Student-teachers' professional identity development while guiding PBL through team-teaching in science classes: ...

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The development of student-teachers' professional identity while team-teaching science classes using a project-based learning approach: A multi-level analysis

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HIGHLIGHTS

- Team-teaching PBL in science classes helped shape student-teachers' professional identity.
- The development of the student-teachers' professional identity was associated with three major types of experience.
- Team-teaching PBL resulted in a shift from group-focused to self-focused identity.
- The overall outcome was noticeable professional growth, empowerment, and gains in student-teachers' self-confidence.

ARTICLE INFO

ABSTRACT

The research study deals with the development of professional identity of 17 student-teachers during their pedagogical practicum while team-teaching science classes using a project-based learning (PBL) approach. Data were collected from in-depth interviews as well as reflective reports and analyzed by means of multilevel analysis. Findings indicate that the student-teachers' professional identity was shaped by meaningful experiences in two dimensions: overcoming challenges while leading PBL and involvement in fruitful and supportive cooperation with their peers. The student-teachers progressed from group-focused to self-focused professional identity, indicating professional growth, empowerment, and substantial gains in self-confidence.

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1. Background

One of the central issues of teachers' professional training is the shaping and development of their professional identity - "Who am I, and what/who am I as an educator?" (Caires, Almeida, & Vieira, 2012; Chong, Low, & Goh, 2011; Meijer, De Graaf, & Meirink, 2011; Schepens, Aelterman, & Vlerick, 2009). Recent educational research suggests that student-teachers' professional identity is shaped by meaningful experiences, which they continue to interpret during follow-up reflections (Flores & Day, 2006), as well as by

social interactions, as reflected in their subsequent narratives (Sutherland, Howard, & Markauskaite, 2010; Ursúa & Vásquez, 2008).

Despite abundant research conducted in this field, one question remains open: what kinds of experiences lead student-teachers (i.e., students enrolled in years 1—4 of a B.Ed. degree program) to become teachers who advocate and practice inquiry-based pedagogy? Recent studies in the field suggest that practical experience in classrooms tends to have a positive effect on the views, attitudes and pedagogical practices of student-teachers (Crawford, 2007; Windschitl, 2003; Yoon & Kim, 2010). At the same time, there is a gap in the literature as to how practical experience may shape student-teachers' professional identity to be reflected in their educational believes and practices (Allen & Wright, 2014; Cochran-Smith, 2005; Henry, 2016; Korthagen, Loughran, & Russell, 2006).

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"There is insufficient empirical research associated with the experiences and perceptions of students themselves as they transition through the pre-service program and into the workplace" (Allen & Wright, 2014, p. 138), and without "systematic investigation of the processes within which identities change, the inner dynamics of teacher identity transformations remains a black box" (Van Rijswijk, Akkerman, & Koster, 2013 as cited in; Henry, 2016, p. 291). To shed light on this issue, the present study investigated whether and in what ways student-teachers' experience of implementing project-based learning (PBL) in a team-teaching framework provided meaningful experiences that contributed to their professional identity development.

1.1. Project-based learning in teacher education

PBL is a typical variation of collaborative, inquiry-based learning, characterized by active engagement of students and inductive learning. (Loyens, Kirschner, & Paas, 2010). Students learning in the framework of a PBL process usually work together to resolve a given problem, develop a product for a particular audience, and then assess both the project and the development process (Kokotsaki, Menzies, & Wiggins, 2016; Thomas, 2000). PBL is an efficient method for the development of 21st century skills, because it promotes critical thinking and problem solving, interpersonal communication, information and media literacy, collaboration, teamwork and leadership, creativity and innovation (Chu, Reynolds, Tavares, Notari, & Lee, 2017; Häkkinen et al., 2017).

In Israel, since 2015, "the educational reform for meaningful learning" has promoted the PBL approach as a core learning paradigm. This reform is implemented at all levels, from grade 1 to 12, whereby teachers are required to engage students in hands-on learning projects within the classroom. In elementary schools, projects in sciences are used as an alternative method for assessing students, whereas in high schools, science projects have been made an integral part of the matriculation process, so that working on a project constitutes 30% of the final matriculation grade.

Research that investigated the influence of the PBL approach on student-teachers found that PBL enhanced their problem-solving skills (Mettas & Constantinou, 2008), and academic achievements (Baran & Maskan, 2010) and positively affected their views concerning the teaching profession (Lavy & Shriki, 2008). In addition, student-teachers can benefit from formative assessment (Frank & Barzilai, 2004), and this type of learning helps them become more aware of their teaching objectives, which may then enhance the learning experience of children under their guidance (Ljung-Djärf, Magnusson, & Peterson, 2014).

Yet, there has not been extensive research examining student-teachers' experiences as learners and participants in PBL processes during their teacher-education program, particularly in terms of the participants' experience and their personal insights regarding the events, situations, and phenomena. In the present study, we sought to present the thoughts, feelings, and emotions of the student-teachers as they participated in a particular type of activity (van Manen, 2014). Those scholars who considered the PBL experience from the student-teachers' viewpoint found that these processes provided various significant experiences for the learners (Tsybulsky et al., 2018; Goldstein, 2016; Kaplan & Rafaeli, 2015; Dag & Durdu, 2017). For example, Tsybulsky et al. (2018) studied meaningful experiences reported by Jewish and Bedouin student-teachers when learning according to a PBL process and showed that during their studies, they were able to undergo deep introspection regarding their personal and professional self-perception.

As far as it could be ascertained, no previous studies have investigated the experiences of student-teachers who used PBL processes as part of the pedagogical practicum, or the ways in which they envisage the use of PBL in their future teaching. The current study focuses on this aspect and examines student-teachers' experiences of applying the PBL pedagogy while team-teaching during their pedagogical practicum.

1.2. Team-teaching

The concept of "team-teaching" refers to two or more teachers working together at a certain level of collaboration in the planning, delivery, and/or evaluation of a course (Carpenter, Crawford, & Walden, 2007; Crow & Smith, 2005; Murata, 2002), which principally involves sharing of teaching expertise and reflective dialogue (Chang & Lee, 2010; Jang, 2008).

