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Research paper

Facebook group PETCoN (Physical Education Teacher Collaborative Network). An innovative approach to PE teacher in-service training: A self-determination theory perspective



TEACHING ND TEACHER EDUCATION

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HIGHLIGHTS

• PE teacher in-service training can be delivered effectively as a CoP through Facebook groups.

• Facebook appears a promising tool to tackle the attrition issue in on-line training.

• PETCoN participation leads/contributes to increased autonomy need satisfaction.

• PETCoN increases relatedness need satisfaction and decreases relatedness frustration.

• Self-determination theory is well suited when designing teacher in-service training.

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ABSTRACT

The purpose of the study was the evaluation of a teacher in-service training program, namely "PE.T.-Co.N.", an online community of practice via Facebook groups. Drawing from Self-Determination theory (SDT), the program aimed at satisfying teachers' autonomy, competence, and relatedness needs and facilitating their autonomous motivation. Pre-post measurements showed significant improvements in key variables that can determine training success. Preliminary quantitative group insights supported by qualitative data revealed enhanced participatory dynamics in terms of members' interaction. Findings suggest that PE.T.Co.N. is a promising, innovative approach to teacher training. Implications are discussed in light of SDT.

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1. Introduction

Traditional teacher (and PE teacher) training has been frequently criticized as inadequate and ineffective (e.g., Borko, 2004; Hardman & Marshall, 2008). On the other hand, Communities of Practice (CoP) may serve as an effective alternative for inservice PE teachers' professional development (e.g., Deglau & O'Sullivan, 2006; Yoon & Armour, 2017) and there has been a call for a shift from traditional provision of teacher training to supportive and collaborative "learning partnerships" (Wenger-Traynor, 2014) such as teacher learning communities (Lieberman & Miller, 2011). Unfortunately, such collaborative-interactive groups of PE teachers rarely exist. A more contemporary, innovative approach to conventional teacher CoP, is to develop online CoP which is a very promising perspective in effectively enhancing teacher learning and practical knowledge (Baran & Cagiltay, 2010; Jonassen, Howland, Marra, & Crismond, 2008). In this line, recent research evidence with samples of pre-service and in-service teachers supports the beneficial role of social networks, such as Facebook, for educational purposes and teacher training/professional development (Bissessar, 2014; Rutherford, 2010; Çevik, Çelik, & Haşlaman, 2014).

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A key factor for teacher successful in-service training is their motivation to participate in learning situations (Gorozidis & Papaioannou, 2014; Shulman & Shulman, 2004; Van Eekelen, Vermunt, & Boshuizen, 2006). Recent research in the Greek context shows that PE teachers who decide to participate in optional or mandatory in-service training present high levels of self-determination and take part mostly for autonomous rather than for controlled reasons (Gorozidis & Papaioannou, 2014, 2016). According to Self-determination theorization (SDT; Ryan & Deci, 2000), educators would be autonomously motivated when working and training conditions actively contribute to the fulfillment of their innate psychological needs for autonomy (sense of volition/ choice), competence (sense of efficacy/efficiency on what they do) and belongingness/relatedness (sense of being accepted group member). Thus, it is expected that the creation of such conditions through online CoP, which are teacher initiated, self-regulated and supportive for cooperative social learning, would satisfy teacher needs for autonomy, competence and relatedness thus enhancing their autonomous motivation towards training/learning.

1.1. Teacher Communities of Practice

1.1.1. Teachers' networks or CoP

Research has shown that it is common practice, for teacher training, both in Greece and internationally, one or two day seminars, following a top-down approach, organized by relevant stakeholders. This practice is not facilitative to further develop teacher everyday practices. Therefore, current teacher professional development programs are often described as poor, inadequate and insufficient by researchers and educators (e.g., Garet, Porter, Desimone, Birman, & Yoon, 2001; Karagiorgi & Symeou, 2008; Villegas-Reimers, 2003). In response to this shortcoming, findings from recent research indicated that successful professional development may occur if based on collaborative professional learning (Hargreaves, 2001), where teachers collaborate, learn from each other, discuss and exchange opinions regarding their teaching. This particular kind of learning process seems to occur through professional learning communities, discourse or communities of practice, or teacher networks (Cochran-Smith & Lytle, 1999; Deglau & O'Sullivan, 2006; Lieberman & Miller, 1999; Putnam & Borko, 2000). These networks or teacher action-learning CoP draw from a social-constructivism perspective by Vygotsky (1978), Lave and Wenger (1991), and Wenger (1998), that posit that learning is defined as a social-cultural outcome and is a result of social participation, interaction, and collaboration. Therefore, these communities are often acknowledged as informal, structured communities that are formed by individuals with common professional pursuits during their leisure time (Wenger, 1998). In the present research the aforementioned theories serve as a starting point for the development of a teacher collaborative learning environment namely Physical Education Teacher Collaborative Network (PE.T.Co.N.) which was designed and implemented online as a social learning group via Facebook.

1.1.2. E-Social networks & online teacher CoP

A current form of teacher networks or learning communities are online group networks which are commonly created and operated within popular social networks (e.g., Facebook, Twitter) (e.g., Xing & Gao, 2018). Social researchers suggest that using social networking as a means for developing and operating CoP has a wide range of benefits for the teachers and it may eventually lead to the advancement of their teaching practices (Duncan-Howell, 2010; Lieberman & Pointer Mace, 2010; Ranieri, Manca, & Fini, 2012).

Overall, there is a positive attitude towards this direction among teachers (Davis, 2015). The potential significance of using such e-

communities is high as teachers have the opportunity to get involved in cooperative and interactive activities from diverse locations at minimal cost. Further, such communities offer potential advantages for the participant teachers as they could adapt their interaction with the e-community at their own pace, according to their habits and daily needs. These e-communities seem promising as this approach integrates successful elements of previous effective interventions such as flexibility, accessibility, collaboration with and support from colleagues without the limiting effects of potential common setbacks as time, location, absence from work and participation costs (Armour & Yelling, 2004, 2007).

In recent years, there has been a growing interest in the development and use of social networking by the teacher communities in favor of their professional development. Recent research findings suggest that such means provide teachers with useful and effective tools to achieve enhanced professional development and learning (Bissessar, 2014; Kelly & Antonio, 2016; Macià & García, 2016; Rehm & Notten, 2016). However, studies regarding the reasons that lead teachers' participation and sustainability of such e-communities and interactive networks, are still lacking (Hur & Brush, 2009; Ranieri et al., 2012).

A further challenge in the present study, is that digital learning environments seem very diverse from the traditional continuing professional development context and the daily practice of inservice PE teachers whose teaching and learning reality, normally takes place in a physical environment with practical tasks and activities, which is far less demanding in terms of technological competencies and skills compared to normal school classes (of other teacher specializations).

Thus, taking also into consideration the growing popularity of online learning and social networks, and the relatively scarce theoretically driven empirical research in the particular context, it is of great importance to test research hypotheses based on contemporary socio-cognitive theories (such as SDT) and to examine their applicability in this type of learning contexts/environments. As participation in CoP is generally voluntarily and the nature of online training creates minimal social pressure (Sproull & Kiesler, 1991), participants have the freedom to withdraw at any given time. This stresses the fact that creating a highly motivating e-learning environment is pivotal for challenging participants to engage actively in the training process and reduce withdrawal rates.

Having this in mind, the present online training was designed and delivered, in an unobtrusive manner emphasizing the fact that teacher participation in the group, learning tasks and the training process would be self-paced, self-regulated and volitional. Although traditional learning processes have been applied in elearning environments (Margaryan, Bianco, & Littlejohn, 2015), there is a gap in literature as to how design effective learning strategies that ensure active and sustained participation in CoP and to set the stage for a framework that considers jointly e-learning environments and autonomous learning.

1.1.3. The case of facebook/facebook groups

In the present research, Facebook was chosen due to its constantly growing global popularity (Wilberding & Wells, 2019) which also applies in the Greek context. Researchers suggest that the social network Facebook can be used for educational purposes, because it has the potential, as an informal teaching tool, to promote learning outcomes (Fewkes, McCabe, 2012; Greenhow & Lewin, 2015; Prescott, Stodart, Becket, & Wilson, 2015; Yu, Tian, Vogel, & Kwok, 2010). Despite, several constraints (e.g., privacy-security issues, file sharing limitations), researchers suggested that Facebook group function has pedagogical, social and technological affordances (e.g., sharing ideas and resources,

communicating, collaborating, easiness of use) making it a useful medium to supplement learning (Kop, Fournier, & Mak, 2011; Manca & Ranieri, 2013; O'Bannon, Beard, & Britt, 2013; Wang, Woo, Quek, Yang, & Liu, 2012).

Based on SDT and Facebook groups characteristics, we surmised that this form of social learning, may satisfy teachers' basic psychological needs for autonomy, competence, and relatedness and facilitate their autonomous motivation and learning. For instance, Facebook participation is self-initiated, provides individuals with the required autonomy, facilitates communication with the colleagues-"friends" they choose to interact with, and therefore making the use of the platform self-regulated and fun (Quan-Haase, Young, 2010; Sheldon, 2008). Additionally, user familiarity with Facebook interface might reduce the risk of technological frustration, and consequently attrition, for participants with low levels of digital skills (Manca & Ranieri, 2013), thus increasing active participation. This condition may also facilitate their competence need satisfaction during participation in online training procedures via Facebook groups. In addition, findings from relevant studies suggest that educators' professional development through social networking promotes a sense of belonging according to the group members (Davis, 2015). Above that, educators seem to highly appreciate the knowledge acquired informally due to cooperation and interaction with colleagues, because the acquired knowledge can be applied in everyday professional settings and therefore, to improve their abilities and professional skills (Armour & Yelling, 2007). Furthermore, Facebook has corresponding applications for mobile operating systems (e.g., android, ios), making it feasible for participants to "carry" the training with them, in their pocket, at all times. This feature provides participants with the possibility to participate conveniently whenever/wherever they choose.

If these assumptions are correct then teacher training via Facebook groups (or other/future social networks with similar features) might be a response to the challenge of designing effective online CoP, with the aim to motivate and actively engage participants through completion, as from what we know from Massive Open Online Courses (MOOCs) literature, attrition rates in elearning environments are very high (Jordan, 2015; Martin, Kelly, & Terry, 2018).

