



# Encouraging teacher participation in Professional Learning Communities: exploring the Facilitating or restricting factors that Influence collaborative activities

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## Abstract

With the ease of using information technology tools, the explosive growth of smartphone applications (apps), and the rise of learning communities on social media, the acceptance of learning communities has become one of the most significant challenges for higher education institutions in Taiwan. In order to better understand teachers' collaborative performance in learning communities, this study employs the cognitive dimension (opportunism) and internal tension dimension (e.g. rising expectation, relationship burden) as restrictive factors; on the other hand, it uses emotional support, sense of belonging, and interpersonal altruism as facilitating factors; and community interaction, relationship performance, and collaborative performance as endogenous factors. With a cross-sectional survey method and a quantitative approach, this study further dives into the collaborative performance of professional learning communities. A total of 157 teachers (87 male and 70 female) were surveyed, and a structural equation modeling approach was used. It was found that social media learning communities have done better than previous courses of field learning in unrestraining learning styles and increasing the breadth of knowledge. Facilitating and restrictive factors led to the rearrangement of the entire knowledge contribution process, enabling new configurations of individuals, members, and community. Moreover, community interactions are important drivers of relationship and collaboration performance supported by empirical data. The findings offer guidelines for policymakers and educators who evaluate teachers' collaborative performance and relationship performance to promote teaching efficiency and effectiveness by incorporating cyberethics in educational activities.

**Keywords** Professional Learning Communities · Socioemotional selectivity theory · Cyberethics Education · Partial least square · Collaborative learning

## 1 Introduction

In the past, teachers' professional development mainly involved improving their professional skills and mastering new teaching strategies, with teachers being positioned as knowledge recipients. More recently, the availability of training through online environments has allowed for the sharing of professional knowledge and resources, expressing opinions, and connecting with colleagues. This new form of professional learning style, which is more flexible and responsive to new fields, has enabled teachers to enhance their professional growth beyond earlier constraints (Abdigapbarova & Zhiyenbayeva, 2022; Aubusson & Schuck, 2013; Ping et al., 2018; Schuck et al., 2013; Tam, 2015; vanOostveen et al., 2019; Xue et al., 2021). Concurrently, the role of teachers has changed from delivering knowledge to generating professional content, necessitating the need to produce knowledge content through collaboration and independent exploration (Cameron et al., 2013; Hutchison & Colwell 2012; Prestridge, 2019). Social media-based online communities has enabled teachers to participate in even more self-directed learning opportunities depending on their personal interests, unhindered by spatiotemporal limitations.

The broad scope of professional knowledge and increasing complexities associated with topic knowledge require teachers to adopt a highly personalized and cooperative learning model, as well as the practical operations of collaborative learning (Frei-Landau et al., 2022; Garcia, 2021; vanOostveen et al., 2019; Yadegaridehkordi et al., 2019; Zalavra & Papanikolaou, 2022). This consequently allowed them to focus their efforts on collaborative learning and professional development in order to transform real and context-based ideas into next generation course plans. According to Nguyen et al., (2022), collaborative community learning integrates three aspects: technology, teaching, and content/knowledge. Moreover, for computer-supported collaborative learning (CSCL) in a learning community, the collaborative learning process includes personal knowledge exploration, community interaction processes, knowledge development about learning groups, and knowledge creation in small Internet-based groups. The collaborative learning cultivates learners' cognitive thinking during the process of interpersonal communication, maintains their community participation during the group discussion process, and builds knowledge through community interactions (Aubusson & Schuck, 2013; Damsa, 2014; Nguyen et al., 2022; Schuck et al., 2013; Tam, 2015). In-depth exploration of knowledge may trigger interactions among learning partners who further promote knowledge building within the learning group. This collaborative learning process commences usually when learners undertake research on a common topic or problem and identify information related to the topic of discussion.