Student-teachers are able to enjoy several advantages through team-teaching (Baeten & Simons, 2014; Simons & Baeten, 2016), including emotional and professional support (e.g., Bullough et al., 2003; Gardiner & Robinson, 2009; Goodnough, Osmond, Dibbon, Glassman, & Stevens, 2009), increased professional learning (e.g., pedagogical skills), and personal development (e.g., gains in self-confidence) (Birrell & Bullough, 2005; King, 2006). According to Wassell and LaVan (2009), both sharing field experiences and social interaction enable student-teachers to critically review their own practices as they learn to teach.

Team-teaching has been shown to provide diverse and valuable learning experiences for novice teachers and to assist their professional and personal growth (Tsybulsky, in press; Jang, 2006; Roth, Tobin, Carambo, & Dallard, 2004). Working in a team enables teachers to share authority and expertise on various topics and transforms them from being the "expert" to be an "expert learner." Collaborating in the classroom, teachers and students are able to share a process of discovery (Wentworth & James, 2002). Working in a team allows learners to look at a familiar topic from a different perspective or with a different pedagogical approach, and this can be a most rewarding experience.

Aside from these advantages, team-teaching has also some disadvantages. The increased workload experienced during team-teaching (i.e., collaborative lesson planning, joint reflection with a peer) is more time-consuming for the student -teachers (Gardiner & Robinson 2011; Nokes et al., 2008; Vacilotto & Cummings 2007). In addition, lack of congeniality among the team members could result in a negative experience for all involved (Bashan & Holsblat 2012; Gardiner & Robinson 2011; Stairs et al., 2009). Having established a habit of working alone, student-teachers tend to find collaborating with a peer an unfamiliar situation which can lead to anxiety or difficulty (Bashan & Holsblat, 2012). Moreover, student-teachers argue that during team-teaching, their individual gains are likely to be less meaningful than in an individual teaching setting, and that this lack of individual experience prevents them from feeling confident in their ability to teach independently (Bullough et al., 2003; Gardiner & Robinson, 2009, 2011; Kamens 2007).

Notwithstanding these disadvantages, due to their collaborative work, the team-teachers achieve more than they would if working alone (Gardiner, 2010). Teachers can attain higher levels of performance when they collaborate with and receive the support of their peers (Smith, 2004; Walsh & Elmslie, 2005). Mentors also play an important role in the team-teaching process, for instance, by encouraging good professional relationships among the student-teachers, providing both group and individual feedback (Scantlebury et al., 2008) as well as offering enough support to student-teachers (Carter & Francis, 2001). However, student-teachers seek help from their peers more frequently than from their mentor (Hsu, 2005; Goodnough et al., 2009) who plays a less directive role in the team-teaching process (Bullough et al., 2003).

Team-teaching (i.e., collaboration with other student-teachers)

is therefore considered to be a worthwhile strategy during field work. It is within this context that the present study attempted to identify experiences that could be considered significant in shaping student-teachers' professional identity, when team-teaching using a PBL approach in science classes.

1.3. Defining professional identity

Defining identity in general, as well as professional identity specifically, has always been a problematic issue (Beauchamp & Thomas, 2009) and, from the post-structural perspective, any understanding of identity cannot be considered finite or fixed (Johnston, 2012). In our study we relied on Erikson's notion of *personal identity*, understood as one's sense of self-knowledge (Erikson, 1994; Schwartz, Zamboanga, Wang, & Olthuis, 2009). We further conceptualized student-teachers' professional identity within two theoretical frameworks.

First of all, we related to the legacy of Vygotsky's work, by referring to his sociocultural theory of development as an ongoing process in which the development of the individual and social identities is intertwined, and personality is viewed as formulated primarily through social experience (John-Steiner & Mahn, 1996; Vygotsky, 1978; Wertsch, 1991). While Vygotsky (1978) mainly addressed the process of personal development in children, we as many others beforehand (e.g., Kelly, 2006; Olsen, 2008; Roth & Lee, 2007; Sfard & Prusak, 2005; Shepel, 1995) find it appropriate to expand his theory to the discussion of student-teachers' professional development.

Secondly, our work was inspired by the postmodern theory of identity, particularly as elaborated by Gee (2011a, 2011b), who showed that identity develops through social mediation and interactions with others. According to Gee, a viable approach to the study of identity development is to examine the ways in which the self and others view and interact with the individual. Gee (2001) described four ways to view identity. The first is the Nature Identity, which refers to a person's innate characteristics that do not result from actions or achievements, meaning that such an identity is shaped by nature rather than by society. The second is the Institution Identity, i.e., one's position in society. The third is the Discursive Identity, which addresses a person's individual traits through the lens of one's interactions with others. Finally, Gee (2001) refers to the Affinity Identity which is defined through an individual's belonging to a particular group with its distinctive practices. The latter identity was the focus of this study, and is considered to be interrelated with the Discursive Identity. Hence, for the sake of our work, we dealt with the student-teachers' Affinity Identity in the context of their participation in the same practice, namely, team-teaching PBL in science classes. The Discursive Identity then relates to how the student-teachers perceive and position themselves through discursive interactions.

1.4. Shaping student-teachers' professional identity

While the most rapid changes in the development of a professional identity occur once student-teachers graduate and begin working in school classrooms (Flores & Day, 2006; Luehmann, 2007), the development of a professional identity begins during their preservice education (Walkington, 2005). During this educational period, they have what Flores and Day (2006) call a "pre-teaching identity," meaning that their professional identity derives from their beliefs and concepts of what constitutes a good teacher and their implicit theories of teaching. Processes of reflection help student-teachers refine this pre-teaching identity and formulate a more sophisticated understanding of their role and the scope of their work as teachers. They are taught to use such reflective strategies throughout their formal studies as well as during the pedagogical practicum that takes place in school classrooms (Geijsel & Meijers, 2005; Korthagen & Vasalos, 2005). Sutherland et al. (2010) pointed out that student-teachers develop and refine their identity as teachers when they interpret and reinterpret their experiences through the processes of reflection.

