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Reflection using mobile portfolios during teaching internships: tracing the influence of mentors and peers on teacher self-efficacy

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ABSTRACT

Digital portfolios offer opportunities for reflection and collaboration in teacher education. However, the affordances of mobile devices have scarcely been explored in this context. A mixed-methods study was conducted wherein 44 student teachers collaboratively used a mobile portfolio app for reflection with peer students and mentors during teaching internships. The analysis focused on the collaborative content of mobile portfolios and its relationship with self-reported outcomes after the internship. The results showed that portfolios often included multimedia records (i.e. pictures, video and audio) of student activity in the classroom and written reflections on teaching strategies. Mentors recorded more videos in portfolios, while peer records varied and correlated with student teachers' self-efficacy gains. Cluster analysis showed higher teacher self-efficacy gains when all collaborators actively contributed to the portfolios. These findings highlight the importance of mentors and peers when using mobile devices for reflection during teacher education internships.

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Reflection; digital portfolios; teacher education; mobile learning; internships

1. Introduction

Digital portfolios are promising technologies for reflection and collaboration in teacher education (Adadan & Oner, 2018; Cohen et al., 2013; Maharsi, 2019; Schon, 1983). In particular, the affordances of mobile devices for anytime, anywhere use that is combined with ubiquity have significant potential for integration into teacher education internships (Baran, 2014). Affordances are usually described as opportunities or potential courses of action according to the characteristics of an educational setting and may take the form of tools with examples of possible use (Kennewell et al., 2008; Laurillard et al., 2000). For instance, in the case of mobile portfolios, student teachers and peers or mentors can walk through the classroom and capture evidence of student and teacher activity, with the aim of reflecting on more efficient/effective teaching and student learning. This is especially relevant in teaching internships, where the connection between educational theory and classroom practice is the main aim of reflection for student teachers and may be supported with digital tools. Although there is some initial evidence that shows the promising use of mobile devices in teacher education, the impact of integrating such technologies into student teachers' internships and their outcomes has been scarcely explored (Baran, 2014; Çelik et al., 2018; Michos et al., 2022; Petko et al., 2019). Further, student teachers usually reflect on their internships in a social context (e.g. with mentoring sessions, discussions, peer teaching), and the role of mentors and peer students has shown various benefits. However,

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there is limited understanding of the process of constructing portfolio artefacts with mobile portfolios collaboratively and reflecting on classroom internships. This study seeks to explore and investigate mobile portfolio use in classroom internships when mentors and peer students are involved in this process. The aim is to understand student teachers' internship process through the content of digital portfolio artefacts (i.e. classroom evidence and written reflections) and the relationship between the collaborative reflection process with mobile devices and student teachers' outcomes.

The article is structured as follows. Section 2 presents the affordances of digital portfolios for reflection in teacher education. Section 3 presents the effective strategies for using digital portfolios in teacher education and internships, and our main research questions. Section 4 explains our methodology and mixed-methods study, while Section 5 presents the main results. Section 6 discusses the results of the study based on previous research, and Section 7 presents our main conclusions.

2. Affordances of digital portfolios for reflection in teacher education

Reflection is a core component of teacher education and the ongoing professional development of teachers (Adadan & Oner, 2018; Oner & Adadan, 2011; Schon, 1983; Shulman & Shulman, 2009). Reflection refers to the deliberate and systematic process of examining and analysing one's teaching practices, beliefs and experiences to get a deeper understanding, improve instructional effectiveness and enhance personal and professional growth (Korthagen & Nuijten, 2022; Schon, 1983; Zeichner & Liston, 2013). Different forms of reflection have been defined according to the time and nature of reflection for teaching (Chan & Lee, 2021; Korthagen & Nuijten, 2022). Reflection on-action refers to teachers' thinking of past teaching experiences to evaluate and improve future situations (Schon, 1983). Reflection in-action refers to active or interactive teachers' thinking during the teaching practice where immediate observations or actions can be taken (Schon, 1983). Finally, Van Manen (1991) identified another type of reflection-for-action which can be defined as 'preflection' before action and relates to teachers' thinking of possible situations or problems that may happen during teaching practice. Several studies across the world showed that teacher reflection within internships enhances pre-service teachers' teaching skills by focusing on several aspects such as classroom management, lesson planning and pedagogy (Prakasha & Kenneth, 2023).

A prominent approach to supporting reflective processes in teacher education is the use of portfolios. According to Shulman (1998), a teaching portfolio is 'the structured, documented history of a set of coached or mentored acts of teaching, substantiated by samples of student portfolios, and fully realized only through reflective writing, deliberation, and conversation' (p. 37). Digital portfolios are a technology that enables the collection of digital artefacts and evidence capturing the working or learning process (Lorenzo & Ittelson, 2005; Stefani et al., 2007). Lin (2008) differentiated between portfolios that include only evidence and portfolios that also have reflective commentaries. Digital portfolios have been used and explored in many professional domains and teacher education programmes, such as medical education, general education and vocational education (Könings et al., 2016; Petko et al., 2019; Renner et al., 2016). In the context of teacher education, a variety of digital technologies, such as video-based feedback, weblogs, microblogs and social media, have been investigated. Digital teaching portfolios integrate the affordances of these technologies for supporting documentation, reflection and collaboration (Ahmed & Ward, 2016; Berrill & Addison, 2010; Gaudin & Chaliès, 2015; Hanuscin et al., 2014; Iredale et al., 2020; Kay, 2006; Koehler et al., 2017; Kori et al., 2014; Zubizarreta, 2009). Digital portfolios can support teacher education internships by creating digital artefacts and digital stories before, during and after the teaching session (Kloser et al., 2021). These digital representations can be further exposed to social processes, such as assistance or feedback from peers and mentors. Some examples of digital portfolio artefact include the documentation of lesson plans and instructional materials or videos, audio and images of students' activities in the classroom (Kearney, 2009; Kloser et al., 2021; Koehler et al., 2017; Moran et al., 2013; Pelliccione & Raison, 2009). Further, posterior reflective writing as part of the teacher education

curriculum or self-directed learning journals are common elements for digital portfolios in teacher education (Gurvitch & Metzler, 2009; Kay, 2006).

Although the affordances of digital portfolios have been explored in previous research, for example, assistance for reflection, exchange of feedback and asynchronous interactions (Ahmed & Ward, 2016; Birello & Pujola Font, 2020; Hanuscin et al., 2014) and might facilitate teachers' reflection, the use of mobile devices and apps for reflection are promising technologies in the context of teacher education. In particular, mobile apps enable the collection and dissemination of rich multimedia content in real time and provide spaces for discussion with voice, text and multimedia (Traxler, 2007). Mobile portfolios can empower the 'two faces of ePortfolios' (Barrett, 2010, p. 7) by facilitating the collection of immediate evidence of learning-in-action and providing grounds for reflection-on-action at a later stage (Camacho & Tur, 2012; Gulzar & Barrett, 2019; Tur et al., 2019). This process can facilitate situated learning (Sophonhiranrak, 2021). Relevant studies show that student teachers are more engaged in focused feedback when they use mobile devices and seem to appreciate the use of mobile devices in teacher education (Çelik et al., 2018). Although mobile devices have significant potential for reflection in different domains, empirical evidence in teacher education internships is still fragmented and scarce (Baran, 2014; Michos et al., 2022; Petko et al., 2019).

3. Effective strategies for using digital portfolios in teacher education and internships

Previous studies have examined the use of technology during student teachers' internships and showed that digital tools increased their confidence and self-efficacy (Al-Awidi & Alghazo, 2012) regardless of student teachers' beliefs (Han et al., 2017). In particular, videos of classroom practice have been repeatedly used to reflect on internship experiences because videos provide authentic representations of the teaching practice and classroom environment and offer anchors for feedback (Gaudin & Chaliès, 2015).

Concerning the reflection process with digital portfolios, some qualitative or mixed-methods studies have been conducted. These studies analysed the content of digital teaching portfolio artefacts and showed discrepancies about the levels of reflection and outcomes in teachers' learning and knowledge (Koehler et al., 2017; Ogan-Bekiroglu, 2014; Pelliccione & Raison, 2009; Sung et al., 2009; Thomas & Liu, 2012). These qualitative or mixed-method studies propose scaffolding student teachers' reflection process with further guidance and supervision by teacher educators and mentors (Kilbane & Milman, 2017; Pelliccione & Raison, 2009; Thomas & Liu, 2012). Towards this direction, several teacher education programmes have followed the Interstate New Teacher Assessment and Support Consortium (InTASC) standards as a common framework to support and evaluate preservice teachers' competencies in the classroom with digital portfolios (Bond, 2019; CCSSO, 2013). These teaching standards are commonly grouped into four categories: learner and learning, content, instructional practice and professional responsibility (Foulger et al., 2017). Related studies show that teachers can incorporate teaching standards into their reflections and develop their dispositions with or without digital portfolios (LaPaglia, 2019; Lin, 2008).