Pusey & Sadera (2011) founded that education on cyberethics must emphasize both theory and practice. Continuous technological innovations have widened the gap between improper online behaviors and the law, but in the courses of cyberethics, the legal content being taught often lags behind current Internet misconducts. Most scholars in this area have tended to focus on ethical education, norms in codes of ethics, and the improvement of information literacy (Paris et al., 2013; Sanger & Osguthorpe, 2011; Warnick & Silverman, 2011). These are used as countermeasures to deal with and correct students' inappropriate Internet behaviors in terms of number

and frequency. However, cyberethics education must better integrate the technological environment and cross-domain learning. Teachers must respond to the needs in this area through their own professional growth and training. In addition to absorbing new knowledge, teachers in community learning groups must share or compare information on problems, discover and explore Internet misconducts and misconceptions, and examine the consistencies or inconsistencies between law and misconduct. In this sense, teachers' professional development becomes a key factor for their personal growth and the success of cyber-ethical education (Tsiotakis & Jimoyiannis, 2016; van den Bergh et al., 2015). During the teaching period, working with an online learning communities can be a useful strategy for teachers to enhance their professional knowledge and practice (Abdigapbarova & Zhiyenbayeva 2022; Özüdoğru, et al., 2022; Ping et al., 2018; Tzanavaris et al., 2021; vanOostveen et al., 2019; Xue et al., 2021). Scholars have considered that teachers in learning community can embark on this collaborative learning process to enrich their professionalism in response to teaching needs (Aldosemani, 2020; Nelimarkka et al., 2021; Shek et al., 2021). By promoting effective community interactions, online collaborative learning supports the processes of knowledge acquisition, sharing, and reflection, as well as the mutual sharing of experiences and the co-building of knowledge (Ng et al., 2022; Nguyen et al., 2022; Yadegaridehkordi et al., 2019).

Relationship performance during interactions reflects more than varying degrees of contribution in terms of community and cognitive inputs (Tirado et al., 2015): learners can also synthesize, criticize, and reflect on other participants' ideas. There is a close connection between community interactions and cognitive participation in a group, which acts as a key driving force for group members to continue interacting within an active participation environment (Nguyen et al., 2022; Yücel & Usluel, 2016; Tirado et al., 2015) put much emphasis on the importance of community interactions and on the need to explore mutual connections among group partners in order to improve the quality of collaborative learning. Nguyen et al., (2022) also found that in an asynchronous learning environment, there were positive correlations between network cohesion and centralization and the frequency of interaction and knowledge creation. In this study, individuals' positive and negative perspectives on professional learning communities are used to examine not only the variations in the degree of community interactions and participation but also their impact on both teachers' community relationship performance and collaborative performance.

Research has shown that when individuals learn with the support of socially shared regulation (SSR) technological tools, they are aware of their emotions and motivations, which facilitates their learning process (Burdan & Kearney, 2017; Järvelä et al., 2016; Jiang et al., 2016). They can also use information technology tools for self-regulation to promote their learning (Azevedo & Gašević 2019; Banert & Reimann, 2012, Tour, 2017) and create new platforms for communication and interactions. Collaboration among members can ensure the effective building of professional knowledge (Al-Samarraie & Saeed 2018; Özüdoğru, et al., 2022; vanOostveen et al., 2019; Zalavra & Papanikolaou, 2022). All these experiences help increase interactions among learners, improve their problem-solving skills, and enhance their professional knowledge. Through the activities, individuals can share knowledge and address issues that occur during knowledge exchanges. In order to understand teach-

ers' usage of virtual learning communities and collaborative performance, this study aims to address the following research questions (RQs):

**RQ1** Within educational courses on cyberethics, teachers have formed online collaborative learning groups for professional growth. What are the factors in collaborative learning that lead to the formation of positive and negative emotions?

**RQ2** How do those positive and negative emotions further influence the community learning performance chain (community interaction, relational performance, and collaborative performance)?

In this study, individuals' perspectives on socioemotional opinions and the resultant differences in the degree of community participation were studied, examined, and then integrated with the individuals' positive and negative perspectives on collaborative learning. Through self-reporting by teachers in learning communities for professional growth, the impacts of positive and negative emotions arising from collaborative learning on group interactions, relationship performance, and collaborative performance can be verified.

## 2 Literature review

Teachers' professional growth is different from students' learning processes, and it goes beyond the teaching of professional knowledge and problem solving. In this study, the literature review is divided into three subsections and research hypotheses, including a discussion on the "positive" and "negative" outcomes of collaborative learning and a socioemotional selectivity theory.