1.2. Theoretical foundation: self-determination theory (SDT)

According to SDT, the reasons why individuals are involved in an activity determine the type of their motivation, which may be autonomous, controlled or they may be amotivated (Deci & Ryan, 1985). When autonomously motivated, the behavior emanates from ones' self, accompanied with feelings of enjoyment, interest and satisfaction and not because of externally imposed rewards and contingencies. But, on the other hand, when one is controlled motivated, behaviors are performed out of expectations for tangible rewards, prizes, social approval, to avoid punishment or feelings of guilt or shame (Ryan & Deci, 2000).

More than 30 years of empirical evidence have shown that the more self-determined forms of motivation have greater positive impact on behavior in various life domains (Ryan & Deci, 2000, 2002). Additionally, according to SDT, individuals have innate psychological needs (for autonomy, competence and relatedness) to fulfill. An environment that provides support and fulfillment of those needs enhances one's self-determined motivation, personal growth, development and well-being (Deci & Ryan, 2000). Theoretical advancements within SDT have proposed in contrast to need satisfaction, that some contexts not only lead to low need fulfillment but they actively thwart needs satisfaction resulting in needs frustration (e.g., Chen, et al., 2015). Recent reviews have shown that needs frustration in diverse contexts lead to maladaptive

motivational outcomes and decreased well-being, or even psychopathology (Vansteenkiste & Ryan, 2013).

Following SDT definitions of basic psychological needs (see Chen et al., 2015; Deci & Ryan, 2000), for the specific context of teacher continuous training, autonomy need satisfaction corresponds to the volitional participation in a given program and selfendorsement of involvement with any given task, whilst autonomy frustration refers to the mandatory-coerced undertaking of training accompanied by feelings of pressure and control. Competence need satisfaction represents experiencing mastery over the training environment by utilizing and developing skills and expertise, whereas competence frustration denotes experiencing failure and/or ineffectiveness when interacting with training environment, tasks and educational materials. Relatedness need satisfaction concerns the sense of belongingness of a teacher with colleagues and/or instructors in the training accompanied by feelings of closeness, genuine connection and personal value, whilst relatedness frustration connotes experiencing of social alienation/ distance, isolation, exclusion or even rejection by educators and/or fellow teachers in the training.

1.2.1. SDT in teacher training-professional development

Relevant literature has consistently shown that participant motivation is a prerequisite for any learning process, and that applies equally to teachers as well as to learners. Motivation is defined as the force that drives the initiation, direction, intensity and maintenance of a certain behavior (Maehr & Braskamp, 1986).

Research results from the educational context indicate that teachers' strong volition to learn plays a pivotal role in effective learning outcomes (Van Eekelen et al., 2006). Furthermore, the major determinant of teacher participation in training as well as the adoption and application of educational innovations is their quality of motivation, that is, their autonomous motivation which is directed by their learning goals (Cave & Mulloy, 2010; Gorozidis & Papaioannou, 2014, 2016; Lam, Cheng, & Choy, 2010). This evidence is highly significant for educational systems (e.g., Greece, Netherlands, Denmark, Sweden, Norway, Ireland, Turkey) where participation in continuous professional teacher training is not a statutory obligation, and teachers' engagement in retraining is voluntary, depending on their discretion (European Commission/ EACEA/Eurydice, 2018). For instance, in Greece, where this study was conducted, external incentives (monetary or ongoing license requirements) for in-service training are absent and teachers can choose whether they would engage/participate in any provided learning event. In such contexts, SDT framework might reveal important internal motives and corresponding strategies/practices for the promotion of teachers' autonomous participation in continuous training. Accordingly, the examination of teacher cognition within motivational processes is vital in terms of their effective involvement in CoP that are implemented through social networking. However, to the authors' best knowledge, there is a scarcity of publications in relevant literature (e.g., Zhang & Liu, 2019).

1.3. Purpose: research questions & hypotheses

Drawing from social-constructivism, the overall purpose of the present study was to investigate whether specific SDT principles have applicability and can be effective in a real-life situation such as teachers' on-line training CoP context. More specifically, based on these SDT principles, the PE.T.Co.N. methodology was designed (as described below), and evaluated as an in-service training protocol/ procedure. Furthermore, a secondary aim, in terms of CoP implementation, was to identify and highlight the strong features and weaknesses of this novel theory-driven approach to teacher inservice training, namely PE.T.Co.N., in order to inform future researchers, policy makers, and authorities interested to develop effective online professional training. The overarching research question guiding this study was, whether an online CoP (via Facebook groups), which is designed according to SDT principles, can be an effective means of professional training of PE teachers.

Following these purposes, the next research questions with corresponding hypotheses were formulated:

1) RQ1: Can PE.T.Co.N. training promote optimal motivational processes of its members? (i.e., nurture/foster basic psychological needs satisfaction, enhance members' autonomous motivation and satisfaction with training?)

Hypothesis 1a. (H1a): PE.T.Co.N. training will satisfy and lead to enhancement of teacher basic psychological needs for autonomy, competence, and relatedness.

Hypothesis 1b. (H1b): PE.T.Co.N. training will lead to a decreased teacher basic psychological needs frustration.

Hypothesis 1c. (H1c): Teacher autonomous motivation to participate in such training will increase after participants having experienced PE.T.Co.N. online training environment, their interaction and collaboration with colleagues and administrators/ researchers

Hypothesis 1d. (H1d): Participants will be highly satisfied with PE.T.Co.N. training, and subsequently have positive intentions to recommend it to their colleagues.

2) RQ2: Can PE.T.Co.N. participation enhance teachers' self-efficacy on specific core subjects of the training?

Hypothesis 2 (H2): PE.T.Co.N. social learning experience will improve teachers' self-efficacy to promote students' PA outside of school.

3) RQ3: What are the pros and cons of this novel approach and how can it further improve?

2. Methods

2.1. Participants & sampling procedure

After an open call, in the Greek context, that was distributed via online channels (i.e., emails, Facebook), 132 in-service Greek PE teachers responded voluntarily to participate in an innovative online training program namely PE.T.Co.N. This recruitment process included posting an invitation on our Facebook profile page in public view (which was shared to others via Facebook by 30 individuals in their profiles), posting to six Facebook groups for PE, sports and exercise professionals (with about 12,000 membersduplicates included) and sending 230 e-mails to potential participants (in-service PE teachers) that were mainly obtained from previous University trainings and Congresses as they had expressed their interest in participating in future trainings. It is also noted that the degree, to which information regarding PE.T.Co.N. was further disseminated via social media and other means is unknown to authors. Candidates were invited to fill-in an e-application/consent form in order to participate in the online training and research via Facebook groups feature, while confidentiality was emphasized. To ensure teachers' anonymity when responding to electronic questionnaires/quizzes, each member of the private/secret group was provided a unique 5-digit code from the corresponding University Ethics Board, to use it for accessing the e-forms. These codes were further used by the authors to anonymously match subsequent data. Although 132 members initially accepted the invitation, provided consent and registered to the group, six members remained in previewing mode and did not participate in the process at all, and another 10 members were excluded from further analyses as they did not engage with the training at all. Thus, the final pool of active group members consisted of 120 individuals, that is, 116 PE teachers, plus 4 academics (3 researchers-PE teachers and 1 university professor).

Next, we present preliminary data i.e., "group insights" measurements (Facebook feature) from the total number of engaged participants that exhibited at least a minimum level of interaction with the training material and group members (N = 116), and quantitative-qualitative results from a smaller number of teachers (n = 63; 54% response rate) who were responded to electronic questionnaires at three time points (see Table 1 for demographics). These participants, held a bachelor degree from departments of Physical Education and Sport Science of various Greek Universities, and had been working at the time of the study at public schools which were distributed geographically throughout Greece. Given the small number of P.E.T.Co.N. participants and the voluntary nature of the study, the sample represents a wide range of cases (Patton, 2002) regarding samples' demographics i.e., age, experience, school level, geographical distribution (Table 1). The respondents can be considered as information rich participants since they had personally experienced the training under investigation/ evaluation (Patton, 1990).

2.2. PE training central aim

The pivotal aim of the present training was to educate PE teachers on the promotion of students' PA outside school settings. The literature on physical education domain has underlined the significance of a positive PE environment, aiming to increase the quantity and quality of physical activity, and PE teachers are recognized as playing a pivotal role in the quality of engagement in such settings (e.g., Duda, Papaioannou, Appleton, Quested, & Krommidas, 2014). Therefore, providing PE teachers with the knowledge and means to create positive physical activity environments may in turn lead to increased youth PA and quality of life. With this in mind, a panel of PE experts (consisted of six university faculty members), developed a training program consisting of 12 modules that focused on the promotion of students' PA outside school settings (see Table 2 for details), aiming to reach WHO global guidelines on PA for health for children and youth aged 5–17 (i.e., students should accumulate at least 60 min of moderate-to vigorousintensity physical activity daily) (WHO, 2018). According to recent World Health Organization (WHO) physical activity for health report, insufficient physical activity is the leading risk factor for premature death and non-communicable diseases. Unfortunately, 81 percent of youth (aged 11–17 years) in a global scale do not meet the recommended guidelines for daily physical activity (WHO, 2018). Therefore, a progressive increase in physical activity levels is a leading priority, as apart from obvious physical and psychosocial benefits, increased levels of youth physical activity may lead to the adoption of healthy behaviors and to higher academic performance at school.

2.3. Structured informal training

2.3.1. Design characteristics & features

A secret/private group namely PE.T.Co.N. was created in

Table 1Sample demographics.