Concerning the context of student teachers' reflection during internships, the social support provided by mentors is considered to be one main factor that affects the first teaching experiences of student teachers. Mentors essentially intend to provide support for (1) instructional approaches, such as teaching strategies, classroom management and student support, and (2) psychological factors, such as building confidence and reducing levels of stress during internships (Richter et al., 2013). Studies have shown that student teachers perceive their mentors as a source of support for reflection on teaching or practical advices (Richter et al., 2013). Mentor support is positively related to teacher self-efficacy (LoCasale-Crouch et al., 2012) and improved teaching practice (Nevins Stanulis & Floden, 2009; Rozelle & Wilson, 2012). Studies in teacher education have also shown that social relations and co-

teaching with peers affect teacher perceptions about teaching during classroom internships (Clift & Brady, 2005). The social context has also been explored in studies related to mobile apps for reflection in other professional domains (e.g. medical and vocational education and workplace learning), with evidence supporting the enhancement of the reflection process with peers and mentors (Aprea & Cattaneo, 2019; Könings et al., 2016; Mauroux et al., 2014; Renner et al., 2014, 2016).

Although reflection apps and mobile portfolios are also prominent approaches to support reflection during teacher education internships, it is not yet clear how the social context enhances the reflection process with mobile portfolios in classroom internships (Baran, 2014; Çelik et al., 2018; Michos et al., 2022). In this study, we build on the results of a previous experimental study with mobile portfolios in teaching internships (Michos et al., 2022), in which we showed that the internship experience affected the development of teacher self-efficacy and enthusiasm. However, the use of the mobile portfolio app increased teaching enthusiasm only when student teachers worked with mentors. These results necessitated further analysis of reflection with mobile devices and their relationship with teacher self-efficacy and enthusiasm as outcomes of the classroom internships. Thus, in the present study, we analysed a collaborative case in which peers and mentors were involved in the construction of mobile portfolios. We aimed to analyse the reflection process with mentors and peers and its relationship with teaching enthusiasm and teacher self-efficacy as outcomes of the internship experience. We formulated the following:

Research questions

RQ1: What types of content are included in student teachers' mobile portfolios for classroom internships when working with mentors and peers?

RQ2: To what extent do student teachers' reflection processes with mentors and peers influence student teachers' outcomes regarding teacher self-efficacy and teaching enthusiasm?

4. Methods

4.1. Methodology

We followed a mixed-methods research approach (Creswell & Clark, 2017; Johnson & Onwuegbuzie, 2004), given that our research aimed at understanding student teachers' teaching internships in classrooms with a mobile portfolio app and the support of peers and mentors in an authentic classroom context. We performed a content analysis of the artefacts constructed with the mobile portfolio app to analyse the reflection process of student teachers. This qualitative analysis considered (1) the type of multimedia materials collected during teaching internships (e.g. for purposes of reflecting-in-action) and (2) the written reflections included in student teachers' portfolios. Reflection in this context refers to the examination of the documented teaching experiences with the mobile app and written reflections were added before or after the teaching session (e.g. for purposes of reflecting-on-action to evaluate teaching and improve future teaching situations). We also administered a questionnaire to the student teachers before and after the teaching internship to measure the student teachers' outcomes. The analysis was based on previous research on digital portfolios, suggesting that reflection in teacher education involves the elements of process, context and outcomes (Adadan & Oner, 2018). All ethical issues of the present study comply with the ethical standards of the German Educational Research Association. Consequently, data analysis was conducted based on anonymous data.

4.2. Context and participants

Student teachers typically perform a four-week teaching internship in primary schools as part of a teacher education programme in the German-speaking area of Switzerland. During the teacher education programme, student teachers are involved in various mandatory internships in schools that start from the initial observation of a regular teacher until taking full responsibility for a classroom. In this study, during the four-week teaching internship, student teachers were assigned to a class and taught all the primary school curriculum subjects. The main subjects were German, mathematics and an elementary science subject, which consisted of a combination of geography, history, physics and biology. The student teachers were assigned to teach in pairs; thus, each classroom had two student teachers co-teaching together. A mentor regularly visited the classroom to provide feedback and support as part of the teacher education programme. A total of 44 student teachers participated in this study.

To support documentation, reflection and collaboration during their classroom internships, student teachers used a mobile portfolio app (Petko et al., 2019). This app allows the documentation of classroom teaching with multimedia records (e.g. pictures, videos, audio) and reflection on this evidence with written comments (see a detailed description in Petko et al., 2019). Further, users can add collaborators to their portfolios (e.g. a peer student teacher or a mentor) to jointly record classroom activities or to write reflective comments. The mobile app provides a structured way to reflect on classroom evidence based on teaching standards adopted from the InTASC

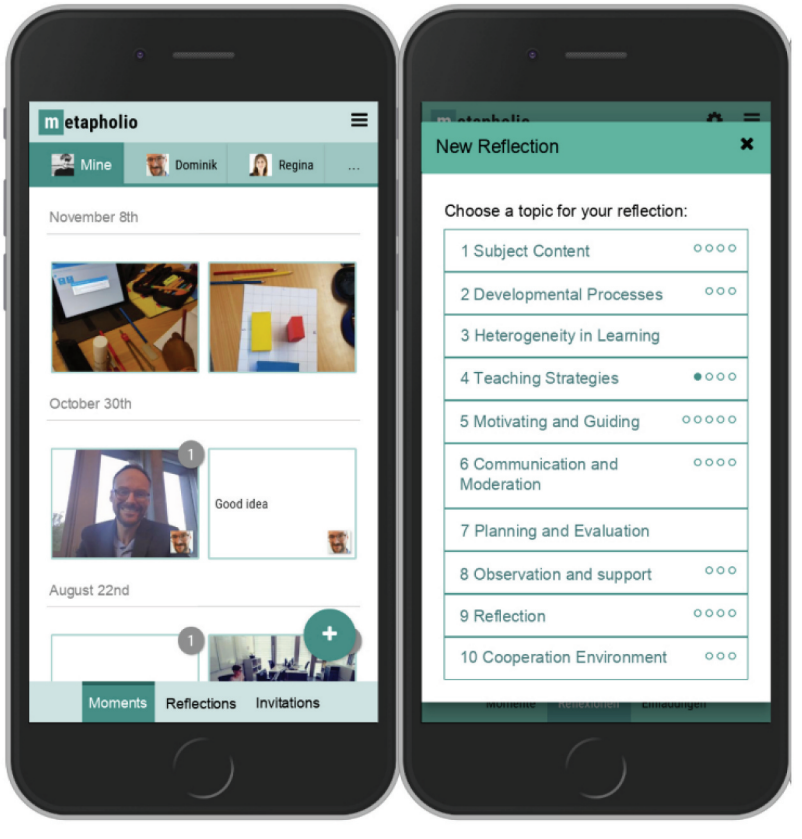

Figure 1. Screenshots from the metapholio app, from left to right: (a) Overview of collected moments, (b) Reflection prompts based on InTASC teaching standards.

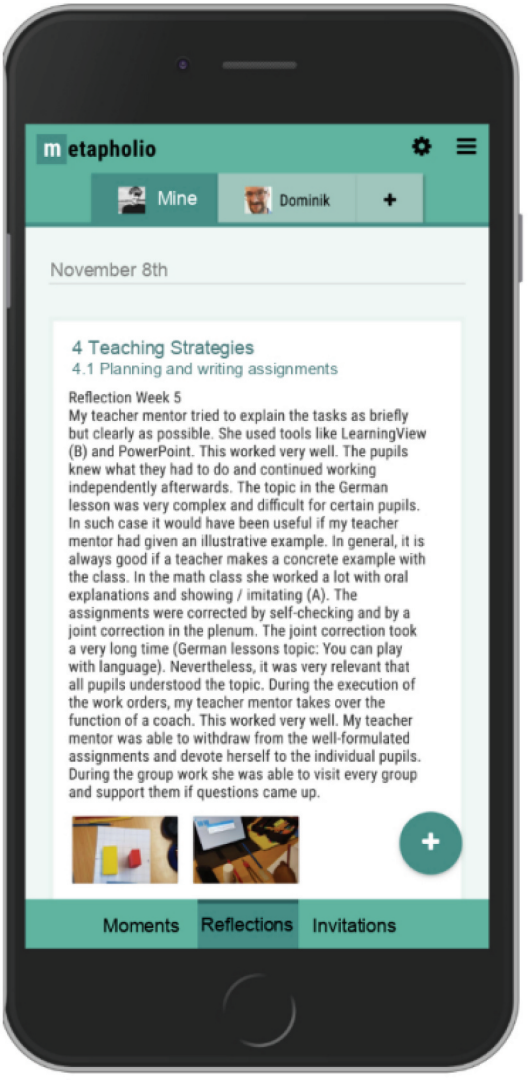

Figure 2. Screenshot from the metapholio app: example of reflection on teaching strategies.

model (CSSO, 2013). Examples of structured reflection topics based on teaching standards include elements of the teaching strategies, subject content, planning and evaluation (see Figures 1 and 2 and Table 2).

The reflection process with the mobile app provides different opportunities for action during and after teaching. During teaching, student teachers, peers or mentors can capture important incidents in the classroom with videos and pictures or can take immediate notes with audio or text to reflect on during the teaching session. After teaching, those important incidents can be further described by adding written reflections to evaluate what happened during students' and teachers' activities. One of the most important actions during this reflection process is that student teachers can identify instructional practices that should be further improved in future teaching sessions and include all the important details with situated reflections and classroom observations. Last, various collaborators can be added to the mobile portfolios and contribute by capturing important incidents and by collaboratively writing comments.