Identities and selves are narratively expressed through the reference system as a linguistic instrument identifying the narrative participants (Eggins, 1994; Halliday, 1994; Martin, 1992). Student-teachers, who are both the main participants and the main presenters of their reflective narratives, tend to rely on the reference system as the main linguistic tool for constructing their identities, using it in two principal ways (Ursúa & Vásquez, 2008). First, they refer to themselves and use *I* to reflect on their personal feelings and experiences, thereby creating a self-focused narrative. Second, the student-teachers may refer to themselves and other participants and use *we* to reflect on their collective experiences, thereby creating a group-focused narrative. In their study, Ursúa and Vásquez (2008) suggested that using group-focused narrative realized through the use of the pronoun *we* highlights the students' feelings of being cautious and seeking approval as well as their image of themselves as collaborative team members. At the same time, creating a self-focused narrative typically suggests that the speaker is knowledgeable, thus contributing to the development of a confident teacher identity.

In our study, we assumed that student-teachers' professional identity develops through meaningful experiences, the interpretation of these experiences in reflections, and through social interactions, which in subsequent narratives are expressed as self-focused or group-focused self-presentation. Therefore, the research questions were composed as follows:

(1) Which experiences (i.e., thoughts, feelings, and emotions) did the student-teachers' undergo during their team-teaching of PBL science classes?
(2) How was their professional identity shaped by that process?

2. Methodology and methods

2.1. The context of the study

Students in the teacher-education college in which the study was conducted typically complete part of their pedagogical practicum in elementary schools in a city located in the same geographical area as the college, i.e., in the country's central region. In one of these elementary schools (which is affiliated with the Jewish secular education system and whose students come predominantly from mid-to-high socioeconomic backgrounds), the format is to give student-teachers full autonomy in teaching a predefined topic selected from the curriculum, for which they assume complete responsibility.

In the academic year 2015—2016, students in their third year of the science teacher-education program of a particular teacher-education college taught science classes in the selected school, as part of their pedagogical practicum module. During the first semester of the practicum, these student-teachers were asked to implement a PBL process in their classes, which required preparing the student-teachers for the project, as at that point in their studies, they were not yet familiar with the PBL method and certainly had never experienced it in their own learning. Therefore, during the first three weeks of the first semester (in total 24 h), the student-teachers were introduced to project-based activities modeling the use of PBL principles. In other words, student-teachers briefly experienced the PBL method in a group learning format, a process that coincided with their first introduction to the method's tools,

ranging from the formulation of a potentially promising question to the selection of a final product that motivates pupils to explore and learn. In this process, the emphasis was on using PBL pedagogy to teach the elementary-school curriculum. While conducting a mini-project to create a final product, the student-teachers were introduced to assessment and reflection methods that help promote the development of teaching skills. Following this brief introduction to the method, student-teachers then implemented the PBL process in their classrooms during the rest of the same semester.

The student-teachers worked in teams, both in the elementary-school classrooms (2—3 student-teachers per class) and when preparing the project at the grade level (4—5 student-teachers plus 2—3 coaching teachers assigned to each grade level, i.e., grades 1—6, ages 6—12). Two of the teams taught in special education classes (grades 3 and 6, age 8 and 12, respectively), in which the number of students was typically small (6—12) and student-teachers worked with the pupils on an individual basis, adapting the materials to address the specific needs of each child. In all of the classes, the student-teachers identified a suitable sub-topic for the PBL process, formulated a central question that the project was intended to address, and then prepared the chronological development of the project. They were assisted by the coaching teachers and the pedagogical mentor, but the ideas originated from and decisions were made by the student-teachers. It should be noted, however, that the PBL method was relatively new to the coaching teachers as well, as they were not accustomed to implementing it in their own teaching. Importantly, the PBL projects met all of the required grade-appropriate educational standards defined by the Israeli Ministry of Education for teaching at the elementary-school level. Here are a few examples of the projects selected. Children in a fourth-grade class were assigned the topic of caring for pets and the related project was to create a Guide for Pet Owners. Student-teachers chose the topic of nutrition for a fifth-grade class, and the assigned project was to "tape a TV show" of a panel discussing the type of foods that should be included in a weekly diet for athletes.

The study cohort included 17 student-teachers in their third year of studies towards an undergraduate degree in education, with a specialization in teaching sciences at the elementary-school level. The sample consisted of women between the ages of 24 and 28 years, who reside in the country's central region and all come from mid-to-high socioeconomic backgrounds. The participants were informed about the research goals and procedure and indicated their willingness to participate, by completing a written informed consent form.

The researchers were not involved in either teaching or assessing the student-teachers' work. All of the student-teacher participants were informed that assessment of the practicum module was completely unrelated to whether they opted to participate in the study, and that participation would be on a voluntary basis. After being informed about the research goals and procedure, the student-teachers indicated their willingness to participate by completing a written informed consent form. The study was approved by the University's Ethical Committee.

2.2. Instruments and data collection

The study used two data collection instruments: in-depth interviews and reflective reports. These instruments were considered particularly appropriate for the purpose of this study, as they allow participants to retrospectively reflect on the topic at hand (van Manen, 1990, 2014). Moreover, interviews and reflective reports are commonly used to collect data when researching the subject of identity (Korthagen, Kessels, Koster, Lagerwerf, & Wubbels, 2001; Larrivée, 2000; Rogers, 2002; Salinas & Ayala, 2018).

2.2.1. Interviews

At the end of the fall semester, we conducted in-depth interviews with the student-teachers (a total of 17 interviews). The focus of the interviews was on the experiences they accumulated in the course of the first semester of the pedagogical practicum, during which they team-taught science classes while applying a PBL process. Each interview lasted approximately 1 h. The time and place of the interview were selected by the interviewee. The interviews were recorded and then transcribed.

We began the interviews by asking an open-ended question, specifically, "What were the most significant experiences you had during this pedagogical practicum?" and from there on, the interview process continued for the course of an hour in the form of an open conversation. None of the questions directly addressed specific aspects of the pedagogical practicum; rather, interviewees were given the opportunity to guide the conversation towards whatever aspect they considered a central part of their experience in this pedagogical practicum (as per Shkedy, 2003). Participation in the interview was done on a voluntary basis.