SAMPLE	Ν	Gender Females	Age M(SD)	Teaching experience	Educational qualification Degrees (MSc,Phd)	Working Position Primary school
TOTAL N	116	51.7% (60)	49.41 (5.1)	17.55 (5.73)	62.2% (69)	57.8% (67)
Pre/Mid/Post respondents Min-Max	63	52.4% (33)	49.94 (4.8) 35–61	18.59 (4.72) 1–32	58.7% (37)	54% (34)

Facebook, as a social learning group and PE teachers Facebook friends who had filled in the application/consent form, were invited to participate in this training group. The training program included in total 16 modules of different topics, consisting of general information, instructions, educational material, knowledge guizzes, questionnaires, and a structured set of educational activities. The whole program comprised of 4 informative-introductoryexplanatory units (A-D; Table 2) plus 12 learning/instructional thematic units (1-12; Table 2). Each thematic module was assigned to a specific PE related topic (see Table 2), aiming to promote students' out-of-school PA. Each topic lasted for a two-week period before the new learning module was introduced. However, it remained open and available for comments and discussion for the entire time of the training, providing time to members to go back and forth and to interact with their colleagues and the educational material in a self-paced manner. Every unit was initiated with a prompt which was posted from the group administrators to trigger discussions between members. After 3-4 days, another question/ prompt was posted for the same topic, to continue interaction and sharing of ideas, and so forth (each unit consisted of 3-4 learning posts; Table 2). After a 12-day period that members have been commenting and reacting to the learning posts, administrators posted a pdf file with a collection of educational material (text, hyperlinks, images, videos), presenting scientific information related to the topic discussed. Administrators during each module encouraged group members to interact with each other (e.g., to comment administrators posts as well as to comment posts from other group members).

In order to overcome Facebook limitation in terms of personal data protection and privacy, Facebook group privacy settings were set to "private" and "hidden", meaning that only group-members could search and find group participants and see what has been posted. In addition, membership approval was not available to the trainees and only administrators could approve new group memberships upon request. Furthermore, confidentiality was emphasized during the recruitment phase as well as in the "group rules" section (see Table 3, Rule 3).

As PE.T.Co.N. drew from SDT, we followed specific strategies to ensure that this informal training allowed participants to experience greater basic psychological need satisfaction (i.e., autonomy, competence and relatedness) as, according to theory, these needs are essential to sustain self-determined motivation.

2.3.2. Autonomy support

PE.T.Co.N. was purposefully structured as to provide participants, via educational activities, a meaningful rationale so that they could find value or personal significance and meaning in these activities. In a similar vein, the organization of PE.T.Co.N. aimed at minimizing coercion as it attempted to engage teachers in the activities in a self-paced manner, as there were no strict or narrow time frame for the completion of quizzes and learning tasks/posts, thus limiting task imposition. Further, tasks were designed in a manner that did not stimulate reward contingencies but rather reflecting intrinsic interest for the activity. Questions, prompts, and interactions between participants aimed at stimulating a high degree of engagement and potentially increase immersion and presence at these educational activities.

Additionally, to support group members' autonomy, on the last two units, administrators asked for their input. Specifically, on unit 11, group members were asked to propose a broad thematic subject that according to their opinion, would probably have a great impact on the project's goal. After a vote-activity among members, it was decided that adding a unit about outdoor/alternative activities, would nicely complement previous units. Finally, as a concluding task, group's members were encouraged to provide their input and contribute in creating an educational guide collaboratively (in a form of a voting poll), according to the previous 11 educational units. This would describe the successive steps that would enable PE teachers to be the most effective in creating such an environment that would facilitate the increase of PE students' out of school PA.

2.3.3. Relatedness support

Discussions during courses were open and with no rigid restrictions regarding the topic discussed. Everyone was invited to provide input and have a say on the topic discussed regardless of his or her experience and teaching background. Administrators attempted to establish trust using an open and sincere communication with the online participants. All opinions were accepted and respected, and in general, an online social climate based on reciprocity, inclusiveness, acceptance and respect was encouraged during interactions. Also, affective expressions such as exclamation marks and reaction buttons ("likes" or heart signs) were used by all participants to express a high degree of acceptance and agreement to posts but these reactions also imply a warm emotional context that potentially can have a motivationally supportive effect within online learning contexts (Scogin & Stuessy, 2015).

2.3.4. Competence support

Administrators throughout the informal training course, attempted to offer an educational context that provided clear competence support by giving attention (feedback) to all participants' posts, by responding or by posting reactions ("likes" or heart signs depending the degree to which administrators agreed with the participants' posts). Further, the Facebook platform was selected to apply the training modules as most participants were familiar with the user's interface and they had already developed digital skills to meet the demands and the requirements of their participation in the training format. In addition, Facebook "social learning" group type features "UNITS" section/tab, which has a special function allowing administrators to choose the order and organization of posts, making possible to create posts in a hierarchical structure on a timeline. This way, learning-posts and educational material were presented in a sequential manner making it easier for participants to find them. Also, we enabled a feature that provides members with an indication of personal progress/completions (see Image1). Furthermore, participants, were challenged to refine their digital skills (e.g., searching information regarding PE.T.Co.N. modules via web and scientific databases) as to build upon their previous knowledge and extend to new topics and subjects relevant to their expertise.

Table 2Structure & Thematic Units of the e-Training.

	Learning posts	Comments	Completions	Likes	Views	Avg. Comment/ post	Avg. Completion/ post
UNIT a Info-Guide	4	38	89	59	91	9.5	87.3
Instructions-Functions			85	38	102		
Notifications-Notes			88	71	109		
Personal Login Information Research confidentiality and anonymity			87	47	84		
INIT b Cetting to know each other – Creetings	3	140	86	46	113	46.7	55
Getting to know each other!!!	5	1 10	37	54	127	10.7	55
Christmas Wishes 2018			42	46	123		
Easter Wishes 2019							
UNIT c Thematic units Outline – Educational Materials Learning Topics	14	61	92 57	62 32	124 124	4.36	54.4
Recommended Themes by PE teacher group-members (10-28/2/19)			613	343	1237		
Edu-materials of the 12 thematic units (12 posts)							
UNIT d Questionnaires – Quizzes	10	117	59	27	127	11.7	65.3
Ending/Completion/Concluding Questionnaire (Post/Time 3)			56	2/	117		
Knowledge Quiz 7 (Concluding) Mini Knowledge Quiz 6			58 58	19	02		
Mini Knowledge Quiz 5			62	35	128		
Evaluation/Feedback Questionnaire (Mid-Season/Time 2)			65	23	117		
Mini Knowledge Quiz 4			64	22	117		
Mini Knowledge Quiz 3			67	30	117		
Mini Knowledge Quiz 2			80	31	125		
Mini Knowledge Quiz 1			84	47	128		
Entry Questionnaire (Pre/lime 1)	4	าาา	02	27	126	55 5	77 5
The necessity of Physical Activity (Why PA is important?)	4	222	82	38	120	55.5	11.5
What is the minimum PA needed?			71	25	127		
How can we inform students for all the above?			74	58	123		
1) Physical activity health benefits (educational material)							
UNIT 2 – Physical Education importance & PE teachers' role	3	95	71	39	126	31.7	70.3
Why Physical activity (PA) is important for education?			71	25	123		
What is the role of PETeachers in promoting PA?			69	41	123		
2) Physical Education Importance & PE teachers role (educational material)	2	70	60	21	127	24	67.2
Definition of Physical Literacy	2	12	68	27	127	24	07.5
How Physical Literacy can be promoted?			65	34	124		
3) Physical Literacy (educational material)							
UNIT 4 – Enjoyment in Physical Education	3	105	62	31	122	35	63.7
Fun and Enjoyment in PE			67	30	126		
Fun learning experiences in PE. Best Practices			62	39	120		
4) Fun and Enjoyment in PE (Determinants) (educational material)	2	70	62	21	100	26	60.2
Division Supporting student's support promotion	2	/0	61	21	122	20	00.5
Supporting/supporting student's autonomy $S_{\rm supporting}$			58	31	115		
5) Promoting/Supporting students' autonomy (educational material)			50	51			
UNIT 6 – Feedback-communication PE teacher-student	3	62	65	25	116	20.7	62
Empowering feedback			60	27	122		
Empowering Communication			61	31	111		
6) Feedback, Student-Teacher Communication (educational material)		107		24	404	25 7	50 7
UNIT 7 – Fitness testing (Assessing Health-related indexes)	3	107	66 59	31	121	35.7	59.7
Monitoring and Assessing student PA and Fitness			55	29 31	127		
7) Fitness testing (Assessing Health-related indexes) (educational material)			55	51	121		
UNIT 8 – Goal setting for Physical Activity promotion	4	27	55	23	113	6.8	55
Goal Setting in Physical Education			57	27	106		
Why and How we set goals to increase PA? (1);			56	20	68		
Why and How we set goals to increase PA? (2)			52	26	120		
8) Goal Setting as a means to increase PA (educational material)							
UNIT 9 – Parents' role in their children PA promotion	3	63	58	19	116	21	55.3
Value to involve parents in promoting their children's PA			50 52	20	117		
9) Parents' role in their children PA promotion (educational material)			52	21	115		
UNIT 10 – Identification of students who mostly need PA. Obstacles for participation	1 3	83	54	21	128	27	52.7
in PA			56	24	120		
Obstacles for participation in PA and how to overcome them			48	25	111		
Identification of students who mostly need PA.							
10) Identification of students who mostly need PA. Obstacles for participation in PA							
(educational inderial)	2	45	56	27	126	22.5	51
Increasing PA via outdoor-alternative recreational activities	2	-IJ	46	27	104	44.3	51
11) Outdoor-alternative recreational activities to increase PA (edu- material)							
	7	33				4.7	55.6

Table 2 (continued)

	Learning posts	Comments	Completions	Likes	Views	Avg. Comment/ post	Avg. Completion/ post
UNIT 12 – Teacher guide co-creation for students' PA promotion	-	_	52	26	111		-
Let's co-create an educational guide!!!			56	36	121		
Step 1 - Best Practice 1 (Poll)			56	24	106		
Step 2 - Best Practice 2 (Poll)			57	26	117		
Step 3 - Best Practice 3 (Poll)			57	20	114		
Step 4 - Best Practice 4 (Poll)			58	26	113		
Step 5 - Best Practice 5 (Poll)			53	31	92		
12) Educational guide aiming to promote students' PA							
Total	72	1348	4424	31.4	114.2	18.7	61.4

Table 3

Group general rules.