Before the teaching internship, the student teachers participated in a workshop to learn about the different functionalities of the app. During the teaching internships, student teachers were instructed to capture important classroom moments (e.g. student and teacher activities or student products) by using the multimedia functionalities of the app and to write at least two reflections per week. Since student teachers were co-teaching with a peer, the mobile app was used as a collaboration tool between them to create a digital portfolio of the teaching internship together. The student teachers' mentors also received training with the mobile app and were instructed to record classroom moments or write reflections using their mobile devices in the collaborative portfolio. In particular, a group of mentors who supported the internship process received instructions for using the mobile portfolio app as a mandatory part of their visit to schools, whereas another group of mentors received a recommendation for the optional use of the mobile portfolio app during classroom visits.

Although the internship and reflection process was usually happening without technological support, the main difference with the mobile app is that students, teachers, peers and mentors had a common, collaborative space to add instant evidence of classroom practices with their mobile devices while moving in the classroom and later reflect based on the topics of the teaching standards. All the multimedia contents and comments are saved as a digital portfolio that may be used in the future to further reflect on the theory and practice of teaching. However, the added value of such a collaborative process with the mobile app required an analysis based on the specific context and sample described above.

4.3. Instruments and measures

We followed a mixed-method approach to evaluate teaching internships with mobile portfolios that included collaboration between student teachers, peers and mentors (see Figure 3). We performed a qualitative content analysis of the artefacts constructed with the mobile portfolio app to

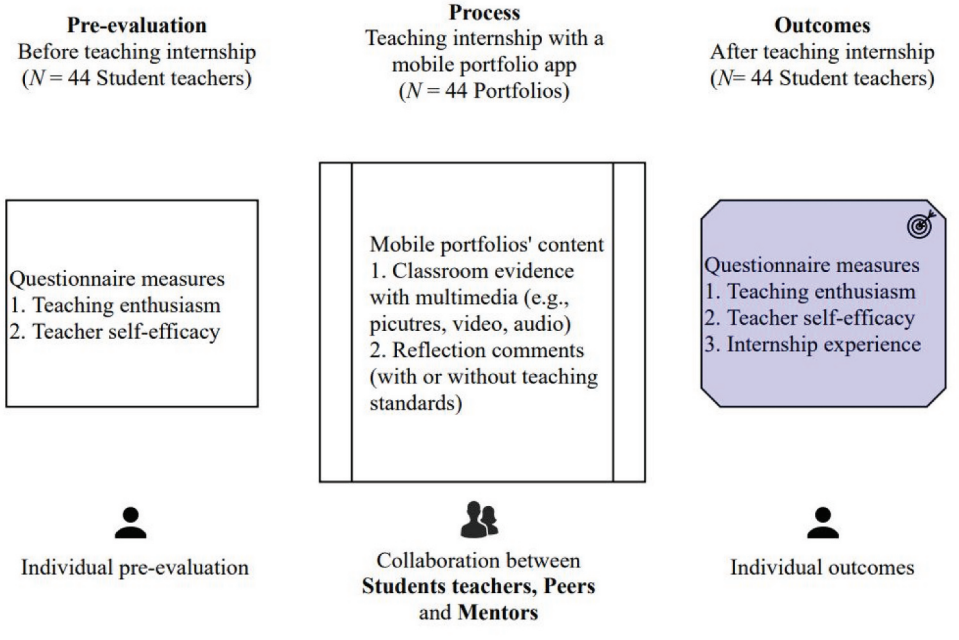

Figure 3. Evaluation of teaching internships with mobile portfolios that include collaboration between student teachers, peers and mentors.

understand the teaching internship process. We also evaluated student teachers' outcomes after the teaching internship based on three constructs: (1) teaching enthusiasm, (2) teacher self-efficacy and (3) the internship experience. To evaluate student teachers' outcomes, a pre-questionnaire was administered to student teachers before the teaching internship to measure teaching enthusiasm and teacher self-efficacy. Teaching enthusiasm was measured based on the scale described by Kunter et al. (2011), with a focus on teacher enthusiasm for teaching without evaluating enthusiasm for the teaching subject (see Appendix Table A3 in the online supplementary materials). Our instrument (Cronbach's $a = .811$) included five items on a 4-point Likert scale, ranging from 1 = *Does not apply at all* to 4 = *Fully applies* (sample items: 'I always enjoy teaching students new things', 'It is a pleasure to teach'). Teacher self-efficacy was measured with a short version of the instrument by Tschannen-Moran and Hoy (2001) (see Appendix Table A4 in the online supplementary materials). Our instrument (Cronbach's $a = .745$) included 12 items on a 5-point Likert scale about three elements: efficacy for instructional strategies (sample item: 'To what extent can you craft good questions for your students?'), efficacy for classroom management (sample item: 'How much can you do to control disruptive behaviour in the classroom?') and efficacy for student engagement (sample item: 'How much can you do to motivate students who show low interest in school work?'). After the teaching internship, another questionnaire was administered to student teachers to evaluate the same constructs: (1) teaching enthusiasm (Cronbach's $a = .895$), (2) teacher self-efficacy (Cronbach's $a = .726$) and (3) their internship experiences. To measure internship experiences, we adopted an instrument (Cronbach's $a = .970$) by Moser and Hascher (2000) that includes 44 items for professional development after the internship (see Appendix Table A5 in the online supplementary materials) on a 5-point Likert scale, ranging from 1 = *Very low* to 5 = *Very high*, including aspects such as the role of the teacher (sample item: 'Explaining your own educational ideas and goals'), general lesson planning (sample item: 'Familiarising yourself with a larger subject area'), lesson preparation (sample item: 'Structuring a lesson (rhythm and schedule)'), teaching (sample item: 'Activating and motivating individual students or the whole class'), evaluation (sample item: 'Analysing and judging your own teaching activities self-critically'), dealing with students (sample item: 'Actively involving students in the classroom') and school (sample item: 'Making contact with other teachers in the teaching staff').

4.4. Data analysis

4.4.1. Content analysis of mobile portfolio artefacts

To evaluate the reflection process, we performed a content analysis of the portfolio artefacts. The analysis was conducted with the qualitative software MAXQDA (Kuckartz & Rädiker, 2019). We followed a two-step process. We initially inserted the complete mobile portfolio artefact ($N = 44$) of each student teacher in the software (see Figure A1 in the Appendix in the online supplementary materials), and this represented all the documentation and written reflections during the four-week teaching internship. The unit of analysis was each portfolio entry (i.e. each time a person recorded an incident with the mobile app), which included either *captured moments with multimedia* or *written reflections*. We then used an emerging coding scheme based on the functionalities of the mobile app and the main elements of the student teachers' instructional activities. In particular, we coded captured moments with multimedia that included *pictures, video or audio* (see Table 1 and Table A1 in the Appendix in the online supplementary materials) and differentiated between the moments that record *student activity* (*SA)*, for example, students working on a classroom task, and moments that record *teacher activity (TA*), for example, student teachers walking through the classroom and providing support to students. We also coded all the moments that included *pictures* related to *student products* (*StP*), for example, students' artefacts during an exercise, or *pictures* related to *student material* (*StM*), for example, a working sheet prepared by student teachers to support a student learning activity. Lastly, we coded *pictures* that included other elements (*Oth*), such as artefacts for classroom management or classroom space distribution.

Table 1. Coding scheme for mobile portfolios in teaching internships.

Artefact type	Code	Description	Multimedia
Captured moments with multimedia	SA	Student activity	Pictures or video or audio
	TA	Teacher activity	Pictures or video or audio
	StM	Student supporting material	Pictures
	StP	Student product	Pictures
	Oth	Other	Pictures
Written reflections	RM/TS	Reflection with multimedia and reference to teaching standards	Picture or video or audio
	RM	Reflection with multimedia but without reference to teaching standards	Pictures or video or audio
	R/TS	Reflection without multimedia but with reference to teaching standards	
	R	Reflection without multimedia and without reference to teaching standards	

Table 2. The coding scheme of written reflections according to the functionalities of the mobile app regarding core InTASC teaching standards.

Categories (InTASC standard)	Code	Description
Subject content (Content)	C	Reflection on subject-specific scientific and subject-specific didactic knowledge
Developmental processes (Learner and learning)	D	Reflection on the development process of learners (e.g. how students learn and how to support cognitive, social and personal development)
Heterogeneity in learning (Learner and learning)	H	Reflection on different pathways to learning and creation of situations for each individual learner
Teaching strategies (Instructional practice)	TS	Reflection on a variety of instructional strategies to promote appropriate skills to learners
Motivating and guiding (Learner and learning)	M	Reflection on motivational processes of learners and classroom management
Communication and moderation (Learner and learning)	CM	Reflection on verbal and non-verbal forms of communication with learners to promote active learning, collaboration and mutual exchange in the classroom.
Planning and evaluation (Instructional practice)	PE	Reflection on the planning, implementation and evaluation of teaching based on an understanding of content, lesson plan, guiding ideas of the school and professional science background
Observation and support (Instructional practice)	OS	Reflection on various assessment systems to continuously assess, ensure and promote the cognitive, social and personal development of learners
Reflection and professional learning (Professional responsibility)	R	Reflection on the impact of decisions and activities on others (learners, parents and other teachers) and professional development
Cooperation environment (Professional responsibility)	CE	Reflection on professional engagement with school, social environment, relationships with colleagues and parents

Table 3. Descriptive analysis of qualitative codes.