### 2.1 Linking collaborative learning activities with "positive" outcomes

Learners' positive emotions effectively increase their participation rates, and emotions such as curiosity, excitement, and enjoyment help them remain engaged in the course and stay persistent (Al-Samarraie & Saeed, 2018; Özüdođru, et al., 2022; vanOostveen et al., 2019; Zalavra & Papanikolaou, 2022). However, negative emotions such as boredom, weariness, and anxiety have the opposite effect (Linnenbrink-Garcia et al., 2011; Tzafilkou et al., 2021). When learners subjectively believe that learning activities can be controlled and that learning tasks are valuable, they will have more positive emotions and curiosity, while the level of their anxiety and other negative emotions will be reduced. As learners reflect on their collaborative learning behaviors, their emotional states are feedback symbols of learning outcomes. Scholars have indicated that during the process of collaborative learning, positive emotions are the best predictors of learning participation and task performance (Butz et al., 2016; Tzanavaris et al., 2021). In an online CSCL environment, emotional awareness—self-awareness, group awareness, and learning reflection—has shown differences between the genders (Avry et al., 2020). Online professional learning community platforms often lead to better integration of the learning process and accu-

mulation of community knowledge content (Järvelä & Bannert, 2019; Nelimarkka et al., 2021). In particular, Tour (2017) argued that professional learning is socialized and that an active learning process can be conducted through the learning community platform when learners can take advantage of personal knowledge and opportunities to help others. Doing so not only maintains and strengthens relationships among the members, but also improves their performance at collaborative learning (Carpenter & Krutka, 2015; Chuang, 2016; Kelly & Antonio, 2016; Tzanavaris et al., 2021; vanOostveen et al., 2019). Within the structure of learning community and the culture of sharing, learning outcomes are enhanced and teachers' professional qualities are improved, given the emphasis on the concept of "collaboration, sharing, and support" (Carpenter & Krutka, 2015; Nelimarkka et al., 2021).

## 2.2 Linking collaborative learning activities with "negative" outcomes

Agrawal & Krishna (2021) proposed that individuals are becoming lonelier and having communication apprehension due to psychological stress in online learning environment, especially when the current pandemic prevails. Failure to maintain relationships also has negative effects on subsequent learning outcomes. According to Tzafilkou et al., (2021), negative emotions affect both motivation and knowledge improvement, and boredom can make individuals refuse to participate in online collaboration with peers. Lavoué et al., (2015) observed the moment of self-reflection after collaborative activities had ended and found that learners' expectations for their learning partners tend to increased, especially in conflict situations: those involved needed to make learning adjustments and modulate their learning status. Tzafilkou et al., (2021), who observed the interactions of 116 college students during COVID-19 crisis, noted that a large amount of information contained in the fully remote course had caused anxiety and frustration, leading to negative emotions that obstructed collaborative learning. The findings of Siemon et al., (2019) indicated that the rising expectations of virtual teams may lead to dependence, and even overdependence, on interpersonal relationships. When there is a rise of opportunistic atmosphere in learning community activities, learners must prevent negative emotions from happening, in order to maintain the performance of community relationship.

## 2.3 Socioemotional selectivity theory

Carstensen's (1995) socioemotional selectivity theory (SST) explains changes related to social behaviors and their durations from the perspectives of affective states and interpersonal interactions. SST links individuals' perception of time with their selection and pursuit of goals. Selectively narrowing down community interactions is adaptable and can maintain or even intensify relationships with close friends (Delahunty et al., 2014; Hod & Katz, 2020; Jarvelä et al., 2000). In contrast, short durations often result in prioritizing affective states and goal satisfaction, including feeling good and having the motivation to obtain emotional meaning from life (Carstensen, 2006; Delahunty et al., 2014; Isohätälä et al., 2020). After members have satisfied the general goals of acquiring knowledge or establishing new community relationships, emotional regulation becomes the main motivation. SST claims that duration-related

motivational transformations often lead to changes in dynamic interactions between individuals and their environment, pushing them to prioritize optimizing emotional experiences within the environment. When people are “newer” members of learning communities, they often turn their attention to the emotionally meaningful aspects of the learning activities, such as fulfilling the desire to live a meaningful life and to feel socially interconnected, as well as establishing community relationships (Bakhtiar et al., 2018; Hod & Katz, 2020; Isohäätä et al., 2020). Increased duration of participation in a community results in the “need for a sense of belonging” becoming stronger. As people remain in one community for a long time, they tend to shift from knowledge goals to emotional goals (Bakhtiar et al., 2018; Isohäätä et al., 2020; Jarvelä et al., 2000).