Group Rules
1 Comments/Replies should be included in the original post
2 Comments/Discussions should be posted only as a reply to the original posts (thematic unit) of administrators (comments should not act as posts detached from the original posts)
3 Be kind and courteous.
We're all in this together to create a welcoming environment. Let's treat everyone with respect. Healthy debates are natural, but kindness is required.
4 Respect everyone's privacy.
Being part of this group requires mutual trust. Authentic, expressive discussions make groups great, but may also be sensitive and private. What's shared in the group should stay in the group

5 No promotions or spam messages.

Give more than you take to this group. Self-promotion, spam and irrelevant links aren't allowed



Image 1. PE.T.Co.N. short guide about UNITS and personal progress/completion bar.

2.4. E-training evaluation study

2.4.1. Data collection process

Before conducting this study, approval from the University's Ethics Committee was obtained. In the beginning of the training process, one week after the official initiation of the group, the first online psychometric questionnaire (T1) became available for all the group members (October 2018) and remained open for responding for a 10-day period. Upon the completion of the first phase of teachers' training (T2), the second online questionnaire was distributed in order to collect participants' opinions/views regarding the PE.T.Co.N. project so far (January–February 2019). The same procedure was repeated/followed upon the completion of

the last phase (T3) of the e-training (June 2019). In order to respond to our research questions, we collected quantitative data and we complemented them with qualitative data. The basic criterion to collect our data was to sample teachers already participating in this informal e-training program, which was designed according to SDT propositions. To ensure data collection of high quality, a screening item for inattention check was included in the e-surveys (i.e., "I read the instructions carefully. To show that you are reading these instructions, please leave this question blank.") (Maniaci & Rogge, 2014). Furthermore, survey completion times of less than 5 min were considered insufficient. In total, 3 cases failed the screening question and 2 cases completed the questionnaire in insufficient time, therefore, their data were excluded from further analysis.

In order to establish prolonged engagement with the context of the study, the first author served as participant observer (kept notes) during the entire e-training process, having the dual role of moderator/administrator and group-member. In addition, the second author monitored also the process by serving as group administrator along with the other members of the research group. Researchers' observations and notes together with the collected data used later on, as different sources for data triangulation (Patton, 1990, 2002). Moreover, in order to build rapport, the researchers engaged in informal chats via messenger app and/or emails, with group members whenever they had any query or they needed further assistance.

2.4.2. Quantitative data

We targeted specific quantitative variables in two time points T1/T2 and T3 that could provide us with useful information to answer research questions 1 and 2.

- (a) "Teacher basic needs satisfaction/frustration", can inform us whether the training virtual environment can promote or thwart teacher needs for autonomy, relatedness and competence.
- (b) "Teacher autonomous motivation to participate in PE.T.Co.N. training", can inform us whether PE.T.Co.N. training

participation tends to increase or diminish teachers' selfdetermined motivation to take part in this training.

- (c) "Teacher self-efficacy to promote students' self-regulation in out-of-school PA". Teachers self-efficacy is considered a key variable on the implementation of innovative teaching practices in PE and the effectiveness of teaching (Gorozidis & Papaioannou, 2011). Thus, any increase or decrease in teachers' self-efficacy as a result of PE.T.Co.N. training, would be of great importance for the promotion/achievement of PE.T.Co.N. main goals.
- (d) "Teacher internal satisfaction with Training", can inform us of the level of participants' satisfaction with the training.
- (e) "Teacher intention to recommend PE.T.Co.N. to their colleagues" can provide us with information on the degree to which teachers had positive (or negative) perceptions about PE.T.Co.N. training.
- (f) "Facebook group insights" was an objective measure that we used to monitor members' active engagement throughout the entire duration of the training. By making use of the "Facebook group insights" feature, we were able to check in detail, the numbers of participants (active group members), completions of learning posts and member's engagement (posts, comments and reactions e.g., "likes").

2.4.3. Qualitative data

We collected qualitative data that could provide us with useful information to answer research Q3 and to complement and triangulate quantitative data (Patton, 1990, 2002) corresponding on research Q1 and Q2. Thus, participants were invited to express personal beliefs and opinions regarding PE.T.Co.N. functioning (in open-ended questions) in two-time points (T2-T3), in order to gain an insight into better understanding their needs and the effectiveness of the PE.T.Co.N. strengths and weaknesses of the implementation. In addition, to complement these data, we kept notes of members' spontaneous-sporadic comments relevant to training procedure throughout the process, that were made either in public view as comments or in person via messenger chat or emails.

2.5. Measures - instruments

2.5.1. Quantitative

(a).

(i) Teacher Basic Needs Satisfaction scale (T1 -T3)

PE teacher basic needs satisfaction was measured by Basic Needs Satisfaction Scale (NSFS; Longo, Gunz, Curtis, & Farsides, 2016; Gorozidis, Tzioumakis, Krommidas, & Papaioannou, 2020), which was adapted for the specific context. This 7-point likert type scale (1/strongly disagree-7/strongly agree) comprises three subscales with 3 items each, reflecting teachers' basic needs satisfaction. Following the stem, "In PE.T.Co.N. training ..." participants responded in items as "I feel/felt completely free to make my own decisions" (autonomy satisfaction), "I feel/felt highly effective at what I do/did" (competence satisfaction), "I feel/felt very close and connected with other people (within PE.T.Co.N.)" (relatedness satisfaction). This newly tested scale for the Greek context, in a study with pre-service PE teachers produced valid and reliable results (Gorozidis, Tzioumakis, Krommidas, & Papaioannou, 2020). Accordingly, in the present study, confirmatory factor analyses results supported the construct and test-retest validity of the 9-item 3-correlated factors model, producing acceptable goodness of fit indices (Pre/Post: TLI = 0.910/1.00, CFI = 0.940/1.00, RMSEA = 0.083/.000, χ^2 = 34.19/21.41, df = 24, χ^2/df = 1.43/0.9). In addition, Cronbach's alpha for each T1-T3 subscale was over 0.73 (see Table 4).

(ii) Teacher basic needs (relatedness) frustration scale (T1 -T3)

PE teacher basic needs frustration was measured by Basic Needs Frustration Scale (NSFS; Longo et al., 2016; Krommidas, Gorozidis, Tzioumakis, & Papaioannou, 2019), which was adapted for the specific context. Similar to the previous scale, PE teachers responded to items such as "In PE.T.Co.N. training ..." "Sometimes, I feel a bit rejected by others" (relatedness frustration). This scale in a study with pre-service PE teachers produced valid and reliable results (Krommidas, Gorozidis, Tzioumakis, & Papaioannou, 2019), however, in the present study, confirmatory factor analyses results did not support the construct validity of the 9-item 3-correlated factors model. Thus, we decided to omit autonomous and competence frustration items and to retain only relatedness frustration items which presented high internal consistency. Cronbach's alpha for relatedness frustration subscale T1-T3 was above 0.81 (see Table 4).

(b) Teacher Autonomous Motivation to participate in PE.T.CO.N. training (T1 -T3)

PE teachers' self-determined motivation to participate in PE.T.-Co.N. training was assessed using the 2 relevant subscales (i.e., intrinsic & identified) with 3 items per scale, from the Greek version of the Work Task Motivation Scale for Teachers (WTMST: Gorozidis & Papaioannou, 2014: Fernet, Senecal, Guav, Marsh, & Dowson, 2008). Following the general stem "Why do you/have you participate/participated in the PE.T.Co.N. training?" teachers responded to items as, "Because I like doing it" (intrinsic), "Because I consider PE.T.Co.N. important for the academic success of my students" (identified). Answers were given on a 7-point Likert type scale ranging from 1 (does not correspond at all) to 7 (corresponds completely). According to SDT, intrinsic and identified regulation share common features (e.g., choice, internal locus of causality) therefore, they can be merged to formulate an autonomous motivation variable (see Ryan & Deci, 2000; Vansteenkiste, Simons, Lens, Sheldon, & Deci, 2004). Thus, for the purposes of the present study, two Autonomous motivation variables were constructed (pre and post), by combining together, intrinsic and identified items of each time point. Cronbach's alphas for this scale was 0.85 and 0.89, for T1-T3 respectively.

(c) Teachers' self-efficacy to promote students' self-regulation in out of school PA (T1 -T3)

Teachers' self-efficacy was measured with *Self-efficacy in promoting students' exercise self-regulation* (Gorozidis & Papaioannou, 2011) scale. The instrument consists four items. Following the general stem "In your school, how confident are you that you can help all your students to ..." PE teachers' responded to items such as "... exercise outside school more than today?". Answers were given on 11-point scales ranging from not confident at all (0%) to absolutely confident (100%). Cronbach's alphas for these scales were 0.90 and 0.94, for T1-T3 respectively.

(d) Teachers satisfaction with training (T2 -T3)

Teacher degree of internal satisfaction with PE.T.Co.N. training was measured with a 5-item instrument, adapted to the specific context/situation (Duda & Nicholls, 1992). Group members were asked to mark in a 5-point Likert type scale (from 5/strongly agree to 1/strongly disagree) their degree of agreement with statements

as: "I like PE.T.Co.N."; "I find PE.T.Co.N. interesting". Cronbach's alphas of this instrument for T2-T3 measurements were 0.91 and 0.92 respectively.

(e) Teachers' intentions to recommend PE.T.CO.N. to their colleagues (T3)

Following the Theory of Planned Behavior (TPB), and Ajzen's (2002) guidelines, two items assessing PE teachers' intentions to recommend PE.T.Co.N. to their colleagues were used: "During the next season I plan to recommend to my PE teachers colleagues to become members of PE.T.Co.N. training ..." and "During the next season I am determined to recommend to my PE teachers colleagues to become members of PE.T.Co.N. training ..." And "During the next season I am determined to recommend to my PE teachers colleagues to become members of PE.T.Co.N. training ...". Participants responded in 7-point semantic differential scales (likely/unlikely and yes/no, respectively). The coefficient alpha for this scale was 0.67, but, given the small number of scale's items (only 2) it was considered acceptable.

(f) Facebook group insights data

From Facebook platform automated functions provided, we made use of specific insights and results/figures which were available to group-members, (i.e., likes, post views, learning posts completions), and engagements details (posts, comments, reactions).