	Mean	Median	*SD*	Min.	Max.
Captured Moments	68	56	57.7	20	352
Student activity	33.3	26	30.1	2	157
Teacher activity	8.68	3	18.3	0	120
Student material	9.84	8	7.29	1	29
Student product	10.3	7.5	9.33	0	38
Other	6	4.5	5.49	0	23
Written reflections	16.3	10	18	1	115
RM/TS	5.73	3	13.4	0	88
RM	1.09	0	2.33	0	10
R/TS	5.52	5.5	4.73	0	27
R	3.95	1	7.12	0	30

Regarding the written reflections, we coded comments based on the functionalities provided in the mobile app (i.e. structured reflection prompts). Thus, we coded written reflections that included a link to captured moments (multimedia) and a pre-selected teaching standard (*RM/TS*). Further, we coded written reflections that included a link to captured moments but without pre-selected teaching standards (*RM*). Lastly, we coded all written reflections that did not provide a link to captured moments with multimedia but a pre-selected teaching standard (*R/TS*) and written reflection that solely provided a comment without associated captured moments or teaching standards (*R*).

One individual researcher went through the mobile portfolio artefacts and defined an initial open coding scheme. The codes were discussed with another researcher until a consensus was reached on the main categories. Adjustments were made based on the discussion. For example, after the discussion, the categories of *student activity* and *teacher activity* were determined to differentiate between student and teacher activities with all the multimedia records (videos, audio, pictures) in the classroom. The student teachers also used the mobile portfolio app in collaboration with peers or mentors; thus, we included a code about the person who inserted a record in the portfolio (student teacher, peer or mentor). The reason for creating this code was to evaluate the recorded activity of each collaborator. We coded all written reflections that included pre-selected teaching standards to identify the main topics of reflection (see Table A2 in the Appendix in the online supplementary materials for examples of written reflections). We defined a coding scheme according to the functionality offered in the mobile app to pre-select reflection topics adopted from InTASC standards (see Figure 1). Table 2 shows the 10 main categories of written reflections, which included pre-selected teaching standards.

We then used descriptive statistics (e.g. mean, median, standard deviation, percentage) to report the frequency of appearance of the above codes based on the content analysis. Thus, each portfolio had its descriptive metrics according to the coding scheme. We conducted a cluster analysis to differentiate portfolios groups according to the activity of the three collaborators (peers, mentors and student teachers).

4.4.2. Outcomes after the internship experience with mobile portfolios

As explained above, we used a pre- and post-questionnaire to evaluate the outcomes of the internship experience with a mobile portfolio. We then triangulated the questionnaire data with a content analysis of mobile portfolios by assigning the responses to the questionnaires to the particular student teacher who created a portfolio. Based on this analysis, we were able to associate the documentation with the mobile portfolios with the outcomes. We performed correlation analysis to observe patterns in our data and relationships between the content of mobile portfolios and student teachers' outcomes. Multiple regression analysis was performed to determine differences in outcomes between clusters of portfolios according to collaborators' contributions to the portfolios.

5. Results

5.1. Descriptive analysis of mobile portfolio content

Ourdescriptive analysis showed that, on average, almost 80% of the total portfolio entries were captured moments with multimedia, with a range between 20 and 352 entries, which shows variance in student teachers' and collaborators' (peers, mentors) activity when documenting classroom evidence (see Tables 2 and 3).

The largest portion of the captured moments was evidence of *student activity* recorded with pictures, video or audio (on average, 47%), followed by pictures of *student material* (16.6%) or *student products* (15.8%) from classroom activities. A smaller portion of the captured moments (almost 10%) were evidence of *teacher activity* (*TA*) with pictures, video or audio, and other pictures, including material for classroom management or classroom space distribution. Almost 20% of portfolio entries

included written reflections, with a range between 1 and 135 reflection entries, which also show the variance in student teachers' level of reflection. In these reflections, which were mainly written by student teachers, the largest portion (41.2%) were written comments without associated multimedia evidence but with pre-selected teaching standards *(R/TS)*, followed by reflections using associated multimedia evidence and pre-selected teaching standards *(RM/TS)*. Less frequent were reflections that did not include pre-selected teaching standards (almost 30% of the written reflections). Considering all the portfolio entries, a noteworthy observation is the high variance in student teachers' documentation and reflective activity, ranging from 21 to 487 portfolio entries.

Regarding the written reflections that included teaching standards, we observed a variety of topics (see Appendix in the online supplementary materials for the concrete examples from the app). The category *cooperation environment* (on average 1%) was the least frequent, thus reflecting the professional engagement of student teachers and their relationships with colleagues and the school. The most frequent categories were *teaching strategies* (16.8%), *motivating and guiding* (15.1%), *developmental processes* (13.7%) and *planning and evaluation* (13.1%), which covered almost 60% of all these written reflections in each portfolio. The other categories, including *reflection* (10.5%), *heterogeneity in learning* (9.21%), *subject content* (7.22%), *communication and moderation* (5.49%) and *observation and support* (3.69%), appeared less frequently, and these categories covered almost 37% of all the written reflections with pre-selected teaching standards in each portfolio.

As an example of *teaching strategies*, a teacher reflected based on the evidence provided (e.g. pictures, videos and audio) and mentors facilitated the process of revising teaching methods or introducing new ideas as follows:

> The mentor told me that she thought the idea of the mind map was very good, but that I could extend it. Instead of only naming known foods, one could also show foods based on the picture and then have them named or revealed. That would have been an extended possibility. This took place in the subject English. (ST1)

In another example of reflection for *motivating and guiding*, one student teacher explained how the instructional material could motivate students and whether it worked well in the classroom as follows:

> In the subject German, I activated the students based on a picture. The blurred pictures allowed the students to express what they thought was in the picture. Then I used the picture of the bat to start off further questions. What do the students already know about these animals? The topic could thus be introduced easily and this increased the learners' motivation. The text comprehension worked surprisingly well. (ST2)

Finally, as an example of *developmental processes*, one student teacher reflected on how students learned and how to support their development as follows:

> In the lesson on the subject 'Nature, People, Society', the students dealt with four tasks in a relatively self-directed way. In two of the tasks, they did written work, the other two tasks were done actively. The aim was for the students to learn about the importance of joints and the structure of bones. They got to know these areas better by means of worktables. They were intensively engaged in the exercises on these tables, even though it took about 1 hour. They actively worked on the worksheets and activities. (ST3)

5.2. Collaborators and differences regarding student teacher and mentor involvement in portfolios

Considering the social context and collaborators who constructed portfolios with their mobile devices, most of the portfolio entries were from student teachers (on average, 71.6% of all entries), followed by mentors (on average, 15.9%) and peers (on average, 12.5%). As Table 4 shows, the collaborators (peers and mentors) mainly recorded classroom moments and wrote reflections less frequently. Reflections were mostly written by student teachers.

Another observation is that a group of portfolios included contributions by all collaborators (student teachers, peers and mentors), whereas another group of portfolios did not include

Table 4. Descriptive statistics of student teachers', peers' and mentors' activities with the mobile portfolio app.

	Mean	Median	Min.	Max.
Student teacher all	54.6	44.2	16	242
Student moments	41.8	37.7	6	200
Student reflections	12.8	9.46	1	42
Peer all	10.5	14.3	0	58
Peer moments	10.2	14.4	0	58
Peer reflections	0.23	0.815	0	4
Mentor all	12.7	18.0	0	69
Mentor moments	11.5	18.1	0	69
Mentor reflections	1.12	3.15	0	14

contributions by mentors. This occurred because half of the mentors received instructions for mandatory use of the mobile app, whereas the other half of the mentors received a recommendation for optional use. For this reason, we analysed the portfolios that included mentors' entries ($n = 23$ portfolios) and those that did not include mentors' entries ($n = 21$ portfolios). Mann–Whitney U tests were run to understand differences in portfolio content with/without mentors' contributions (see Table 5) because the data were not normally disturbed. As indicated above, most portfolio entries included *student activity*, but when mentors also recorded moments, a significantly higher number of *videos* were found in portfolios. Although we observed a higher number of student products and reflections without multimedia or teaching standards in the group with mentors' input in portfolios, these differences were not significant. However, a significantly higher number of pictures (*Other*) regarding classroom management or classroom space distribution was found in portfolios that did not include mentors' input. The same analysis was repeated to differentiate these two portfolios' groups concerning the reflection topics. Although we observed that student teachers reflected more often on topics related to the learner and learning (*motivation and guiding, developmental processes*), when mentors included their input in portfolios, these differences were not significant. We also observed a higher number of reflections about *teaching strategies* in the group that did not include mentors' input, but the difference was also not significant.

As an example of a collaborative portfolio that included mentor input, one student teacher reflected on the instructions given to students, classroom management issues and feedback and selected the teaching standard *motivating and guiding* as follows:

> When I teach and give an assignment, I always say clearly how it should be done. I have learned in this internship that I-messages are sometimes very useful and sometimes help more than anything else. The relationship with

Table 5. Descriptive statistics per portfolio group (with mentor activity: $n = 23$, without mentor activity, $n = 21$) and Mann–Whitney U test results.