2.2.2. Reflective reports

Students wrote their reports on a daily basis during the pedagogical practicum, reflecting on the process they were experiencing. In addition, after completing the implementation of the PBL process in their classes, they wrote a summary reflection on the process as a whole (a total of 119 reflective reports were reviewed). The student-teachers were asked to write their reflections in an open-ended manner, with no guidelines provided regarding which aspects or particular categories of the teaching-learning processes they were to address. The only instruction was to describe on a weekly basis the experiences that were significant to them, by noting what happened, what they felt and what they thought, as well as what they learned from the experience and what they wanted to hold on to for future reference. For the summary reflection, they were asked to consider the entire process experienced in this pedagogical practicum and to describe what they found significant, their feelings and thoughts during the process, the difficulties they encountered, what they learned from the process, and the lessons learned that might serve them in the future.

The writing of reflective reports was part of the student-teachers' assignments for the pedagogical practicum module, but it was emphasized that these assignments would not be graded, nor would their participation or performance on these assignments affect their final grade for the course.

2.3. Data analysis

In order to answer the research questions, we applied multilevel analysis, integrating qualitative-constructivist content analysis with linguistic analysis. It should be noted that both the content analysis and the linguistic analysis are methods that are typically used in identity related research (e.g., Ursúa & Vásquez, 2008), and the combination of the two adds to the trustworthiness of the study. In addition, the reliability and validity of this study were ensured using two methods: (a) triangulation of the research instruments, i.e., using multiple instruments to examine the same research question (as explained above), and (b) a careful review, conducted by the two researchers, of the stages of analysis. Brainstorming sessions and discussion sessions were held, focusing on the research questions and the relevant data found by each of the researchers. In cases of disagreement, the issue was pursued until full agreement was reached.

2.3.1. Content analysis

The data obtained from 17 interviews and 119 reflective reports were analyzed using the qualitative-constructivist content analysis method (Shkedy, 2011). The analysis included several stages. The data collected from **the interviews and the reflective reports** were analyzed according to the thematic-cognitive method, which is based on open-content analysis (Shkedy, 2011). Following the first reading of the data, initial categories were suggested in order to enable a first attempt at coding. It bears mentioning here that the reflective reports were written in an open-ended manner without any guidance and that the in-depth interviews also employed open-ended questions. As a result, a great amount of data were collected, from which the researchers selected narratives that were directly related to student-teachers' experiences and self-perception. In this manner, a first-order analysis of texts rendered the categories of *Experiences* and *Self-perception*. Careful attention was used in selecting categories that provided a focal framework. In stage 2 of the analysis, units of significance were mapped, to identify major categories and the relationships between the categories were outlined. Next, in conjunction with the literature review, the focal analysis was conducted, in the course of which the researchers selected essential categories that demonstrated clear results related to the research questions, while simultaneously eliminating categories that were not directly relevant to the focus of the study. Specifically, the selection of the two first-order categories (Experiences while team-teaching PBL science classes and Self-perception) was conducted in the following manner. When interviewees used words such as "I felt," "I experienced," or "I sensed" to describe experiences, thoughts and feelings related to team-teaching using the PBL method — these narratives were included under the category of *Experiences*. Examining these narratives at different time points along the process of analysis enabled us to construct subcategories of the types of experiences accumulated in the course of the pedagogical practicum. Thus, for example, when the relevant narratives conveyed a sense of accomplishment, they were assigned to the subcategory labeled *positive experiences*. When the narratives presented thoughts and feelings about oneself in the context of the overall process (including expressions related to self-evaluation and learning about the self), the relevant expressions were assigned to the subcategory of either *personal* or *professional* self-perception.

In the final stage of using the focal analysis, we conducted a theoretical analysis, which included relating the selected narratives to the professional literature on identity and selecting representative quotes from the interviews and the reflective reports.

2.3.2. Linguistic analysis

According to Gee (2011a), it is in language use where we are likely to be recognized as taking on an identity or a role. This method of analysis uses a systemic-functional linguistic framework, which deals with language use in context (Eggins, 1994; Halliday, 1994; Martin, 1992) and is in line with narrative identity theory (Bruner, 2002; de Fina, 2003; Lucius-Hoene & Deppermann, 2000; McAdams, 2011).

In the linguistic analysis, the 17 final reflective reports summarizing the entire process were coded for all the instances that included first-person pronouns — *I, me, my, mine*, a category that was then split into singular or plural first-person pronouns (*we, us, our, ours*). When referring to themselves along with others, the student-teachers identified themselves as team members, whereby *team* included reference to one's peers, or, on much rarer occasions, reference to a coaching teacher or a mentor. Identifying these two subcategories of personal pronouns reflected a distinction between student-teachers' self-centered and group-centered narratives (Ursúa & Vásquez, 2008). To control for the length of the reports,

the instances of "I me, my, mine" and "we, us, our, ours" references were seen as percentages of all first-person references observed in the narratives. The percentages of the first-person singular pronouns (writer/speaker only category) were compared to the percentages of the first-person plural pronouns (writers/speakers with another person(s) category) through three types of experiences reported by the student-teachers while leading PBL: difficulties, coping with and overcoming the difficulties, and a sense of success and satisfaction.

3. Results

The findings are described in two sections. The first section describes the student-teachers' experiences and their interpretations of these experiences, accumulated in the process of team-teaching science classes using the PBL approach. The second section describes the ways in which the student-teachers' identity was shaped over that process.

3.1 Section 1. The student-teacher teachers' experiences during their leadership of a team working according to the PBL approach

Regarding the experiences throughout the process, the majority of the participants (5/6 teams) reported having three types of the experiences related to the use of PBL pedagogy: encountering difficulties, coping with and overcoming difficulties, and experiencing a sense of accomplishment and success. All the teams (15 of the 17 student-teachers) reflected on these three types of experiences as related to approximately the same points in time during the project's progression, but their reports varied in terms of the intensity with which the feelings were conveyed.

It is important to mention that one of the student-teacher teams did not reflect distinctly on experiencing a sense of accomplishment and success towards the end of the project, but rather reported some dissatisfaction. Anat, for example, was continuously reflecting on the difficulties faced throughout the process, even towards the successful conclusion of the project:

> In all of our science lessons, the learning was collaborative, with almost no time dedicated to individual and independent learning, which made it very difficult. I wasn't comfortable with this. Pupils argued a lot —over who should go first, who should write the answer, etc., which became an obstacle to the actual learning ….