2.5.2. Qualitative

2.5.2.1. Open-ended questions (T2 -T3). Qualitative data collection was made through three open-ended complementary questions, which were included in the e-surveys in two time points throughout training, in the middle and at the end of the season. Specifically, teachers were asked:

- (a) "What do/did you like in the PE.T.Co.N. training course?",
- (b) "What don't/didn't you like about the PE.T.Co.N. training course?" and
- (c) "What would you suggest to improve the PE.T.Co.N. project?".

All participant responses produced 367 short statements, corresponding to 14 digital pages (Times new roman 12, 1.5 spacing).

2.5.3. Data analysis

2.5.3.1. Quantitative. Data analyses were made with SPSS v.22 and AMOS v.20. Descriptive analysis included the calculation of mean and standard deviation for each variable. Construct validity of BNSS was evaluated via Confirmatory Factor Analysis (CFA). Internal consistency of the scales evaluated through Cronbach's alpha index. Mean differences across time points were examined via paired samples t-tests (pre/mid vs post), and effect sizes via Cohen's *d* index.

2.5.3.2. Qualitative. As soon as data were collected and became available, there was an on-going reflection and analyses of them (Rossman & Rallis, 1998). Qualitative data from open-ended questions was handled with QSR Nvivo 8 software. Raw data were analyzed following the first three generic steps suggested by Creswell (2003) consisting of a) organizing and preparing the data, b) reading thoroughly to gain a general impression and to reflect, c) comprehensive text analysis to generate codes and categories (coding process) (Creswell, 2003, p. 191). Thematic analysis of the data was conducted following a deductive (theory-driven) approach following suggestions by Boyatzis (1998): a) generating a code, b) reviewing and revising the code in the context of the

nature of the raw information, and c) determining the reliability of the coders and therefore the code. (Boyatzis, 1998, pp. 35–36). This approach was used because the purpose of the study was to evaluate online training design features (examine if there is any agreement of the data with SDT) based on the SDT framework. The data that did not fit into any theory-driven categories were further analyzed inductively, generating new themes. In order to establish credibility and to check for the accuracy of the findings a peer debriefer (Creswell, 2003, p. 196) enhanced the whole procedure by reviewing and asking questions, while a second analyst (coder) assisted the coding process, until consensus was met (analyst triangulation) (Patton, 1990).

3. Results

3.1. Quantitative

3.1.1. Descriptives-reliability

Means and Std. deviations of the study variables are depicted at Table 4. It appears that in general, teacher basic needs satisfaction, autonomous motivation and satisfaction with training were high in both time points presenting mean scores above $5.0 \pm .82$ in 7-point scales, with the only exception of relatedness need satisfaction which presented slightly lower levels with mean scores below $5.0 \pm .02$ in both time points, and relatedness frustration which was found to be very low, with mean scores below 2.5 ± 1.1 . Self-efficacy mean scores were also high with mean scores above 7.0 ± 1.7 in 11-point scales. Teacher intention to recommend PE.T.Co.N. to colleagues were very high with mean score above 6.1 ± 1.1 in a 7-point scale confirming hypothesis (H1d). Internal consistency of all the scales were satisfactory with alpha scores >.73, apart from intention scale which was low (0.67) but it was considered acceptable due to the small number of scale's items (only 2).

3.1.2. Time1/Time2-Time3 differences

In order to examine differences in teachers' basic needs satisfaction, three paired samples t-tests were conducted suggesting: (a) a significant increase in teachers' *autonomy* need satisfaction scores from T1 (M = 5.19, SD = 0.78) to T3 (M = 5.83, SD = 0.90) measurement, t (62) = -5.80, p < .001, d = 0.73; (b) a significant increase in teachers' *relatedness* need satisfaction scores from T1 (M = 4.40, SD = 0.83) to T3 (M = 4.81, SD = 0.88) measurement, t (62) = -4.32, p < .001, d = 0.54; (c) but also, a significant decrease in teachers' *competence* need satisfaction scores from T1 (M = 5.25, SD = 0.83) to T3 (M = 4.99, SD = 0.91) measurement, t (62) = 2.35, p = .022, d = 0.30; (d) and, a significant decrease in teachers' *relatedness* need frustration scores from T1 (M = 2.52, SD = 1.07) to

Table 4	
Descriptives & alphas of study	variables

	N	Mean	Std. Deviation	alphas
Autonomy Satisfaction (T1-pre)	63	5.19	.78	.73
Autonomy Satisfaction (T3-post)	63	5.83	.90	.77
Competence Satisfaction (T1-pre)	63	5.25	.83	.76
Competence Satisfaction (T3-post)	63	4.99	.91	.84
Relatedness Satisfaction (T1-pre)	63	4.40	.83	.76
Relatedness Satisfaction (T3-post)	63	4.81	.88	.77
Relatedness Frustration (T1-pre)	63	2.52	1.07	.81
Relatedness Frustration (T3-post)	63	2.14	1.04	.85
Autonomous Motivation (T1-pre)	63	5.67	.89	.85
Autonomous Motivation (T3-post)	63	5.81	.97	.89
Training Satisfaction (T2-mid)	59	5.07	.88	.92
Training Satisfaction (T3-post)	63	5.36	.92	.91
Teacher Self-Efficacy (T1-pre)	63	7.02	1.69	.90
Teacher Self-Efficacy (T3-post)	63	7.65	1.78	.94
Intention to recommend it (T3-post)	63	6.13	1.12	.67

T3 (M = 2.14, SD = 1.04) measurement, t (62) = 2.43, p = .018, d = 0.31. These results, with the only exception of *competence* need satisfaction, confirmed H1a and H1b hypotheses.

Furthermore, two paired samples t-tests were conducted in order to examine differences in teachers' satisfaction with training and motivation to participate in P.E.T.Co.N. Expectedly, teachers' internal satisfaction with training showed a significant increase in scores from T2 (M = 5.0, SD = 0.87) to T3 (M = 5.37, SD = 0.94) measurement, t (46) = -4.16, p < .001, d = 0.61, confirming H1d hypothesis. Interestingly, *autonomous motivation to participate in training* scores from T1 (M = 5.67, SD = 0.89) to T3 (M = 5.81, SD = 0.97) measurement, even though it was increased, this improvement did not reach a statistical significant level, t (62) = -1.23, p = .22, not confirming H1c.

In order to examine differences in teachers' self-efficacy to promote students' self-regulation in out of school PA, a paired samples *t*-test was conducted suggesting a significant improvement in self-efficacy from T1 (M = 7.02, SD = 1.69) to T3 (M = 7.65, SD = 1.78) scores, t (62) = -3.25, p = .002, d = 0.41, confirming hypothesis (H2).

3.1.3. Group insights-active participation

Group insights (posts, comments, reactions, active engagement, task completions) feature of Facebook groups revealed enhanced participatory dynamics in terms of active membership (reading and commenting on other's posts and comments) active actions (such as sharing links, writing posts, sharing resources, etc.) (Image 2). The active participants of the group were 116 PE teachers/members, along with the 4 administrators/researchers of the project. In the end, about 80 members (69%) completed the training process by fulfilling a minimum attendance of over 60% of the learning-posts. These data underscore the dynamic and cooperative climate of the training, and the relatively small number of attrition rate.

We recorded 4424 completions of learning-posts (Image 3), 1348 comments-posts, and about 7310 reactions (e.g., likes), to the 72 learning-posts posted by group administrators during the entire training; each unit included several posts with a large number of completions each (from 46 completions in the "Outdoor-alternative recreational activities for PA promotion (educational material)" post, to 92 completions in the "Learning Topics" post). On average, each learning post had about 114 views, 31 likes and 19 comments, and each learning post was completed by 61 participants (see Table 2 for details).

3.2. Qualitative: participants' views/opinions (Time 2 & 3)

Qualitative analysis of open-ended questions generated three themes corresponding to SDT basic needs satisfaction, namely autonomy, relatedness and competence, and three respective themes reflecting SDT basic needs frustration. Furthermore, after inductive analysis was concluded, the data that did not fit into these themes resulted in the three last categories presented in Table 5.

Accordingly, some participants commented positively on the overall training procedure, during and in the closing of the training (expressing gratitude and praise for the initiative), confirming the general sense of written answers/statements in the questionnaires. This was also evident during their personal communications via messenger chat and/or emails.

4. Discussion

4.1. General discussion: main outcomes

The focus of the present study was Physical education teacher in-service training, which was delivered in the form of an online CoP via social networking, utilizing "Facebook groups" function as a tool. Although recent research applying SDT in online learning environments seems promising (e.g., Chen & Jang, 2010; Hsu, Wang, & Levesque-Bristol, 2019; Martin et al., 2018; Wang et al., 2019), there is a scarcity of research in the context of SNSs such as Facebook, testing SDT applicability not only to samples of students, or undergraduates (e.g., Saini & Abraham, 2019) but to inservice teachers as well. To address this gap, an online in-service PE teacher training which was founded on SDT, implemented and evaluated in terms of participants' motivation and active engagement with the learning process.

Overall, our results suggest that teacher training delivered in the form of a CoP such as PE.T.Co.N., can be beneficial in enhancing teachers' basic needs fulfillment, autonomous motivation, selfefficacy and satisfaction with the training supporting in the most part our theoretical hypotheses. The quantitative and qualitative data collected at three time-points were in agreement, complementing and confirming each other. PE teachers reported that they were highly satisfied with the training and the educational materials, and they would definitely recommend PE.T.Co.N. training to their colleagues. Pre-post comparisons of quantitative data revealed that teacher participation in PE.T.Co.N. training has led to improvements in diverse significant dimensions for training success.

In specific, teacher need for autonomy was found to be fulfilled in the context of PE.T.Co.N. since a quite high score was found and a significant increase revealed at the closing of the program. This evidence suggests that PE.T.Co.N. training was delivered in an autonomous supportive way, providing participants sufficient opportunities to interact, share (experiences, ideas etc.), and learn, out of their free will, following their personal needs and choices. It should be noted that autonomy need satisfaction was already relatively high from the beginning of the training, since it was emphasized that participants would undertake the training volitionally in an unobtrusive manner following their own pace in terms of attendance. However, at the end of the program, autonomy need satisfaction indicated a significant increase in scores presenting a remarkable effect size which was quite high in magnitude, suggesting that participants felt as being the source/origin of their own behavior during PE.T.Co.N. training.