	M (SD)				
	With mentor	Without mentor	*U*	*Z*	*P*
Captured Moments	64.8 (42.41)	71.6 (71.77)	261	.458	.647
Student activity	34.4 (25.84)	32 (34.81)	292.50	1.199	.230
Teacher activity	5.70 (6.86)	12 (25.37)	202	−.934	.350
Student material	8.30 (6.62)	11.5 (7.75)	181.50	−1.413	.158
Student product	12 (10.22)	8.38 (8.06)	299	1.353	.176
Other	4.39 (3.6)	7.76 (6.64)	158.50	−1.963	.050
Multimedia					
Pictures	24.70 (15.92)	27.67 (17.6)	206	−.835	.404
Video	9.22 (12.07)	3.9 (3.98)	353.50	2.644	.008
Audio	1.48 (3.96)	0.19 (0.4)	302	1.76	.077
Written reflections	15.3 (9.93)	17.4 (24.24)	266.50	.590	.555
RM/TS	3.04 (2.68)	8.67 (18.92)	213	−.677	.498
RM	1.39 (2.29)	0.76 (2.38)	308	1.93	.053
R/TS	5.35 (3.17)	5.71 (6.08)	260	.437	.662
R	5.48 (8.99)	2.29 (3.78)	308	1.93	.053

> the students is cultivated. If things get a bit noisy, they are told to keep it down. I have improved and learned this since the beginning of my internship. At the end of the lesson, more attention is paid to giving the students feedback. This can be about how they have worked or how well they have solved a task. More positive feedback may also be given. (ST4)

In another example of portfolio without mentor input and a reflection on *motivating and guiding students*, a student teacher reflects on the time management issues as follows:

> I did a text comprehension today in the subject German. I planned one lesson for this. In the end, however, I realised that I had underestimated the time that is required. By introducing the lesson appropriately and discussing an example question in plenary, I am sure that the students understood the content of the text. I just have to plan for more time next time. (ST6)

Considering the two examples, the first one that includes mentor input elaborates on multiple topics such as instruction, classroom management and feedback while the second one without the input given by mentors included reflection only on the topic of time management.

5.3. Correlations between portfolios content and student teachers' outcomes

Spearman's rank-order correlations were run to determine the relationship between the portfolios content (frequency of qualitative codes) considering the reflection process and student teachers' outcomes because the data were not normally distributed. There was a moderate, positive correlation between the frequency of portfolio entries that included pictures of *student material* and the overall *internship experience* (see Table 6). This relationship was also found when considering the percentage of the overall captured moments that included *student material* r_s (42) = .399, p = .007. Further, there was a moderate, positive correlation between the number of pictures that show *student material* and the number of multimedia records about *student activity* in the classroom. There was also a weak, positive correlation between the frequency of portfolio entries that included written reflections about *teaching strategies* and the development (delta value) of *teachers' self-efficacy in student engagement* (see Table 7). This relationship was also found when we considered the percentage of overall written reflections that included *teaching strategies* (r_s (42) = .358, p = .017).

We also analysed the portfolios content based on collaborators' activity and how this related to student teachers' outcomes after the teaching internship. The results showed a weak, positive correlation between the peer activity (number of contributions in portfolios) and the development of student *teachers' self-efficacy* from pre-test to post-test (see Table 8).

5.4. Cluster analysis and teacher self-efficacy outcomes

We further analysed the three collaborators' contributions (student teacher, peer and mentor) to mobile portfolios to understand whether they influence student teachers' outcomes after the internship. Considering the content analysis, we explored whether different portfolios groups had different collaborative characteristics and how these portfolios groups related to student teachers'

Table 6. Spearman's correlation matrix between collected moments in portfolios and student teachers' outcomes (teacher self-efficacy, teaching enthusiasm, internship experience).

	1	2	3	4	5	6	7
1. Student activity							
2. Teacher activity	0.477**	–					
3. Student product	0.370*	0.205	–				
4. Student material	0.191	0.396**	0.103	–			
5. Other	−0.047	0.025	0.293	0.245	–		
6. Teacher self-efficacy delta	0.201	0.276	0.147	0.042	−0.074	–	
7. Teaching enthusiasm delta	0.090	0.201	0.113	0.194	−0.080	0.348*	–
8. Internship experience	−0.035	0.062	−0.067	0.394**	−0.003	0.212	0.247

Note: *p < .05, **p < .01, ***p < .001.

Table 7. Spearman's correlation matrix between written reflections on teaching strategies and teacher self-efficacy.

	1	2	3	4
1. Reflections on teaching strategies	—			
2. Teacher self-efficacy (TSfE) delta	0.240	—		
3. TSfE_student engagement delta	0.315*	0.684***	—	
4. TSfE_instructional strategies delta	0.231	0.784***	0.378*	—
5. TSfE_classroom management delta	−0.017	0.617***	0.071	0.294

Note: *$p < .05$, **$p < .01$, ***$p < .001$.

Table 8. Spearman's correlation matrix between collaborators' activity (student teacher, peer, mentor) and student teachers' outcomes (teacher self-efficacy, teaching enthusiasm, internship experience).

	1	2	3	4	5
1. Student teacher activity	—				
2. Peer activity	−0.054	—			
3. Mentor activity	−0.208	−0.121	—		
4. Teacher self-efficacy delta	−0.052	0.383*	−0.079	—	
5. Teaching enthusiasm delta	0.155	0.232	0.074	0.348*	—
6. Internship experience	0.199	0.140	−0.004	0.212	0.247

Note: *$p < .05$, **$p < .01$, ***$p < .001$.

outcomes. We performed a cluster analysis to create groups of portfolios with respect to the three collaborators. The analysis focused on the number of portfolio entries by each collaborator. We defined three categorical variables with high and low number of portfolio entries according to the frequency of entries by each collaborator using the median (student, mentor, peer, where 0 represented low number of entries and 1 represented high number of entries). We then performed a K-Modes cluster analysis because we used categorical data to identify our cluster solution. The analysis was performed with the package 'klaR' in *R*-4.1.2. The results showed a three-cluster solution (see Table 9). Cluster 1 included portfolios ($n = 16$) with high mentors' activity, high peers' activity and low student teachers' activity. Thus, Cluster 1 had portfolios whose main characteristics were the mentors' input and peers' inputs and could be regarded as 'high collaboration of peers and mentors'. Cluster 2 included portfolios ($n = 18$) with high peers' activity and low mentors' and student teachers' activity. Thus, portfolios in Cluster 2 were characterised by a high number of entries by peers and could be regarded as 'medium collaboration, especially by peers'. Cluster 3 ($n = 10$) included portfolios with low mentors' and peers' activity but high student teachers' activity. Cluster 3 had portfolios with less collaborative content creation because both mentors and peers were inactive; thus, the cluster could be regarded as 'low collaboration by peers and mentor'. Table 9 shows descriptive statistics regarding gain scores of student teachers' outcomes (difference from pre-test to post-test) in the three clusters. It is noteworthy to observe that student teachers whose portfolios included higher peers' and mentors' activity (Clusters 1 and 2) showed a higher increase from pre-test to post-test in teacher self-efficacy and teaching enthusiasm compared to Cluster 3, in which collaborators were inactive.

We further analysed whether student teachers' outcomes were significantly different according to these three types of created portfolios (three clusters) using the cluster membership and by merging

Table 9. Gain scores of student teachers' outcomes with respect to teacher self-efficacy and teaching enthusiasm across the three clusters of their mobile portfolios.

	Cluster 1 'High collaboration of peers and mentors' *M (SD)*	Cluster 2 'Medium collaboration, especially by peers' *M (SD)*	Cluster 3 'Low collaboration by peers and mentors' *M (SD)*
Teacher self-efficacy _delta	0.25 (0.32)	0.30 (0.32)	0.07 (0.12)
Teaching enthusiasm_delta	0.11 (0.30)	0.11 (0.37)	−0.16 (0.46)

the questionnaire data for each student teacher. Considering our sample size, we performed a multiple linear regression analysis (Jenkins et al., 2020) with teacher-self efficacy or teaching enthusiasm at post-test as the outcome variable. As predictor variables, we used teacher-self efficacy or teaching enthusiasm at pre-test and the cluster variable. Cluster 1 was the reference group because it included a higher number of collaborative activities by mentors and peers. Table 10 shows the multiple linear regression results for teacher self-efficacy.

The results showed that these predictor variables explained almost 40% of the variance in teacher self-efficacy in the post-test: F (3, 40) = 8.47, p = .000, R^2 = 0.389. There was a significant difference between Cluster 1 and Cluster 3 in teacher self-efficacy gains from the pre-test and post-test. This result suggests a difference in teacher self-efficacy gains when student teachers constructed portfolios with 'high collaboration of peers and mentors' compared to student teachers who constructed portfolios with 'low collaboration by peers and mentors'. The multiple linear regression model regarding teaching enthusiasm did not show differences between the three clusters (see Tables 10 and 11).