The following sections provide a detailed description of each of the three types of experiences reported by the majority of the students. The three types are presented according to the chronology of their appearance in the reflective reports.

3.1.1. Difficulties

In the initial stages of the project, most of the student-teachers described predominantly negative experiences, associated with their sense of frustration due to the gap between their actual experience and their expectations. Student-teachers faced three major difficulties while implementing PBL. First and foremost, the students were struggling with disciplinary problems, meaning that children would argue about role assignment and their social and academic standing, which led to disciplinary problems. The student-teachers found themselves unprepared to manage the classroom in this format: "At first there were lots of arguments between the pupils during the group work" (Noam); "Pupils argued about who would be responsible for notetaking; others asked to be assigned to a different group where their friends were" (Ayelet). Secondly, the student-teachers found it difficult to manage time

while both teaching and planning the lessons, i.e., group learning took up more time than traditional frontal teaching and, hence, the material was covered at a slower pace. "Learning in groups took up more time than other teaching methods" (Adi). As to the student-teachers' professional identity at that stage, their reflective narratives indicated a lack of confidence, as well as doubts regarding the chosen teaching method.

3.1.2. Coping with and overcoming difficulties

At this intermediate stage of the project, almost all the student-teachers had to devote most of their efforts to coping with the difficulties they were facing in relation to PBL. Parallel to applying pedagogical thinking and planning the project in terms of its content, the student-teachers also had to apply their skills to oversee the pupils' groups, which included managing disciplinary problems on both the individual and the group level. Pamela described her coping experience in the following manner.

> We had to cope with issues at several levels. On the social level, we empowered positive behaviors that we noticed in the group. That included halting classroom activity and paying attention to the way a particular group was working. The pupils sought this kind of reinforcement and their behavior improved significantly. On the personal level, we held private talks with students who were taken outside, in order to understand the nature of the problem. Many times, we acted as ambassadors, trying to demonstrate that there are two sides to every disagreement, which should be worked at until a common and shared decision was reached.

As the project developed, student-teachers understood that more organization was needed for running PBL project successfully. They intervened in the way the groups were divided, mediated the issue of the various roles within the groups, and understood that they had an important mediating role, despite the independence granted to the pupils in the small-group learning format. "I felt that despite the effort to encourage independent learning, the students were young and needed a guiding figure who would be available to mediate among them" (Ayelet).

> The pupils were supposed to divide the assignments and roles among themselves, but there were students who found it very difficult to relinquish a role they wanted, which led to heated arguments between the group members. One of the ways the student-teachers coped with this was to raffle out the different roles. What happened in today's lesson was that one of the pupils wanted very much to be the one to go outside and bring in sand, but when the raffle was held and someone else drew the desired role, this child began to cry. He finally overcame his disappointment, performed a different role and even helped the girl who returned to class carrying the sand. Of course, we complimented him effusively for such mature behavior (Chen).

At that stage, the quantity of student-teachers' portrayals of negative experiences was gradually being reduced and replaced with positive experiences. As an example, we relate the chronological developments of coping with and overcoming difficulties stage of the process, as described by Adva.

A. While working on the project I encountered various constraints imposed by the school system, which created a gap between the original plan and its implementation. For example, one of the lessons was cancelled at the last minute, which led to a cascade of changes. Given that the time span allotted for this project is relatively short, I had to consult with my team mates on how we should continue and the changes that should be made. This was not an easy task. (The fourth week from the beginning of the project)

B. There are a number of pupils in the class who tend to voice comments, interrupt, complete the task quickly or ignore it completely and thus interfere with other pupils' learning. (The sixth week from the beginning of the project)

C. I felt that the atmosphere in class had changed for the better. The pupils were curious about the classroom activities, asked questions, introduced their own ideas, and were enthusiastic about the project. (The eighth week from the beginning of the project)

D. I noticed that pupils who tended to shy away from participating in the regular lessons found an opportunity to express their ideas in the framework of the project. The small-group format and the kind of learning that took place throughout the project gave me the chance to address them individually and to empower each as he or she needed. (The ninth week from the beginning of the project)

E. There was a positive and pleasant atmosphere during the lessons. I felt that I was able to cope with the difficulties that arose on the way. In addition, because of the group format, I noticed that I was able to get to know each pupil a little better than before, and so I made it my goal to ensure that in the final phase of the project, the pupils would be able to participate in the way that best suited their personal style. (The tenth week from the beginning of the project)

In sum, the experience of overcoming difficulties may be seen as a turning point in the student-teachers' perception of themselves as teachers; they understood that the success of the project was their responsibility and was achievable due to their efforts, knowledge and acquired skills. At that stage their doubts and concerns gave way to a more confident and responsible perception of themselves as teachers.

3.1.3. Success

About midway through the project, the majority of the student-teachers began to feel that they were making progress in implementing the PBL process and they realized the advantages of this pedagogical approach. At this stage, they were experiencing a sense of success. One of the most notable aspects of this was the opportunity to forge personal relationships with pupils: "Working with small groups and the method of teaching used in the project enabled me to personally approach pupils who had trouble in class and I was able to empower them in a way that suited their needs" (Adva).

At this stage, almost all the student-teachers were feeling the change that had affected their classes. The atmosphere in their classes had altered; their pupils were cooperating and demonstrating an increased motivation to learn. Furthermore, the cooperative work had also affected the pupils' social interactions: those who were taught via PBL were helping and empowering one another. They had learned to cooperate and respect one another in their efforts to overcome difficulties. "Towards the end [of the project], you could tell that the pupils were overcoming their difficulties, helping each other, cooperating with one another, and demonstrating teamwork" (Chen). By witnessing the changes brought about by their efforts to successfully implement the PBL process, the student-teachers felt more empowered, which was reflected in a change in their subjective perception of themselves as teachers.

The last lesson of the project, in which we were working on preparing the products, was the culminating moment for me. The pupils were working together and better than ever before, helping each other, explaining things to one another, thinking creatively, and demonstrating patience for one another as they waited in line to get the materials I was distributing or to use the hot glue. I had a sense that we had succeeded beyond [my] expectations in advancing students' values and enabling them to acquire social skills, while successfully integrating academic topics (Yifat).