In similar line, teacher relatedness need satisfaction exhibited significant improvements at the closure of the process, suggesting that their participation in PE.T.Co.N. training enhanced their sense of belongingness by making them feel as an integral and equal part of the teacher online community. In accordance to this, initial relatedness need frustration scores were low and mean scores declined even further at the closing of the program. These findings can be easily explained considering some of the training features such as membership in a CoP characterized by sincere and open interaction between group-members and administrators (digital friends) with the use of kind non-evaluative and non-judgmental language; mutual respect, acceptance and appreciation of every opinion with the provision of positive feedback and affective reactions to every individual comment (e.g., "likes", heart signs). However, relatedness need satisfaction mean scores in both times were relatively moderate suggesting that the sense of relatedness fulfillment may have further potential for improvement within this particular context. This was apparent also in teachers' responses in open-ended questions. Specifically, a number of participants suggested that participants' interaction could be more intense and stable over time and they would prefer more direct interactions and fruitful participation from their colleagues in each topic of the training. This may be related to individual psychological characteristics of the participants, as probably some of them attach greater importance to the fulfillment of relatedness (e.g., Schwartz



Image 2. PE.T.Co.N. training group insights: Engagement details screenshot.

& Bardi, 2001). This has great implications for the success of the training as identifying the unique contribution and the strength of each need in perceived need satisfaction, could lead researchers in creating more positive motivational environments.

Surprisingly, although teacher competence need satisfaction was relatively high in both time points it was the only motivational variable, that demonstrated a significant difference in the opposite direction than expected (even though small in magnitude) by decreasing from T1 to T3. This evidence may be interpreted in light of the fact that participants were not familiar to this type of on-line training, where learners interact, share, and discuss each topic and actively form/shape and purposefully direct the learning process. Indeed, some teachers stated that they would prefer a more "classic" approach to training with more intense and correctional presence of administrators/instructors and the provision of educational materials before the initiation of discussion on each topic. However, some participants admitted that they were unfamiliar with some of the topics (e.g., Physical literacy) and that the format of questioning without providing any educational material in advance, challenged them to search for resources and answers. Another interpretation could be that some participants were not familiar with the social-learning groups function of Facebook and its features. In this direction, a limited number of group-members acknowledged the fact that they could not navigate easily between the training posts, facing difficulties in accessing some learning-posts and comments (e.g., the current learning-post, their last comment, and their completion progress). This may also reflect the fact that many users decided to participate in the group, while



Image 3. PE.T.Co.N. training group insights: Learning Posts completion & Main Units screenshot.

Table 5

Categorization of PE teacher responses to open-ended questions (T2-T3) (N = 75).

13

SDT driven categories	Teacher representative statements	n
	What I like/liked is/was	
Autonomy need Satisfaction	• " the acceptance of all opinions, the democracy and the kindness of the coordinators/managers." (M, 42YO, 15 YE, P, T3)	20
	 " the ability/flexibility to choose when to watch each module without time pressure and the fact that I can refer to the previous modules whenever I want" (F, 50YO, 18 YE, S, T2) 	6
Relatedness need Satisfaction	• " that there is a very good climate among colleagues" (M, 53YO, 20 YE, S, T2)	51
	• " that I had the opportunity to interact with colleagues and exchange experiences and ideas." (F, 51YO, 18 YE, S, T2)	
	• " is the feeling of belonging to a social group that has the ability to make great suggestions in the field of Physical Education." (M	,
	54YO, 20 YE, P, T2)	
Competence need Satisfaction	• " that I have updated my knowledge on the theory of PE, but also on practical issues that I come across daily." (F, 51YO, 18 YE, S, T3)) 12
	• " the provision of knowledge, and the respect of each member's personal view." (F, 52YO, 18 YE, P, 13)	
Autonomy need Emistration	what i don't alan't tike ispla for an and time due to professional & formity deity altimations which makes is relatively different to	~
Autonomy need Frustration	consistently participate in PETCON training." (M, 58YO, 25 YE, S, T2)	5
Relatedness need Frustration	• " that the participation was not the same in every module/unit" (F, 51YO, 18 YE, P, T3)	16
	• " the typical, superficial participation of some members" (M, 39YO, 16 YE, S, T3)	
Competence need Frustration	 " the (my) inability to easily understand what I have completed (from the learning posts/tasks) (M, 51YO, 20 YE, P, T2) " the big volume of posts-comments (M, 50YO, 20 YE, S, T3) 	10
Non SDT driven categories		
Training materials-tasks	• "I liked the quizzes and the presentations of each unit, that included videos and links for greater in-depth understanding" (F, 43YO 19 YE, S, T3)	, 22
	• "I like the quality of training material and final presentations" (M, 58YO, 25 YE, S, T2)	
Suggestions for improvement	• "The creation/construction of a relevant web page" (M, 50YO, 21 YE, S, T3)	66
	• "To do it annually and to increase the number of participants, in order to listen as much opinions as possible" (F, 50YO, 18 YE, S, T3)) 11
	 "To have more direct communication, and to organize live events (workshops, daily conferences, videoconferences/online meetings etc)" (e.g., F, 54YO, 29 YE, S, T2) 	5
	• "A different educational/communication platform (e.g., moodle) because via Facebook there are lots of limitations" (M, 42YO, 15 YE, P	,
	13) . Source asked for more learning guizzes and more presentations and educational materials in additional topics such as "first-	-
	 several cases ascer for more realining quizzes, and more presentations and educational indertials in additional topics such as first aide" (baltby diar" (lagring difficultier" dially practical matter/problems" (work related issue") 	L
Nothing Negative - Nothing to	and s, heating acc, heating differences, daily plattical matters providing, work related issues	49
improve	There is nothing negative of anything to improve about the LETROIT, training.	-15

Note: F: female, M: male, YO: years old, YE: years of experience, S: Secondary, P: Primary, T: time point.

accessing the training units via their mobile devices, such as smart phones or tablets. The user interface of the Facebook application for mobile devices (e.g., android and iOS) is displayed quite differently compared to a PC browser, and subsequent frequent updates of Facebook mobile applications altered the way PE.T.Co.N. appeared in mobile screens. This evolving characteristic of Facebook might have resulted in increased difficulty for some participants, hindering their ability to seamlessly navigate between the learning units thus diminishing teacher perceptions of efficiency on training attendance.

The finding that teacher autonomy and relatedness needs satisfaction were enhanced while competence need satisfaction was diminished, could explain why the improvements in teacher autonomous motivation did not reach statistical significance. It seems that the decrease of competence need satisfaction might have counteracted the increases of autonomy and relatedness need fulfillment and their potential positive effect on teachers' autonomous motivation, suggesting that the satisfaction of all three needs should improve in order to enhance autonomous motivation significantly. However, this notion should be further examined and interpreted with caution, because teacher autonomous motivation was quite high from the beginning, leaving very small room for improvement due to scales' limitation. Teacher high scores on autonomous motivation can be easily explained by the recruitment process whereby they responded voluntarily to our open call and decided willingly to participate in the training in the absence of external incentives and/or impositions. In general, all the present findings should be interpreted taking into consideration the particular characteristics of the specific teacher group which was highly motivated since the onset of the training.

Regarding teacher confidence to promote students' PA levels outside school, as expected, self-efficacy increased significantly, suggesting that this form of informal training has the potential to improve teachers' perception that they can succeed in promoting students' self-regulation in out-of-school PA, which was a central aim of the training. This according to past research (Gorozidis & Papaioannou, 2011) can be considered as a first stage for teachers' adoption/implementation of innovative teaching practices such as the teaching strategies proposed by PE.T.Co.N. training.

Moreover, even though teachers' internal satisfaction with training in the middle/half of training was already high, in the ending of the training after members having experienced the whole process and had a complete image of the PE.T.Co.N., they responded even more positively, presenting significantly improved levels of satisfaction with the training. Teachers' intention to recommend PE.T.Co.N. training to their colleagues were highly positive which seems reasonable/justified since they were very satisfied with the project at both time-points that they provided information.

Overall, teachers' responses to open questions showed that they were highly satisfied with PE.T.Co.N. informal training. It was found that specific features of this form of training supported teachers' basic needs satisfaction. Specifically, the absence of strict deadlines and the option to navigate backwards and forwards into training modules as these were unfolding, provided all participants the opportunity to customize their engagement/involvement with the training according to their personal choices/needs and availability. Furthermore, the fact that this group comprised of in-service PE teachers who exchanged ideas and shared their experiences from their day-to-day (professional) lives/practice with students, was a pivotal feature that most of the participants considered important.

Our results are in accordance with past research evidence with samples of pre-service and in-service teachers suggesting that Facebook groups is a well promising medium to enhance teacher learning, formally and/or informally (Bissessar, 2014; O'Bannon et al., 2013; Ranieri et al., 2012; Rutherford, 2010). In a similar vein, the fact that 80 out of the 132 registered participants (60.6%),

remained active throughout the training process and completed it is considered satisfactory, thus supporting the premise that well designed online training, drawing from SDT principles, has the potential to motivate and sustain participants' engagement effectively, which is consistent with recent research evidence in MOOC literature (Martin et al., 2018). In addition to this, it is pivotal that online training is delivered in an autonomous supportive, collaborative social environment such as SNSs (i.e., Facebook) in the form of a CoP as it has the potential to minimize attrition rates (i.e., noncompletion or drop-out) in on-line learning contexts. In the present study, the percentage of active participants that successfully completed the training, (i.e., 69 percent) seems significantly higher than the average (i.e., 12 percent) that has been reported in similar online learning courses (Jordan, 2015).