6. Discussion

The project used a novel mobile portfolio app to strengthen the collaboration between student teachers, peers and mentors during teaching practice. The study investigates whether this approach has the expected positive impact on the actual interaction between them and as a result, on teacher self-efficacy and teaching enthusiasm. Our first research question **(RQ1)** focused on the content of mobile portfolios to examine the reflection process with peers and mentors. In this study, 44 student teachers worked with peers and mentors to capture multimedia evidence in the classroom and to write reflections during teaching internships in a German-speaking area of Switzerland. Our analysis showed that mobile portfolios often included depictions of student activity in classrooms (e.g. when students performed a learning task), recorded with photographs, videos and audios. Depictions of teacher activity (e.g. teacher support during a learning task) were less frequent. Portfolios also often included records of student materials (e.g. exercise sheets) and pictures of student products (e.g. final students' artefacts), which also provided further evidence of student activity in the classroom. With regard to reflection processes, we observed that student teachers frequently linked their reflections to teaching standards. An explicit link to the multimedia evidence was less frequent. Artefacts seemed to be helpful in documenting internship experiences, as a majority of student teachers recorded a large number of photos, videos and other records; however, the links between artefacts and reflections were

Table 10. Multiple linear regression on teacher self-efficacy.

Predictor	Estimate	SE	*t*	*p*
Intercept[a]	2.1308	0.479	4.448	<.001
TSfE_pre	0.5179	0.1216	4.258	<.001
Clusters_collaborators				
2–1	−0.013	0.092	−0.141	0.889
3–1	−0.2277	0.1071	−2.127	0.04

[a]Represents reference level.

Table 11. Multiple linear regression on teaching enthusiasm.

Predictor	Estimate	SE	t	p
Intercept[a]	0.893	0.546	1.63418	0.11
te_pre	0.782	0.151	5.18745	<.001
Clusters_collaborators:				
2–1	−7.83e − 4	0.125	−0.0062	0.995
3–1	−0.219	0.152	−1.4449	0.156

[a]Represents reference level.

surprisingly low. This aligns with findings from other studies on web-based portfolios, which also found varied levels of reflection. The selection of artefacts and their connections with teaching standards requires an advanced set of skills and knowledge by teachers (Moran et al., 2013; Strudler & Wetzel, 2005). Although student teachers did not seem to struggle with links to teaching standards (Moran et al., 2013), the selection of artefacts and subsequent reflection might be more challenging (Nagro & deBettencourt, 2018). The collection of artefacts might also serve a specific purpose, apart from reflection. Kearney (2009) also found evidence that these digital records have emotional purposes and affirmative functions rather than serving as a starting point for reflection. However, Pelliccione and Raison (2009) explained the need to support teachers and provide guidance for an effective reflection using portfolios' artefacts and enhance the scholarship of teaching. Thus, the suggestions provided in previous studies on web-based portfolios such as the structuring of written reflections seem to be confirmed in the context of mobile portfolios that seek to support spontaneous and situated learning by creating evidence (Camacho & Tur, 2012; Tur et al., 2019).

Previous findings on teacher reflection in classroom internships suggest that student teachers need to develop skills for observing critical and meaningful moments for reflection in the classroom and acting as professional observers (Nagro & deBettencourt, 2018). To support subsequent teacher reflections in this study, the mobile portfolio app included topics related to teaching standards. Our study showed that the highest average percentage of reflections was related to teaching strategies (InTASC: instructional practice). Further, reflection topics about motivating and guiding the learner and developmental processes (InTASC: learner and learning) and reflection (InTASC: professional responsibility) were also frequent. However, all the reflection topics, such as planning and evaluation (InTASC: instructional practice) and subject content (InTASC: content), were identified in the portfolios, which shows that student teachers used a variety of teaching standards to structure their written reflections. The reflections on leadership and collaboration were less frequent, which aligns with previous findings (LaPaglia, 2019), but this could also be attributed to the lack of relevant videos or photos during the teaching internship. Reflections on teaching strategies have been identified in studies regarding the development of pedagogical reasoning with digital portfolios (Harris & Phillips, 2018; Koehler et al., 2017; Smart et al., 2013), and our analysis shows that mobile devices can also facilitate this process by collecting evidence collaboratively in the classroom.

In our study, reflection occurred within a *social context* because student teachers collaborated with peers and mentors to construct their portfolios and had the opportunity to discuss artefacts and reflections (Adadan & Oner, 2018; Kloser et al., 2021). Investigating the activities of the different actors, the student teachers created the majority of the content of their portfolios and wrote almost all written reflections. However, mentors and peers also facilitated the documentation and construction process by capturing multimedia evidence. When mentors contributed, more videos appeared in the portfolios, which assisted in showing a more complete 'picture' of the classroom activities, especially those of student teachers. This relates to research on video-based feedback (Gaudin & Chaliès, 2015) when using mobile devices in practicums (Hadjistassou & Allen, 2018), and our study shows that mentors frequently capture videos of authentic classroom practice with their mobile devices. In summary, the main change that this mobile portfolio app can introduce for teaching training and teaching internships compared to traditional e-portfolios or without the use of technology, is that collaborators work together from the noticing part not only in posterior reflection. This happens with the collection of observations and notes in practical situations during the lesson by everyone who is invited in the portfolio.

Our second research question **(RQ2)** examined the relationship between this reflection process with peers and mentors and student teachers' outcomes, which were measured by self-reported ratings of teacher self-efficacy, teaching enthusiasm and internship experiences. Our results regarding *the outcomes* showed that specific types of mobile portfolio content relate to student teachers' outcomes. In particular, pictures of *student material* correlated with more positive internship experiences. The reflections on *teaching strategies* correlated with student teachers' self-efficacy gains regarding their abilities for student engagement. We also found correlations between the number of portfolio entries by peers and teacher self-efficacy gains, which showed a connection between peers'

activity and teacher self-efficacy outcomes. To further understand collaborators' influence on these variables, a cluster analysis showed three distinct patterns. One group of portfolios showed low collaboration by mentors and peers, another group showed high collaboration by mentors and peers, and the third group showed medium collaboration, especially by peers. Our multiple regression analysis indicated that when student teachers constructed portfolios with low contributions from collaborators, their self-efficacy gains were lower after the internship compared to student teachers who constructed portfolios with high contributions from peers and mentors. These findings might align with other studies that found evidence of a positive relation between teachers' portfolios and mastery experience (Iaochite & Costa, 2020), reflections and self-efficacy beyond portfolios (Moradkhani et al., 2017; van Dinther et al., 2015), collaborative reflection and self-efficacy in general (Bokiev et al., 2017; Hamilton, 2020). The main difference in our study is that mentors' and peers' collaborative use of the mobile portfolio app can add visibility and connectivity in the reflection process (Lam, 2022) and influenced student teachers' self-efficacy.

This study has several limitations, including the fact that its findings cannot be easily generalised to other teacher education contexts or other digital portfolios with mobile devices due to the specific collaborative case, the small sample size and the specific functions of the mobile app that we analysed. However, one main strength of our study is that we used mixed methods to understand the relationships between portfolio content and teacher outcomes and the fact that we analysed an authentic setting of school classroom internships. This study also provides further evidence supporting our previous experimental study (Michos et al., 2022) that showed positive developments in teaching enthusiasm with the mobile portfolio app, especially when mentors were involved in this process, although we did not find evidence of teacher self-efficacy gains compared to individual uses of the app. However, our content analysis of portfolios showed that mentors and peers also had an impact on the development of teacher self-efficacy.

7. Conclusions

The use of mobile portfolios is a prominent approach for ubiquitous and situated learning in the context of teacher education. However, few studies have provided empirical evidence regarding the use and content of mobile portfolios and their benefits for student teachers during teaching internships. Based on our mixed-methods study, we present results that show the influence of mentors and peers on the content of mobile portfolios and on teacher self-efficacy gains, teaching enthusiasm and the evaluation of internship experiences. These results have practical implications for teacher education internships with mobile portfolios. Regarding the internship process, although student teachers seem to incorporate teaching standards into their reflection, further work is needed to facilitate student teachers' connecting teaching competencies with specific evidence captured in the classroom (e.g. connecting their reflections on teaching strategies with evidence of created student materials). One possible way to facilitate student teachers in this regard is to provide further training with reflection activities before or after the teaching internship (e.g. reflecting with teacher educators and mentors on the final portfolio artefacts) and further support the development of skills related to meaningful observations for reflection in classrooms. We also showed that the *social context* (e.g. support by peers and mentors) had an impact on the content of portfolios. Thus, we recommend that future practices encourage collaborators (e.g. peers and mentors) to be involved in the evidence-collection process and contribute with written feedback collaboratively to construct knowledge on teaching practices. The use of mobile devices in the classroom requires just-in-time support, and thus additional, posterior training activities might be blended with internship experiences to enhance the collaborative reflection process. Finally, we show that the process and the context of creating mobile portfolios in teaching internships relate to the final student teachers' outcomes, especially concerning the enhancement of teachers' self-efficacy. These results are relevant for further research on mobile portfolios in teacher education as well as their practical use for reflection activities in teacher education programmes.