To sum up, the process that shaped the student-teachers' identity was the overcoming of difficulties and thus crossing the threshold between negative and positive experiences. Student-teachers mentioned two major factors that had helped them achieve success: (a) the support of the pedagogical mentor and coaching teachers while giving them (the student-teachers) room to operate independently in the field; (b) the cooperation and sharing experiences with their peers.

Regarding the **support of the pedagogical mentor and coaching teachers**, the student-teachers, on the one hand, felt support from their mentors; on the other hand, the student-teachers were given total pedagogical autonomy while leading PBL. All the student-teachers attributed significant importance to their team work and to the fact that they guided the PBL process from beginning to end. In other words, they alone were responsible for this process. Teacher-educators and pedagogic mentors aided and supported them, but definitely did not manage the projects. This experience of freedom of action and complete professional responsibility for the process was seen by the student-teachers as a meaningful experience, which contributed to the shaping of a more confident autonomic teaching self.

We performed the project in full cooperation with M, the coaching teacher. M was the instructor and was the ideal partner for me in delivering the project. On the one hand she gave us complete freedom to act, from the choice of subject for the project, through its transmission and the choice of products, but she was also not hesitant to criticize and add [her own opinions], but only so as to improve things. M fully endorsed our work, she demonstrated her support and even reinforced the lessons outside our practicum days, doing all this in order to promote the project and to contribute as much as possible to its success (Adi).

I felt that our position, as students, was dominant. Personally, I took hold of the project, understanding that I and my colleagues were responsible and would work independently so that the project would succeed. I was happy that this was an opportunity to experiment and to "dive right into the deep end" in this process. It made the practicum really effective for me (Tali).

While describing the importance of **cooperating and sharing experiences with their peers**, the student-teachers reflected on the following four major aspects that contributed to their professional success. These factors are demonstrated by the following examples, which we considered the most illustrative.

(1) Emotional support was crucial during the initial stages of implementing PBL, which was accompanied by mostly negative feelings and experiences.

In my opinion, one of the most significant things about the cooperation among the team members was the ability to address the difficulties in the course of the project. Working in small groups was not a simple matter at first … Meeting with the team members at the end of the day gave us the opportunity to unburden, share, and receive support (Lidor).

(2) Mutual intellectual enrichment

It was such a pleasure to work as a team, things flowed between us although we had different ways of thinking and we succeeded in overcoming every obstacle that was set before us (Meital)

(3) The feeling of solidarity among peers

Over this entire process, I had an optimistic, comfortable and good feeling, because I knew that I was surrounded by other students who were undergoing the same process with me (Tali).

(4) The routine and ongoing group discussion of their experiences

I understood that it was important and worthwhile to talk about things and state my requests and desires to the professional team (Noam).

These four factors, related to cooperation and the sharing of experiences among the -student-teachers, contributed to the shift from negative to positive experiences while team-teaching and implementing a PBL approach. The change in the quality of experience led to a change in student-teachers' self-perception. The experience of encountering and overcoming difficulties as a group led to the successful implementation of the PBL, thereby changing the perception of the student-teachers' perception of themselves not only as teachers, but also as individuals.

3.2 Section 2. Shaping the student-teachers' professional identity

We found that all of the student-teachers had experienced a transformation —to varying degrees– in terms of their self-perception of their professional identity. From feeling insecure as novice teachers at the beginning of the project, they proceeded to gain confidence as professionals, perceiving themselves to be more expert and independent teachers than they had been at the beginning of the PBL. In the initial stages of leading and team-teaching using PBL, the majority of the student-teachers were wary about their professional abilities, but gradually they felt increasingly more capable as teachers, which resulted in a sense of personal and professional empowerment and increased their self-confidence regarding their ability to cope with new pedagogies in the future (see examples 1–4).

For example, while reflecting on the beginning of the project, Nadya noted:

(1) At the planning stage, I initially felt slightly lost, but since we were a team of five women we succeeded in consolidating an idea that gradually took on a clearer form … this led us to choose a topic for the project, which of course was what led us to design the learning program and embrace the school's "eco-friendly" approach concerning environmental quality and recycling.

In contrast, when reflecting on the final stages of the project, Nadya wrote:

(2) I learned about myself that I am capable of coping and capable of expressing my personality, not only through the conventional methodology which I had been taught originally, but also using an unfamiliar methodology, with which I felt less

secure. I learned to dare, to let go, to go with the flow, and to be much more flexible than I ever thought I could be. I learned not to feel afraid or anxious about applying new and unfamiliar pedagogies. I discovered many advantages in methods about whose usefulness and efficacy I had been skeptical, such as group work, for example. I found out that I have more confidence and charisma than I realized. This experience helped me advance personally, and professionally as a future teacher.

A further example shows the same process undergone by Adi. The initial stages of her work were described as follows.

(3) We approached the project with a general idea about what we wanted to work on. We chose to focus on pet animals, because the subject was closer to the students' hearts and we felt that this would arouse more interest. After the subject was determined, ideas flowed, so we sat down with the project paper and laid out the ideas in a spatial perspective, showing how each activity was connected to the subject and which secondary issues we would study more deeply (Adi).

On the other hand, Adi's reflection on the later stages of the project contains the following description.

(4) I learned something about myself — that as a teacher I am able to avoid my square [conventional] way of thinking that I can think outside the box …. The actual success of the project made me feel good and influenced the way I see myself as a future educator (Adi).

It should be emphasized that these findings show that student-teachers' reflections on their negative experiences coincided with their self-presentation as cautious novice, teachers. Similarly, positive experiences described by the student-teachers coincided with their feeling more skilled and self-confident as teachers.

The linguistic analysis allowed us to follow the process of transformation of the student-teachers' perception of their identities (see Table 1). It was found that, at the initial stage of leading PBL, about the same amount of "I" and "we" personal references (46% vs. 54%. respectively) were used by the student-teachers when describing the difficulties experienced and simultaneously acknowledging the importance of collaboration with their peers. More instances of "I" pronoun (65% vs. 35%) were used by the student-teachers when reflecting on coping with and overcoming the problems that arose in relation to the PBL project. The highest percentage of "I" references (86% vs. 14%) was used by the students to describe the sense of success they were experiencing.

