teaching practice. They managed to transform their work context to adapt it to SSI teaching, and have been supported and recognized by their peers for this competence. They thus implicitly become benchmarks for SSI teaching.

The analysis of the relationship with oneself sheds light on this transformation. Aline and Léon's personal commitment to the values of eco-justice and citizenship, and the importance they attach to educational work on these values, authorize them to act on their work context to adapt it to what they feel is right (even if this means going beyond the institution or creating new courses). Rather, it is individualistic values, focused on the satisfaction of setting up innovative devices to motivate students, that drive Florent's SSI teaching practices.

Thus, several configurations of professional identity seem to be conducive to the regular practice of SSI teaching. In particular, it seems important for this identity to be rooted in a combined expertise in the disciplinary knowledge to be taught and in the development of the context in which the profession is practiced (involvement of colleagues, implementation in the curriculum or in the pedagogical progression).

5.8 Conclusion

An SSI sub-identity is constructed on the basis of several pillars. Firstly, values are indeed the driving force for the commitment to teaching SSI (Hancock *et al.*, 2019). However, this pillar should not be stated without considering the foundation of the teacher's professional identity in his or her profession and discipline. Indeed, in our study, novice teachers dared to teach an SSI because they felt secure in their training framework. They concede, however, that they will not be able to commit to it the following year in their institution of assignment, and that it will be some time before they take such a risk.

Secondly, the context in which they practice plays an important role. It seems easier to unite a number of colleagues with differing opinions when one is working in a training curriculum with a professional objective. The challenge of training responsible future professionals appears to be a lever that facilitates the implementation of SSI teaching. General education courses are further removed from these issues, meaning it can be more difficult to overcome disciplinary divisions.

Investment in SSI is therefore driven more by the desire of some teachers to implement pedagogical innovations to motivate students than by a desire to transform society.

Finally, the relationship with colleagues is illuminating here. Teachers confide that without teamwork it is difficult to study an SSI. This teamwork makes it possible to address the interdisciplinary complexity of knowledge and gives security to educational stakeholders. Strengthened by this cohesion, the team can act for and against the institution, sometimes to shake up the status quo, by assuming a more critical stance.

The case studies examined in this chapter give indications as to the levers to be pulled in teacher training to enable the construction of a professional identity integrating SSI. The importance of socialization processes in assuming the risk of teaching (support from colleagues or the institution), as well as strategies for gradually changing the work context, should be highlighted.

A first lever consists of providing teachers with pedagogical guides and frameworks to make them secure in class, and thus legitimize certain teaching practices (e.g. debate or controversy mapping).

It can be hypothesized that a values-based approach would enable the individual to persevere and be on the lookout for opportunities that might arise in the future, or else be an obstacle to the pedagogical staging of knowledge that is opposed to one's personal values. Thus, a second avenue concerns training in professional ethics, so that teachers can go beyond the filter of their personal ethics to build a more open professional identity.

Interdisciplinary work and work in teaching teams is a third lever to be exploited from the initial training of teachers, so that teachers have strategies for reducing the risk-taking inherent to such teaching. This collective work is also likely to allow different disciplinary professional identities to rub up against each other and converge (Hancock *et al.*, 2019).

Finally, if there is a need to extend the teaching of SSI beyond the perimeter of teachers already committed to and convinced of its importance, research on the configurations of professional identity that are conducive to these teaching practices should be continued.

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