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References

Adadan, E., & Oner, D. (2018). Examining preservice teachers' reflective thinking skills in the context of web-based portfolios: The role of metacognitive awareness. *Australian Journal of Teacher Education (Online)*, *43*(11), 26–50. https://doi.org/10.14221/ajte.2018v43n11.2

Ahmed, E., & Ward, R. (2016). Analysis of factors influencing acceptance of personal, academic and professional development e-portfolios. *Computers in Human Behavior*, *63*, 152–161. https://doi.org/10.1016/j.chb.2016.05.043

Al-Awidi, H. M., & Alghazo, I. M. (2012). The effect of student teaching experience on preservice elementary teachers' self-efficacy beliefs for technology integration in the UAE. *Educational Technology Research & Development*, *60*(5), 923–941. https://doi.org/10.1007/s11423-012-9239-4

Aprea, C., & Cattaneo, A. A. (2019). Designing technology-enhanced learning environments in vocational education and training. In D. Guile & L. Unwin (Eds.), *Wiley International Handbook on Vocational Education and Training* (pp. 373–394). Wiley. https://doi.org/10.1002/9781119098713.ch19

Baran, E. (2014). A review of research on mobile learning in teacher education. *Journal of Educational Technology & Society*, *17*(4), 17–32. https://www.jstor.org/stable/pdf/jeductechsoci.17.4.17.pdf

Barrett, H. (2010). Balancing the two faces of ePortfolios. *Educação, Formação & Tecnologias*, *3*(1), 6–14.

Berrill, D. P., & Addison, E. (2010). Repertoires of practice: Re-framing teaching portfolios. *Teaching and Teacher Education*, *26*(5), 1178–1185. https://doi.org/10.1016/j.tate.2010.02.005

Birello, M., & Pujola Font, J. T. (2020). The affordances of images in digital reflective writing: An analysis of preservice teachers' blog posts. *Reflective Practice*, *21*(4), 534–551. https://doi.org/10.1080/14623943.2020.1781609

Bokiev, U., Bokiev, D., Othman, M., Ismail, L., & Aralas, D. (2017). Online teaching portfolio as a catalyst for professional development. *The International Journal of Academic Research in Business & Social Sciences*, *7*(4), 440–452. https://doi.org/10.6007/IJARBSS/v7-i14/3680

Bond, H. (2019). Multicultural competency building portfolio. *International Journal of Education (IJE)*, *4*(1), 1–11. https://flyccs.com/jounals/IJEMS/paper/IJE04.VO1.pdf.

Camacho, M. M., & Tur, G. F. (2012). Exploring learners' practices and perceptions on the use of mobile portfolios as methodological tool to assess learning in both formal and informal contexts. *Procedia-Social and Behavioral Sciences*, *46*, 3182–3186. https://doi.org/10.1016/j.sbspro.2012.06.033

Çelik, S., Baran, E., & Sert, O. (2018). The affordances of mobile-app supported teacher observations for peer feedback. *International Journal of Mobile and Blended Learning (IJMBL)*, *10*(2), 36–49. https://doi.org/10.4018/IJMBL.2018040104

Chan, C. K., & Lee, K. K. (2021). Reflection literacy: A multilevel perspective on the challenges of using reflections in higher education through a comprehensive literature review. *Educational Research Review*, *32*, 100376. https://doi.org/10.1016/j.edurev.2020.100376

Clift, R. T., & Brady, P. (2005). Research on methods courses and field experiences. In M. Cochran-Smith & K. Zeichner (Eds.), *Studying Teacher Education: The Report of AERA Panel on Research and Teacher Education*, 309–424. Mahwah, NJ: Lawrence Erlbaum.

Cohen, E., Hoz, R., & Kaplan, H. (2013). The practicum in preservice teacher education: A review of empirical studies. *Teaching Education*, *24*(4), 345–380. https://doi.org/10.1080/10476210.2012.711815

Council of Chief State School Officers. (2013). *InTASC Model core teaching standards and learning progressions for teachers 1.0: A resource for ongoing teacher development*. Author. https://files.eric.ed.gov/fulltext/ED558115.pdf

Creswell, J. W., & Clark, V. L. P. (2017). *Designing and conducting mixed methods research*. Sage Publications.

Foulger, T. S., Graziano, K. J., Schmidt-Crawford, D., & Slykhuis, D. A. (2017). Teacher educator technology competencies. *Journal of Technology & Teacher Education*, *25*(4), 413–448.

Gaudin, C., & Chaliès, S. (2015). Video viewing in teacher education and professional development: A literature review. *Educational Research Review*, *16*, 41–67. https://doi.org/10.1016/j.edurev.2015.06.001

Gulzar, N., & Barrett, H. C. (2019). Implementing ePortfolios in teacher education: Research, issues and strategies. In S. Mann & S. Walsh (Eds.), *The Routledge handbook of English language teacher education* (pp. 488–506). New York: Routledge.

Gurvitch, R., & Metzler, M. W. (2009). The effects of laboratory-based and field-based practicum experience on pre-service teachers' self-efficacy. *Teaching and Teacher Education*, *25*(3), 437–443. https://doi.org/10.1016/j.tate.2008.08.006

Hadjistassou, S. K., & Allen, C. (2018). Using iPad-mediated recordings to offer contingent feedback and introduce pre-service teachers to the epistemology of the teaching practice. *Journal of Computers in Education*, *5*(3), 373–392. https://doi.org/10.1007/s40692-018-0110-4

Hamilton, M. (2020). Evidence-based portfolios: A cross-sectoral approach to professional development among teachers. *Professional Development in Education*, *46*(1), 160–174. https://doi.org/10.1080/19415257.2018.1555183

Han, I., Shin, W. S., & Ko, Y. (2017). The effect of student teaching experience and teacher beliefs on pre-service teachers' self-efficacy and intention to use technology in teaching. *Teachers & Teaching*, *23*(7), 829–842. https://doi.org/10.1080/13540602.2017.1322057

Hanuscin, D. L., Cheng, Y.-W., Rebello, C., Sinha, S., & Muslu, N. (2014). The affordances of blogging as a practice to support ninth-grade science teachers' identity development as leaders. *Journal of Teacher Education*, *65*(3), 207–222. https://doi.org/10.1177/0022487113519475

Harris, J., & Phillips, M. (2018). If there's TPACK, is there technological pedagogical reasoning and action? *Society Information Technology & Teacher Education International Conference* (pp. 2051–2061). Association for the Advancement of Computing in Education (AACE).

Iaochite, R. T., & Costa, R. A. D. (2020). Teacher self-efficacy and its sources in physical education teaching training experiences. *Journal of Physical Education*, *31*(1). https://doi.org/10.4025/jphyseduc.v31i1.3123

Iredale, A., Stapleford, K., Tremayne, D., Farrell, L., Holbrey, C., & Sheridan-Ross, J. (2020). A review and synthesis of the use of social media in initial teacher education. *Technology, Pedagogy & Education*, *29*(1), 19–34. https://doi.org/10.1080/1475939X.2019.1693422

Jenkins, D. G., Quintana-Ascencio, P. F., & Han, G. (2020). A solution to minimum sample size for regressions. *PloS One*, *15*(2), e0229345. https://doi.org/10.1371/journal.pone.0229345

Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher*, *33*(7), 14–26. https://doi.org/10.3102/0013189X033007014

Kay, R. H. (2006). Evaluating strategies used to incorporate technology into preservice education: A review of the literature. *Journal of Research on Technology in Education*, *38*(4), 383–408. https://doi.org/10.1080/15391523.2006.10782466

Kearney, M. (2009). Investigating digital storytelling and portfolios in teacher education. In C. Fulford & G. Siemens (Eds.), *Proceedings of Ed-Media 2009 World Conference on Educational Learning, Media and Technology 187 Multimedia, Hypermedia and Telecommunications* (pp. 1987–1996). AACE.

Kennewell, S., Tanner, H., Jones, S., & Beauchamp, G. (2008). Analysing the use of interactive technology to implement interactive teaching. *Journal of Computer Assisted Learning*, *24*(1), 61–73. https://doi.org/10.1111/j.1365-2729.2007.00244.x

Kilbane, C. R., & Milman, N. B. (2017). Examining the impact of the creation of digital portfolios by high school teachers and their students on teaching and learning. *International Journal of ePortfolio*, *7*(1), 101–109.

Kloser, M., Edelman, A., Floyd, C., Martlnez, J. F., Stecher, B., Srinivasan, J., & Lavin, E. (2021). Interrogating practice or show and tell?: Using a digital portfolio to anchor a professional learning community of science teachers. *Journal of Science Teacher Education*, *32*(2), 210–241. https://doi.org/10.1080/1046560X.2020.1808267

Koehler, M., Greenhalgh, S., Rosenberg, J., & Keenan, S. (2017). What the tech is going on with teachers' digital teaching portfolios? Using the TPACK framework to analyze teachers' technological understanding. *Journal of Technology & Teacher Education*, *25*(1), 31–59.

Könings, K. D., Berlo van, J., Koopmans, R., Hoogland, H., Spanjers, I. A., Haaf, J. A., ten, V., van der, C. P., & Merriënboer van, J. J. (2016). Using a smartphone app and coaching group sessions to promote residents' reflection in the workplace. *Academic Medicine*, *91*(3), 365–370. https://doi.org/10.1097/ACM.0000000000000989

Kori, K., Pedaste, M., Leijen, Ä., & Mäeots, M. (2014). Supporting reflection in technology-enhanced learning. *Educational Research Review*, *11*, 45–55. https://doi.org/10.1016/j.edurev.2013.11.003

Korthagen, F., & Nuijten, E. (2022). *The power of reflection in teacher education and professional development: Strategies for in-depth teacher learning*. Routledge.

Kuckartz, U., & Rädiker, S. (2019). *Analyzing qualitative data with MAXQDA*. Springer.