Examples (1) and (3) show that while reflecting on the initial stages of their work, both Nadya and Adi tended to employ the first-person plural *we* to refer to themselves as team members seeking support from their peers/mentors. At the same time, examples (2) and (4) demonstrate that, while reflecting on the two concluding stages of the project, these (and other) student-teachers tended to use mostly the first-personal singular pronoun *I* when referring to

themselves as knowledgeable, professionally independent, and self-confident teachers.

These findings suggest that, while leading PBL, the student-teachers underwent a process of negotiating their professional identity, which they did by using two different lenses: first they presented themselves as collaborative team members who sought and found confirmation and support from their co-teachers, but then, as they gradually acquired skills and constructed a more confident and autonomous professional identity, they were able to recognize this as an individual accomplishment (expressed in the I-centered narrative), Table 2 summarizes the findings of the study.

4. Discussion

The main purpose of the research was to study the process by which the student-teachers' professional identity was shaped during their practicum experience, while leading PBL processes in elementary-school science classes. For this purpose, the research conducted an in-depth investigation of the student-teachers' experiences and their interpretation of these experiences in terms of their content and quality over time. In addition, a multilevel analysis was performed to examine both the content of the student-teachers' narratives and the pattern of using the personal pronouns in these narratives. It was found that, in the initial stage of the project, the student-teachers had mostly negative experiences, including anxiety and frustration; later on, the student-teachers' negative experiences were gradually replaced with positive ones, and, finally, when reflecting on the end stage of the project, the student-teachers described mostly positive experiences, such as enjoying a sense of success and satisfaction. This finding corroborates the claims made by a group of researchers, who point to the potential of the PBL approach to expose student-teachers to a whole range of constructive and meaningful experiences (Tsybulsky et al., 2018; Goldstein, 2016; Kaplan & Rafaeli, 2015; Dag & Durdu, 2017). Moreover, the finding that involving student-teachers in PBL team-teaching provides a variety of meaningful social and introspective experiences that contribute to professional and personal growth is supported by findings of other studies, (Tsybulsky, in press;). In the same vein, Walkington (2005) established a connection between preservice teacher activity, which empowers them to explicitly rely on their experiences and beliefs, and the development of their professional identity.

The student-teachers' professional self-perception underwent a gradual change, so that after the project, the student-teachers explicitly related to the development of their professional identity, indicating that they had moved towards autonomy and self-efficacy. It was found that while reflecting on their negative experiences, the student-teachers' narratives were, for the main part, group-focused, whereas when describing their positive experiences, their narratives were predominantly self-focused.

The predominance of group-focused narratives when referring to the initial stage of the project may be explained, on the one hand, by the student-teachers' willingness to present themselves as collaborative team members ready to support their peers when difficulties arose, and, on the other hand, by the students' lack of

Table 1
Transformation of student-teachers' Professional Identity through Three Stages.

	Difficulties	Coping with and Overcoming Difficulties	Success and Satisfaction
I (self-focused narrative)	123 (46%)	181 (65%)	209 (86%)
We (group-focused narrative)	140 (54%)	99 (35%)	35 (14%)
Total			
1st-person Pronouns	263 (100%)	280 (100%)	244 (100%)

Table 2
A summary of findings.

Stage in Leading PBL	Type of Experiences	Quality of Experience	Narrative Focus	Examples	Shaping Effect
Initial (approximately 3 weeks)	Difficulties	Mostly negative experiences	Both self- and group-focused narrative with slight predominance of the latter	Nevertheless, we had some mild disagreements and the fact that each group worked separately enables us to bridge these differences (Chen) I felt that I was far from understanding how the project would be implemented and I was also afraid that we wouldn't manage to successfully capture the essence or goals of the project (Tal) When the project was initially introduced, I felt confused, frustrated, I didn't understand or have the needed knowledge, fearful, but also curiosity and anticipation (Lidor)	Having successfully faced a number of unanticipated difficulties, the student-teachers realized the importance of both their persistence and collaboration with peers
From the beginning until midway through the project (approximately 6 weeks)	Coping with and overcoming the difficulties	Negative experiences are being replaced with positive ones	Predominantly self-focused narrative	I was surprised and pleased to see that the pupils were alert and attentive during the activities, and they conducted the experiment properly and independently, with almost no social/disciplinary problems or any misunderstanding of the instructions (Tal) I felt that the pupils were becoming accustomed to this unique project-based way of teaching, which really pleased me (Noa) I was so happy after these lessons that I even enjoyed teaching the mainstream classes this year more than I did the special education classes I taught last year (Shir)	The pupils understood that the success of the project was their responsibility and was achievable due to their efforts, knowledge and acquired skills. The pupils' doubts and concerns gave way to a more confident and responsible perception of themselves as teachers.
From the midpoint until the end (approximately 3 weeks)	Success	Mostly positive	Distinctively predominant self-focused narrative	First of all, I'm very glad that I got to experience this approach while I am a student. I think it is an important to for every teacher to have. On a personal level, I learned something about myself as a teacher: I learned that when I am able to interest and challenge the students, I feel a great sense of satisfaction and motivated to continue teaching. (Inbal) When working one-on-one with pupils within the framework of the project, I was pleased to discover that the pupils were being cooperative and took responsibility for the success of the project (Dafna)	By witnessing the changes that resulted from their efforts to successfully implement PBL, the student-teachers felt more empowered, which was reflected in a change in their subjective perception of themselves as teachers

confidence as teaching professionals and their need to be acknowledged and encouraged. At the same time, high prevalence of self-focused narratives describing the later stages of work may indicate the students' feeling of gains in teaching expertise, self-confidence, and independence. This finding corroborates Ursúa and Vásquez (2008), who drew a distinction between group- and self-focused narratives as indicators of two teaching selves: novice versus expert. Our research expands this understanding, by providing further insight into the process of shaping professional identity, which was found to be both implicitly and explicitly related to the types/quality of experiences they underwent.