4.2. Implications for practice

The proposed novel form of in-service training seems promising and should be further developed and refined in prospective studies. However, it should be underlined that we selected as a "vehicle" to deliver the intervention as a CoP via a popular social medium with the aim to highlight the fact that similar social media have the potential to provide an excellent means to deliver educational training courses online effectively. And, taking into consideration participants' statements and personal observations, it is suggested that there is also potential for improvement. Thus, building upon participants' views in joint consideration with SDT propositions P.E.T.Co.N.'s future improvements should include further actions such as: a) become accessible for more participants from diverse contexts and populations, b) evolve and expand its thematic units with more topics of interest, c) create a corresponding web-site which is user-friendly and easily accessible to anyone interested, d) present more knowledge quizzes and practical examples in media format, and e) enhance synchronous communication with live chats and/or the organization of live video-supported events utilizing diverse virtual tools, f) in order to enhance training portability and to avoid confusion of participants with different devices, the provision by the network operators of several short instructional manuals/videos for each major operating system and device type (phone, tablet, PC), would be beneficial.

Some fundamental design characteristics of the training to those who deliver teacher professional training programs follows below. The social environment of the training should promote teachers' basic needs satisfaction and optimal motivation for teacher participation and active involvement with the learning process, educational materials and tasks. Professional training should underline/promote teachers' ownership and should be delivered in an unobtrusive manner without imposing strict deadlines and obligations. Participants' views and opinions should be valued and accepted without destructive criticism by providing positive, constructive feedback in a polite manner by trainers and colleagues. Teachers should be able to choose the place and pace of attendance and the amount of time they wish to commit/invest. Educational material, tasks and the training process should provide optimal challenges by offering opportunities to teachers to apply their expertise, and to develop new skills. Teachers should have the option to connect and interact openly and sincerely with significant others in the training. A great combination of all these features can be found in a professional training which is delivered online in the form of CoP through a popular social network platform.

4.3. Limitations

When interpreting the present results, some limitations of the study should be taken into consideration. Firstly, the study

recruitment and sample was limited to Facebook users only and even though we did not forbid new users to apply, to our knowledge there was a small number of potential participants (nonusers) that disliked Facebook and did not wish to create a profile for taking part in the training. Further, although the study design included an experimental group, we did not manage to obtain data by a corresponding control group to compare our results. In addition, we did not examine for other confounding factors that might have affected our results, such as teacher participation in diverse educational/learning experiences during the academic year (and simultaneously with PE.T.Co.N.), or their familiarity/experience with online learning environments and social networks. In addition, from participants' demographics it was apparent that most of the group-members, (approximately 60 percent), held postgraduate degrees which is a significantly higher rate compared to the percentage of the general population of Greek in-service teachers that hold similar qualifications (i.e., in 2013 was from 15% for primary school to 21% for high school teachers; KANEP/ GSEE, 2015). This evidence might indicate that most of the members had an inclination towards lifelong learning, and they might have been already more positively predisposed towards in-service training, which may have been reflected in our findings.

5. Conclusions & further research

Regular membership of the PE teachers, and enhanced participatory dynamics of the group members might surmise that PE.T.-Co.N. is an innovative teacher professional development approach that can increase teacher motivation to participate in educational innovations which in turn, may promote youth PA and well-being. Even though this study was conducted prior to the global coronavirus pandemic, current health restrictions make online professional trainings such as PE.T.Co.N., more appropriate than ever, due to the lock downs and social distancing measures imposed globally to limit SARS-CoV-2 spreading. Further, it is suggested that virtual teaching environments that require minimal digital skills, can enhance learning in diverse contexts such as PE. It is of great interest to further investigate whether learning which occurs in these virtual environments transfers in professional contexts that involve a physical environment with practical tasks and activities such as PE students learning environments. In addition, it would be very interesting to further explore how PE.T.Co.N. members reacted/ adapted to students' on-line classes during school lockdown due to COVID-19 pandemic emergency measures, and whether their CoP experience have facilitated their efforts to collaborate with colleagues more efficiently during this unprecedented reality.

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Author details statement

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Appendix A. Supplementary data

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References

- Ajzen, I. (2002). Constructing a TPB questionnaire: Conceptual and methodological considerations. Retrieved 1/9/2008, from http://www-unix.oit.umass.edu/aizen/
- Armour, K. M., & Yelling, M. R. (2004). Continuing professional development for experienced physical education teachers: Towards effective provision. Sport, Education and Society, 9(1), 95–114.
- Armour, K. M., & Yelling, M. R. (2007). Effective professional development for physical education teachers: The role of informal, collaborative learning. *Journal* of Teaching in Physical Education, 26(2), 177–200.
- Baran, B., & Cagiltay, K. (2010). The motivators and barriers in the development of online communities of practice. *European Journal of Educational Research*, 39, 79–96.
- Bissessar, C. S. (2014). Facebook as an informal teacher professional development tool. Australian Journal of Teacher Education, 39(2), 121–135. https://doi.org/ 10.14221/ajte.2014v39n2.9
- Borko, H. (2004). Professional development and teacher learning: Mapping the terrain. Educational Researcher, 33(8), 3–15.
- Boyatzis, R. E. (1998). Transforming qualitative information: Thematic analysis and code development. Sage Publications, Inc.
- Cave, A., & Mulloy, M. (2010). How do cognitive and motivational factors influence teachers' degree of program implementation? A qualitative examination of teacher perspectives. National Forum of Educational Administration and Supervision Journal, 27(4), 1–26.
- Çevik, Y. D., Çelik, S., & Haşlaman, T. (2014). Teacher training through social networking platforms: A case study on Facebook. Australasian Journal of Educational Technology, 30(6), 714–727.
- Chen, K.-C., & Jang, S.-J. (2010). Motivation in online learning: Testing a model of self-determination theory. *Computers in Human Behavior*, 26(4), 741–752. https://doi.org/10.1016/j.chb.2010.01.011
- Chen, B., Vansteenkiste, M., Beyers, W., Boone, L., Deci, E. L., Van der Kaap-Deeder, J., et al. (2015). Basic psychological need satisfaction, need frustration, and need strength across four cultures. *Motivation and Emotion*, 39(2), 216–236. https:// doi.org/10.1007/s11031-014-9450-1
- Cochran-Smith, M., & Lytle, S. L. (1999). Relationships of knowledge and practice: Teacher learning in communities. *Review of Research in Education*, 24, 249–305.
- Creswell, J. W. (2003). Research design: Qualitative, quantitative, and mixed methods approaches. Sage Publications, Inc.
- Davis, K. (2015). Teachers' perceptions of Twitter for professional development. Disability & Rehabilitation, 37(17), 1551–1558.
- Deci, E. L., & Ryan, R. M. (1985). Intrinsic motivation and self-determination in human behaviour. New York: Plenum.
- Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, 11(4), 227–268.
- Deglau, D., & O'Sullivan, M. (2006). The effects of a long-term professional development program on the beliefs and practices of experienced teachers. *Journal of Teaching in Physical Education*, 25(4), 379–396.
 Duda, J. L., & Nicholls, J. G. (1992). Dimensions of achievement motivation in
- Duda, J. L., & Nicholls, J. G. (1992). Dimensions of achievement motivation in schoolwork and sport. *Journal of Educational Psychology*, 84(3), 290–299.
- Duda, J. L., Papaioannou, A. G., Appleton, P. R., Quested, E., & Krommidas, C. (2014). Creating adaptive motivational climates in sport and physical education. In A. Papaioannou, & D. Hackfort (Eds.), *Routledge companion to sport and exercise* psychology. New York, NY: Routledge. Duncan-Howell, J. (2010). Teachers making connections: Online communities as a
- Duncan-Howell, J. (2010). Teachers making connections: Online communities as a source of professional learning. *British Journal of Educational Technology*, 41(2), 324–340.
- Educational Policy Development Center of General Labor Confederation in Greece (KANEP/GSEE). (2015). *key figures of education 2015. Greek primary & secondary education. Part A: The European & international reference framework (2002-2013)* [Title translated from Greek]. ISBN e-book: 978–618–5006–26–6 https:// www.kanep-gsee.gr/ekdoseis/-/etisia-ekthesi-gia-tin-ekpaidefsi-2015/.
- European Commission/EACEA/Eurydice. (2018). Teaching careers in Europe: Access, progression and support. Eurydice report. Luxembourg: Publications Office of the European Union, ISBN 978-92-9492-690-6. https://doi.org/10.2797/309510
- Fernet, C., Senecal, C., Guay, F., Marsh, H., & Dowson, M. (2008). The work tasks motivation scale for teachers (WTMST). *Journal of Career Assessment*, 16, 256–279. https://doi.org/10.1177/1069072707305764
- Fewkes, A. M., & McCabe, M. (2012). Facebook: Learning tool or distraction? Journal of Digital Learning in Teacher Education, 28(3), 92–98.
- Garet, M. S., Porter, A. C., Desimone, L., Birman, B. F., & Yoon, K. S. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal*, 38(4), 915–945.
- Gorozidis, G. S., & Papaioannou, A. G. (2011). Teachers' self-efficacy, achievement goals, attitudes and intentions to implement the new Greek physical education curriculum. European Physical Education Review, 17(2), 231–253. https://doi.org/ 10.1177/1356336x11413654.