Kunter, M., Frenzel, A., Nagy, G., Baumert, J., & Pekrun, R. (2011). Teacher enthusiasm: Dimensionality and context specificity. *Contemporary Educational Psychology*, *36*(4), 289–301. https://doi.org/10.1016/j.cedpsych.2011.07.001

Lam, R. (2022). E-Portfolios for self-regulated and co-regulated learning: A review. *Frontiers in Psychology*, *13*, 1079385. https://doi.org/10.3389/fpsyg.2022.1079385

LaPaglia, K. (2019). *Preservice teacher dispositions: A case study of changes during a teacher preparation program*. Florida Gulf Coast University.

Laurillard, D., Stratfold, M., Luckin, R., Plowman, L., & Taylor, J. (2000). Affordances for learning in a non-linear narrative medium. *Journal of Interactive Media in Education*, *2000*(2), 2. https://doi.org/10.5334/2000-2

Lin, Q. (2008). Preservice teachers' learning experiences of constructing e-portfolios online. *The Internet and Higher Education*, *11*(3–4), 194–200. https://doi.org/10.1016/j.iheduc.2008.07.002

LoCasale-Crouch, J., Davis, E., Wiens, P., & Pianta, R. (2012). The role of the mentor in supporting new teachers: Associations with self-efficacy, reflection, and quality. *Mentoring & Tutoring Partnership in Learning*, *20*(3), 303–323. https://doi.org/10.1080/13611267.2012.701959

Lorenzo, G., & Ittelson, J. (2005). An overview of e-portfolios. *EDUCAUSE Learning Initiative*, *1*(1), 1–27.

Maharsi, I. (2019). Pre-service teachers' reflective practices through teaching practicum e-portfolios. *Proceedings 2019 5th International Conference Education Training Technologies* (pp. 125–129). https://doi.org/10.1145/3337682.3337706

Mauroux, L., Könings, K. D., Zufferey, J. D., & Gurtner, J.-L. (2014). Mobile and online learning journal: Effects on apprentices' reflection in vocational education and training. *Vocations and Learning*, *7*(2), 215–239. https://doi.org/10.1007/s12186-014-9113-0

Michos, K., Cantieni, A., Schmid, R., Müller, L., & Petko, D. (2022). Examining the relationship between internship experiences, teaching enthusiasm, and teacher self-efficacy when using a mobile portfolio app. *Teaching and Teacher Education*, *109*, 103570. https://doi.org/10.1016/j.tate.2021.103570

Moradkhani, S., Raygan, A., & Moein, M. S. (2017). Iranian EFL teachers' reflective practices and self-efficacy: Exploring possible relationships. *System*, *65*, 1–14. https://doi.org/10.1016/j.system.2016.12.011

Moran, W., Vozzo, L., Reid, J.-A., Pietsch, M., & Hatton, C. (2013). How can technology make this work? Preservice teachers, off-campus learning and digital portfolios. *Australian Journal of Teacher Education*, *38*(5), 116–130. https://doi.org/10.14221/ajte.2013v38n5.9

Moser, P., & Hascher, T. (2000). *Lernen im praktikum. Projektbericht*. Universität Bern. Forschungsstelle für schulpädagogik und fachdidaktik. http://edudoc.ch/record/2718/files/zu02055.pdf

Nagro, S. A., & deBettencourt, L. U. (2018). Reflection activities within clinical experiences: An important component of field-based teacher education. In T. E. Hodges & A. C. Baum (Eds.), *Handbook of Research on Field-Based Teacher Education* (pp. 565–586). IGI Global. https://doi.org/10.4018/978-1-5225-6249-8.ch024

Nevins Stanulis, R., & Floden, R. E. (2009). Intensive mentoring as a way to help beginning teachers develop balanced instruction. *Journal of Teacher Education*, *60*(2), 112–122. https://doi.org/10.1177/0022487108330553

Ogan-Bekiroglu, F. (2014). Quality of preservice physics teachers' reflections in their teaching portfolios and their perceived reflections: Do they intersect? *Action in Teacher Education*, *36*(2), 157–170. https://doi.org/10.1080/01626620.2014.901197

Oner, D., & Adadan, E. (2011). Use of web-based portfolios as tools for reflection in preservice teacher education. *Journal of Teacher Education*, *62*(5), 477–492. https://doi.org/10.1177/0022487111416123

Pelliccione, L., & Raison, G. (2009). Promoting the scholarship of teaching through reflective e-portfolios in teacher education. *Journal of Education for Teaching*, *35*(3), 271–281. https://doi.org/10.1080/02607470903092813

Petko, D., Schmid, R., Müller, L., & Hielscher, M. (2019). Metapholio: A mobile app for supporting collaborative note taking and reflection in teacher education. *Technology, Knowledge & Learning*, *24*(4), 699–710. https://doi.org/10.1007/s10758-019-09398-6

Prakasha, G. S., & Kenneth, A. (Eds.). (2023). *Teacher education: An analytical approach to internship practices around the world*. Taylor & Francis.

Renner, B., Kimmerle, J., Cavael, D., Ziegler, V., Reinmann, L., & Cress, U. (2014). Web-based apps for reflection: A longitudinal study with hospital staff. *Journal of Medical Internet Research*, *16*(3), e85. https://doi.org/10.2196/jmir.3040

Renner, B., Prilla, M., Cress, U., & Kimmerle, J. (2016). Effects of prompting in reflective learning tools: Findings from experimental field, lab, and online studies. *Frontiers in Psychology*, *7*, 820. https://doi.org/10.3389/fpsyg.2016.00820

Richter, D., Kunter, M., Lüdtke, O., Klusmann, U., Anders, Y., & Baumert, J. (2013). How different mentoring approaches affect beginning teachers' development in the first years of practice. *Teaching and Teacher Education*, *36*, 166–177. https://doi.org/10.1016/j.tate.2013.07.012

Rozelle, J. J., & Wilson, S. M. (2012). Opening the black box of field experiences: How cooperating teachers' beliefs and practices shape student teachers' beliefs and practices. *Teaching and Teacher Education*, *28*(8), 1196–1205. https://doi.org/10.1016/j.tate.2012.07.008

Schon, D. A. (1983). *The reflective practitioner: How professionals think in action*. Basic Books.

Shulman, L. (1998). Teacher portfolio a theoretical activity. In N. Lyons (Ed.), *With portfolio in hand. Validating the new teacher professionalism*. (pp. 23–37). New York: Teachers College Press.

Shulman, L. S., & Shulman, J. H. (2009). How and what teachers learn: A shifting perspective. *Journal of Education*, *189*(1–2), 1–8. https://doi.org/10.1177/0022057409189001-202

Smart, V., Sim, C., & Finger, G. (2013). *A view into teachers digital pedagogical portfolios showing evidence of their technological pedagogical reasoning*. *Society Information Technology & Teacher Education International Conference*, New Orleans, LA (pp. 3380–3387). http://www.editlib.org/p/48620

Sophonhiranrak, S. (2021). Features, barriers, and influencing factors of mobile learning in higher education: A systematic review. *Heliyon*, *7*(4), e06696. https://doi.org/10.1016/j.heliyon.2021.e06696

Stefani, L., Mason, R., & Pegler, C. (2007). *The educational potential of e-portfolios: Supporting personal development and reflective learning*. Routledge.

Strudler, N., & Wetzel, K. (2005). The diffusion of electronic portfolios in teacher education: Issues of initiation and implementation. *Journal of Research on Technology in Education*, *37*(4), 411–433. https://doi.org/10.1080/15391523.2005.10782446

Sung, Y.-T., Chang, K.-E., Yu, W.-C., & Chang, T.-H. (2009). Supporting teachers' reflection and learning through structured digital teaching portfolios. *Journal of Computer Assisted Learning*, *25*(4), 375–385. https://doi.org/10.1111/j.1365-2729.2009.00312.x

Thomas, M., & Liu, K. (2012). The performance of reflection: A grounded analysis of prospective teachers' ePortfolios. *Journal of Technology & Teacher Education*, *20*(3), 305–330.

Traxler, J. (2007). Defining, discussing and evaluating mobile learning: The moving finger writes and having writ. *The International Review of Research on Open and Distributed Learning*, *8*(2), 1–12. https://doi.org/10.19173/irrodl.v8i2.346

Tschannen-Moran, M., & Hoy, A. W. (2001). Teacher efficacy: Capturing an elusive construct. *Teaching and Teacher Education*, *17*(7), 783–805. https://doi.org/10.1016/S0742-051X(01)00036-1

Tur, G., Marín, V. I., & Camacho, M. (2019). Learning on the move: The role of mobile technology in eportfolio processes for self-regulated learning. *International Studies on Law & Education*, 31/32, 189–204. http://www.hottopos.com/isle31_32/189-204Gemma.pdf

van Dinther, M., Dochy, F., & Segers, M. (2015). The contribution of assessment experiences to student teachers' self-efficacy in competence-based education. *Teaching & Teacher Education*, *49*, 45–55. https://doi.org/10.1016/j.tate.2015.02.013

Van Manen, M. (1991). *The tact of teaching: The meaning of pedagogical thoughtfulness*. Suny Press.

Zeichner, K. M., & Liston, D. P. (2013). *Reflective teaching: An introduction*. Routledge.

Zubizarreta, J. (2009). *The learning portfolio: Reflective practice for improving student learning*. Jossey -Bass/Wiley.