Within the sociocultural theory of Vygotsky (1978), we may interpret our findings as follows. When team-teaching using the PBL approach, two intertwined processes could be observed among the student-teachers: the sharing of personal experiences with other team members on a regular basis and the persistent reflection on and interpretation of their personal feelings during these interactions with their peers. The former may be seen as a social process that turned out to be crucial for the success of the project, as it led to the evolution of student-teachers' self-perception and helped shape their professional identity as teachers. At the same time, the process of reflecting on and interpreting their personal experiences can be seen as an individual process, which, reinforced their confidence in their ability to cope with future problems and thus to become proficient and knowledgeable teachers.

In reference to Gee's conceptualization of identity (2001), our study shows how Affinity and Discursive Identities are interrelated through reflective processes and discursive interactions. These discursive interactions allow individuals to construct identities through self-positioning (Vagan, 2011). According to Akerson, Pongsanon, Weiland, and Nargund-Joshi (2014), the development of professional identity "took place through an interpretation and reinterpretation of self through external factors and others' perceptions, as well as the influence of sub-identities" (p. 2055). In the context of our study, the two major external factors are: (1) cooperating and sharing experiences with peers (emotional support, mutual intellectual enrichment, the feeling of solidarity, regular and ongoing discussion.) and (2) professional support from their mentors who provided pedagogical autonomy and encouraged the student-teachers to collaborate with each other and work independently. The mentors' consultative role in this process is viewed as an effective strategy for the development of student-teachers' professional identity (Bullough et al., 2002; Walkington, 2015).

Another noticeable finding of the present study was that the student-teachers' professional identities were shaped through the social relationships and interactions they had in the process of team-teaching, as well as through the reflective narratives. This finding corroborates those of several studies (Gee, 2000, 2001; Ursúa & Vásquez, 2008). Following the research by Sutherland et al. (2010), our study shows that shaping of student-teachers' identity occurs when they interpret and reinterpret their experiences through the process of reflection. Reflection on action enhances the

development of the practical role of a student-teacher, "and also provides strategies to nurture the ongoing development of a student-teacher identity that has been shaped and will continue to be shaped over a long period of time" (Walkington, 2005, p. 59). Additionally, our study suggests that, along with personal reflective writing, sharing experiences was a significant tool for the construction of a professional identity. Sharing of teaching expertise and participating in reflective dialogue, in addition to successfully conducting PBL activities, as reported in Chang and Lee (2010), also contributed to shaping the student-teachers' professional identity. The team-teaching framework, especially when experienced in the context of an unfamiliar didactic approach (in this case PBL), ensured that the student-teachers received the needed emotional and professional support from their peers, as has been pointed out in the existing literature dealing with team-teaching fieldwork (see Tsybulsky, in press; Bullough et al., 2003; Gardiner & Robinson, 2009; Goodnough et al., 2009).

Teachers' personal and professional histories and their experiences throughout preservice education play a crucial role in determining the flexibility of the professional identities that these teachers develop in the early years of teaching and thus have a significant effect on the kind of teacher they become (Walkington, 2005). In this regard, the contribution of our work lies in providing a comprehensive analysis of the development of student-teachers' professional identity at the advanced stages of their preservice education (one year before the internship).

Based on the results reported in this study, it is possible to formulate several practical recommendations directed at teacher educators (1, 2) and at pedagogical mentors (3–5), regarding the successful implementation of team-teaching among student-teachers.

Sharing is a cultural characteristic of the information era and teacher education must prepare future teachers to function in this culture. Team-teaching using the PBL approach is an integral part of teacher education for student-teachers in general and for teachers of elementary-school pupils, in particular. The period of the teaching practicum is a natural framework during which student-teachers can directly experience the culture of sharing, both in terms of team-teaching and in applying pedagogies that involve group work and sharing among pupils.
Providing the autonomy to work independently is vital, in order to instill a sense of confidence in student-teachers. This factor constitutes an important condition for creating a significant experience of professional commitment and responsibility, which in turn contributes to the development of student-teachers' professional identity.
Pedagogical mentors should be aware of the importance of the autonomy to work independently given to the student-teachers. They must play less directive role and offer the leadership to the student-teachers.
Pedagogical mentors should be aware that sharing of personal experiences is an important tool for student-teachers' personal and professional growth. To encourage sharing among the student-teachers, mentors must provide a regular time and place for student-teachers to reflect on their own experiences, a framework in which student-teachers provide their peers with constructive feedback.
To promote successful implementation of team-teaching, it is recommended to allocate a pre-set time in the schedule for team meetings. That way, meetings are held not only when the need arises, but on a regular basis, at a regular time and place, with all staff members present. The pedagogical mentor should attend the meetings and be available to consult with the

different teams, rather than wait to be called upon only when the need arises.

To summarize, the research demonstrated that the practical experience of leading PBL in science classes in a team-teaching framework was perceived as significant by the student-teachers, as it provided a favorable context that led to meaningful processes of professional-identity construction. These findings contribute to the professional discourse on PBL and other inquiry-based practices. More specifically, they indicate the importance of giving student-teachers the opportunity to actively experience these didactic practices, as a way of shaping their professional identity. This finding is in line with those of previous studies that demonstrated the positive effect of practical experience in classrooms on the views, attitudes and pedagogical practices of student-teachers (Crawford, 2007; Windschitl, 2003; Yoon & Kim, 2010).

It is important to note that the research has several limitations. First, due to the qualitative nature of this study, it cannot be concluded that the experience of implementing a PBL process has a direct and significant effect on the construction of student-teachers' professional identity. The present study merely indicates this correlation and describes it through the eyes of the participants. Further study is required to substantiate this correlation in quantitative terms. Moreover, further research could employ a quantitative approach to examine the differences between the experiences of participants engaged in a PBL vs. a different learning process.

Second, because of the relatively small number of informants (17), it is hardly possible to generalize the findings to the broad population of student-teachers. Moreover, the participants were all Jewish women teaching sciences in elementary schools, who all live in the center of Israel. Hence, the findings cannot be assumed to apply to male student-teachers, student-teachers from other cultural and ethnic backgrounds, those teaching other disciplines, or living in other geographical regions. Additional studies are needed to provide a response to these limitations.

We believe that team-teaching by applying the PBL approach should be assimilated within the framework of teacher education as part of the practicum experience. This may be viewed as one of the steps towards preparing constructivist teachers who advocate and practice inquiry-based pedagogy.

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