- Gorozidis, G. S., & Papaioannou, A. G. (2014). Teachers' motivation to participate in training and to implement innovations. *Teaching and Teacher Education*, 39, 1–11. https://doi.org/10.1016/j.tate.2013.12.001.
- Gorozidis, G. S., & Papaioannou, A. G. (2016). Teachers' achievement goals and selfdetermination to engage in work tasks promoting educational innovations. *Learning and Individual Differences*, 49, 46–58. https://doi.org/10.1016/j.lindif. 2016.05.014.
- Gorozidis, G. S., Tzioumakis, Y. S., Krommidas, C., & Papaioannou, A. G. (2020). Capturing Teacher Basic Needs Satisfaction: Validation Evidence For The Greek Scale Measuring PE Teachers. BNS. European Journal of Education Studies, 7(2), 1–17. https://doi.org/10.5281/zenodo.3712441
- Greenhow, C., & Lewin, C. (2015). Social media and education: Reconceptualizing the boundaries of formal and informal learning. *Learning, Media and Technology*, 41(1), 6–30. https://doi.org/10.1080/17439884.2015.1064954
- Hardman, K., & Marshall, J. (2008). World-wide survey II of school physical education. Berlin: ICSSPE. Final report.
- Hargreaves, D. H. (2001). A capital theory of school effectiveness and improvement. British Educational Research Journal, 27(4), 487–503.
- Hsu, H. K., Wang, C. V., & Levesque-Bristol, C. (2019). Reexamining the impact of self-determination theory on learning outcome in online learning environments. *Education and Information Technologies*. https://doi.org/10.1007/s10639-019-09863-w
- Hur, J. W., & Brush, T. A. (2009). Teacher participation in online communities. Journal of Research on Technology in Education, 41(3), 279–303.
- Jonassen, D. H., Howland, J., Marra, R., & Crismond, D. (2008). Meaningful learning with technology. Upper Saddle River, NJ: Pearson.
- Jordan, K. (2015). Massive open online course completion rates revisited: Assessment, length and attrition. *International Review of Research in Open and Distributed Learning*, 16(3), 341–358.
- Karagiorgi, Y., & Symeou, L. (2008). Through the eyes of the teachers: Revisiting inservice training practices in Cyprus. Teacher Development: An International Journal of Teachers' Professional Development, 12(3), 247–259.
- Kelly, N., & Antonio, A. (2016). Teacher peer support in social network sites. *Teaching and Teacher Education*, 56, 138–149.
- Krommidas, C, Gorozidis, G. S., Tzioumakis, Y. S., & Papaioannou, A. G. (2019). Validation evidence of Basic Needs Frustration Scale for Teachers - Greek version. In Poster presented at the 15th FEPSAC European Congress of Sport & Exercise Psychology 2019, "Building the future of sport & exercise psychology" (p. 144). Münster, Germany: University of Münster. https://www.fepsac2019.eu/.
- Kop, R., Fournier, H., & Mak, J. S. F. (2011). A pedagogy of abundance or a pedagogy to support human beings? Participant support on massive open online courses. *International Review of Research in Open and Distance Learning*, 12(7), 74–93.
- Lam, S.-f., Cheng, R. W.-y., & Choy, H. C. (2010). School support and teacher motivation to implement project-based learning. *Learning and Instruction*, 20(6), 487–497.
- Lave, J., & Wenger, E. (1991). Situated learning: Legitimate peripheral participation. Cambridge university press.
- Lieberman, A., & Miller, L. (1999). Teachers-transforming their world and their work. New York: Teachers College Press.
- Lieberman, A., & Miller, L. (2011). Learning community: The starting point for professional learning is in schools and classrooms. *Journal of Staff Development*, 32(4), 16–20.
- Lieberman, A., & Pointer Mace, D. (2010). Making practice public: Teacher learning in the 21st century. *Journal of Teacher Education*, 61(1–2), 77–88.
- Longo, Y., Gunz, A., Curtis, G. J., & Farsides, T. (2016). Measuring need satisfaction and frustration in educational and work contexts: The Need Satisfaction and Frustration Scale (NSFS). Journal of Happiness Studies, 17(1), 295–317.
- Macià, M., & García, I. (2016). Informal online communities and networks as a source of teacher professional development: A review. *Teaching and Teacher Education*, 55, 291–307.
- Maehr, M. L., & Braskamp, L. A. (1986). The motivation factor: A theory of personal investment. Lexington, MA: Lexington Books.
- Manca, S., & Ranieri, M. (2013). Is it a tool suitable for learning? A critical review of the literature on Facebook as a technology-enhanced learning environment. *Journal of Computer Assisted Learning*, 29(6), 487–504. https://doi.org/10.1111/ jcal.12007
- Maniaci, M. R., & Rogge, R. D. (2014). Caring about carelessness: Participant inattention and its effects on research. *Journal of Research in Personality*, 48, 61–83.
- Margaryan, A., Bianco, M., & Littlejohn, A. (2015). Instructional quality of massive open online courses (MOOCs). Computers & Education, 80, 77–83.
- Martin, N., Kelly, N., & Terry, P. (2018). A framework for self-determination in massive open online courses: Design for autonomy, competence, and relatedness. Australasian Journal of Educational Technology, 34(2), 35–55.
- O'Bannon, B. W., Beard, J. L., & Britt, V. G. (2013). Using a Facebook group as an educational tool: Effects on student achievement. *Computers in the Schools*, 30(3), 229–247.
- Patton, M. Q. (1990). *Qualitative evaluation and research methods*. SAGE Publications, Inc.
- Patton, M. Q. (2002). Qualitative research and evaluation methods. SagePublications, Inc.
- Prescott, J., Stodart, M., Becket, G., & Wilson, S. (2015). The experience of using Facebook as an educational tool. *Health and Social Care Education*, 1–5. https:// doi.org/10.11120/hsce.2013.00033
- Putnam, R. T., & Borko, H. (2000). What do new views of knowledge and thinking have to say about research on teacher learning? *Educational Researcher*, 29(1),

4-15.

- Quan-Haase, A., & Young, A. L. (2010). Uses and gratifications of social media: A comparison of Facebook and instant messaging. *Bulletin of Science, Technology & Society*, 30(5), 350–361.
- Ranieri, M., Manca, S., & Fini, A. (2012). Why (and how) do teachers engage in social networks? An exploratory study of professional use of Facebook and its implications for lifelong learning. *British Journal of Educational Technology*, 43(5), 754–769. https://doi.org/10.1111/j.1467-8535.2012.01356.x
- Rehm, M., & Notten, A. (2016). Twitter as an informal learning space for teachers? The role of social capital in twitter conversations among teachers. *Teaching and Teacher Education*, 60, 215–223.
- Rossman, B. G., & Rallis, S. F. (1998). Learning in the field: An introduction to qualitative research. SAGE Publications, Inc.
- Rutherford, C. (2010). Facebook as a source of informal teacher professional development. *Education*, 16(1), 60–74. Retrieved from http://ineducation.ca/ ineducation/article/view/76.
- Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, 55(1), 68–78.
- Ryan, R. M., & Deci, E. L. (2002). Overview of self-determination theory: An organismic dialectical perspective. In E. L. Deci, & R. M. Ryan (Eds.), *Handbook of self-determination research* (Vol. 2, pp. 3–33). NY: University Rochester Press.
- Saini, C., & Abraham, J. (2019). Implementing Facebook-based instructional approach in pre-service teacher education: An empirical investigation. *Computers & Education*, 128, 243–255. https://doi.org/10.1016/ j.compedu.2018.09.025
- Schwartz, S. H., & Bardi, A. (2001). Value hierarchies across cultures: Taking a similarities perspective. Journal of Cross-Cultural Psychology, 32, 268–290. https://doi.org/10.1177/0022022101032003002
- Scogin, S. C., & Stuessy, C. L. (2015). Encouraging greater student inquiry engagement in science through motivational support by online scientist-mentors. *Science Education*, 99(2), 312–349.
- Sheldon, P. (2008). Student favorite: Facebook and motives for its use. Southwestern Mass Communication Journal, 23(2), 39–53.
- Shulman, L. S., & Shulman, J. H. (2004). How and what teachers learn: A shifting perspective. Journal of Curriculum Studies, 36, 257–271. https://doi.org/10.1080/ 0022027032000148298
- Sproull, L, & Kiesler, S. (1991). Computers, networks and work. Scientific American, 265(3), 116–127.
- Van Eekelen, I. M., Vermunt, J. D., & Boshuizen, H. P. A. (2006). Exploring teachers' will to learn. *Teaching and Teacher Education*, 22(4), 408–423.

Vansteenkiste, M., & Ryan, R. M. (2013). On psychological growth and vulnerability:

Basic psychological need satisfaction and need frustration as a unifying principle. Journal of Psychotherapy Integration, 3, 263–280. https://doi.org/10.1037/ a0032359

- Vansteenkiste, M., Simons, J., Lens, W., Sheldon, K. M., & Deci, E. L. (2004). Motivating learning, performance, and persistence: The synergistic effects of intrinsic goal contents and autonomy-supportive contexts. *Journal of Personality* and Social Psychology, 87, 246–260. https://doi.org/10.1037/0022-3514.87.2.246
- Villegas-Reimers, E. (2003). Teacher professional development: An international review of the literature. Paris: International Institute for Educational Planning, UNESCO.
- Vygotsky, L. S. (1978). In J. M Steiner, S. Scribner, & E. Souberman (Eds.), Mind in society: The development of higher psychological processes cole. London: Harvard University Press.
- Wang, C., Hsu, H. C. K., Bonem, E. M., Moss, J. D., Yu, S., Nelson, D. B., et al. (2019). Need satisfaction and need dissatisfaction: A comparative study of online and face-to-face learning contexts. *Computers in Human Behavior*, 95, 114–125. https://doi.org/10.1016/j.chb.2019.01.034
- Wang, Q., Woo, H. L., Quek, C. L., Yang, Y., & Liu, M. (2012). Using the Facebook group as a learning management system: An exploratory study. British Journal of Educational Technology, 43(3), 428–438.
- Wenger, E. (1998). Communities of practice: Learning, meaning, and identity. Cambridge university press.
- Wenger-Traynor, E. (2014). Communities of practice: Theories and current thinking. UDOL Academic Conference.
- WHO. (2018). Global action plan on physical activity 2018–2030: More active people for a healthier world. Geneva: World Health Organization.
- Wilberding, K., & Wells, G. (February 4, 2019). Facebook's timeline: 15 years. In Wall street Journal. ISSN 0099-9660. Retrieved February 6, 2019.
- Xing, W., & Gao, F. (2018). Exploring the relationship between online discourse and commitment in Twitter professional learning communities. *Computers & Education*, 126, 388–398. https://doi.org/10.1016/j.compedu.2018.08.010
- Yoon, K., & Armour, K. M. (2017). Mapping physical education teachers' professional learning and impacts on pupil learning in a community of practice in South Korea. *Physical Education and Sport Pedagogy*, 22(4), 427–444.
- Yu, A. Y., Tian, S. W., Vogel, D., & Kwok, R. C. W. (2010). Can learning be virtually boosted? An investigation of online social networking impacts. *Computers & Education*, 55(4), 1494–1503.
- Zhang, S., & Liu, Q. (2019). Investigating the relationships among teachers' motivational beliefs, motivational regulation, and their learning engagement in online professional learning communities. *Computers & Education*. https:// doi.org/10.1016/j.compedu.2019.02.013