## 2.4 Theoretical hypotheses development

Professional learning is self-directed and based on an individual’s professional needs or interests. In the process, they often have the opportunity to interact with like-minded peers, thereby establishing connections and cultivating a sense of belonging (Macia & García, 2016; Xue et al., 2021). Through discussing and sharing about their work and their students’ learning situations, they can strengthen their teaching skills (Visser et al., 2014). In CSCL communities, these strategies (open and fair environments; collaborative problem-solving consensus; dialogue feedback mechanisms) facilitate and promote socioemotional interactions and the continuation of altruistic activities (Kutsyuruba & Kovalchuk 2015). Salam & Farooq (2020) asserted that within virtual learning groups, community support (in terms of information and emotions) has a positive effect on the intention to continue using the social networking site Plurk and engage in community interactions. A sense of belonging comes from meaningful community relationships since positive connections can satisfy the “need to belong” and maintain meaningful and respected mentality. In a CSCL environment, positive emotions are correlated with feedback, motivation, and altruistic behaviors. Those factors are crucial for the collaborative learning group as a whole and for the individual learners participating in the collaboration (Cheng, 2014; Siemon et al., 2019; Tzafilkou et al., 2021). Based on the above, the following hypotheses are posited:

**H1:** Individuals’ positive emotions within a learning community affect their interpersonal altruism.

**H2:** Individuals’ sense of belonging within a learning community affects their interpersonal altruism.

According to SST, when knowledge acquisition goals become less important, the emotional trajectory slowly declines and becomes a relationship burden to the group (Stafford & Hillyer, 2012; Tzafilkou et al., 2021). The rising relationship burden leads them to making more selfless efforts to maintain the quality of community relationships. However, the excessive efforts associated with maintaining relationships encourages an atmosphere of opportunism (Haas et al., 2020; Hernández-Sellés et

al., 2019; Park et al., 2016; Siemon et al., 2019; Tzanavaris et al., 2021). With rising expectations from those who will continue to interact and communicate, a lack of emotive communication negatively affects collaborative learning. King & Areepattammannil (2014) found that when there is pressure or risk of failure to complete work on time, unequal investment of resources creates a relationship burden on, or a perception of unfairness in, another party during the development of a learning partnership; as a result, a certain degree of opportunism will be apparently shown. This leads to the following hypotheses:

**H3:** Individuals' relationship burden within a learning community affects their opportunistic attitudes toward the community.

**H4:** Individuals' rising expectations within a learning community affect their opportunistic attitudes toward the community.

Cheng (2014) performed a qualitative analysis of the content on massive open online course (MOOC) forums: the results suggest that altruistic and positive emotions within a community are essential for adults and professional MOOCs because of the desire to maintain a high quality of knowledge. Shek et al., (2021) investigated interactive participation of online discussion group members and discovered that such participation promoted the discussion group's existence and connectivity during the knowledge-building process. Expressing opinions in response to others' comments, raising queries, and theorizing are important factors to achieve knowledge building (Guinot et al., 2015; Nguyen et al., 2022; Shek et al., 2021). A perspective based on interpersonal altruism ensures the continuous creation of new contributions at different times throughout the entire discussion process, continuously maintains personal relationships, and accelerates collaborative performance within the learning community (Habibi et al., 2018; Nelimarkka et al., 2021; Tzanavaris et al., 2021). The sense of community altruism leads to a situation where higher-level community interactions in a CSCL environment are increased, emotional connections are established, and strong team cohesion, respect, and a sense of belonging are formed as a result (Panadero et al., 2015; Tzanavaris et al., 2021; Zhao et al., 2020). Interpersonal altruism can promote positive relationships between members (Isohäätäälä et al., 2020; Laux et al., 2016), and accelerate individual learners' coordination and collaboration with other learners to improve their performance (Blau et al., 2020). Thus, the following hypotheses are proposed:

**H5:** Individuals' interpersonal altruism within a learning community affects their community interactions.

**H6:** Individuals' interpersonal altruism within a learning community affects their relationship performance.

**H7:** Individuals' interpersonal altruism within a learning community affects their collaborative performance.



Following SST, Dohn (2009) argued that a high degree of interaction, closeness, and experience among learning partners makes it impossible for them to objectively judge one another's contributions and efforts regarding their learning activities. In addition, the non-repudiation of web text has reduced the frequency of opportunistic activities and group members' responsible interactions, thereby increasing knowledge source verifiability and learning satisfaction (Nguyen et al., 2022; Tzafilkou et al., 2021). The intangible emotional connection helps create a conducive environment for the team to learn and communicate, and reduce opportunistic activities among members. In an ongoing collaborative relationship, team members can reduce the team's communication costs, avoid losing outstanding members, and enhance the team's learning performance (Ng et al., 2022; Shek et al., 2021). Goodyear et al., (2014) proposed that long-term partners in a CSCL environment can easily search through uploaded and login data to identify evidence of opportunism and unequal effort by their peers. Either of these can produce an opportunistic attitude toward collaborative learning, which leads to the gradual emergence of different attitudes toward interaction activities, relationship maintenance, and group performance (long- versus short-term orientation) among collaborative learning partners. Based on the aforementioned literature, the following hypotheses are proposed:

**H8:** Individuals' opportunistic attitudes within a learning community affect their community interactions.

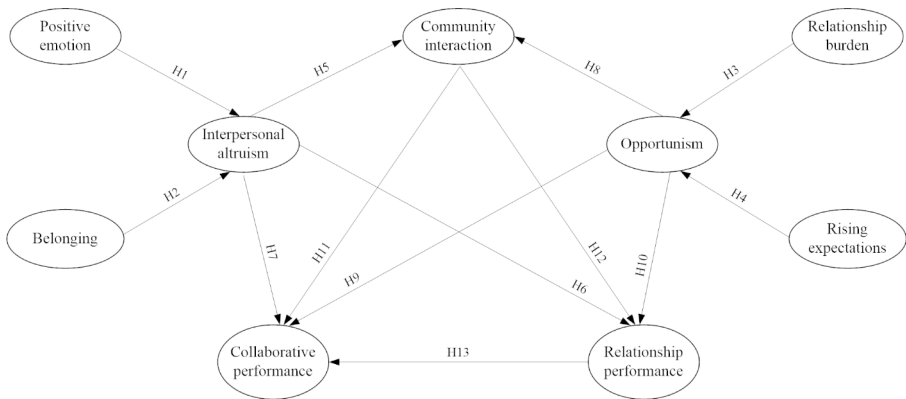
**H9:** Individuals' opportunistic attitudes within a learning community affect their collaborative performance.

**H10:** Individuals' opportunistic attitudes within a learning community affect their relationship performance.

While a community can provide an interactive environment, the long-term learning process involves a collaborative relationship based on common values and mutual dependence (Hernández-Sellés et al., 2019; King & Areepattamannil, 2014; Siemon et al., 2019). Partners can obtain knowledge, resources, and abilities that they need from one another, thereby encouraging the growth of their professional knowledge. This interactive process can accelerate the growth of their professional literacy and the pursuit of individual interests, as well as strengthen learners' collaboration and improve their learning outcomes (Macià & García, 2016; Pyhältö et al., 2015; Tzanavaris et al., 2021; Zalavra & Papanikolaou, 2022). The collaborative platform's technical environment can strengthen intra-group interactions and relationships, and promote learners' collaborative knowledge building (Nguyen et al., 2022; Özüdoğru, et al., 2022; Pavo & Rodrigo 2015; Prestridge, 2019; Tsiotakis & Jimoyiannis, 2016). Based on the above, the following hypotheses are proposed:

**H11:** Community interactions within a learning community affect the individuals' relationship performance.





**Fig. 1** Research model

**H12:** Community interactions within a learning community affect the individuals' collaborative performance.

Prestridge (2019) proposed a framework for professional learning wherein teachers share, collaborate, and provide ideas during community activities, and then elaborate and refine their understanding to build new knowledge. Specifically, knowledge forums facilitate discussions, knowledge resource sharing, and scaffolding activities for knowledge building, so that learners can improve their professional knowledge and learning capabilities. Good relationship performance of individuals usually results in learners' expressing both critical and creative content that contributes to knowledge building, thereby facilitating collaborative performance (Burden & Kearney 2017; Cleveland & Block, 2017; vanOostveen et al., 2019; Zalavra & Papanikolaou, 2022). In response to this line of reasoning, the following hypotheses are proposed:

**H13:** The relationship performance of individuals within a learning community affects their collaborative performance.

It is also important to understand the impact of positive and negative emotions on collaborative interactions and relationship performance before coming to know the consequence of learners' collaborative performance. The findings can help explain teachers' group interactions on the collaborative promotion of cyberethics education and follow up on the relationship performance of teachers' communities' and the results of teachers' collaborative performance. The above hypotheses were used to construct a theoretical model for this study (see Fig. 1).

### 3 Research method

Teachers often apply acquired knowledge of professional growth to their classroom teaching, so they can share their experience and related information with other teachers, and examine and improve on their own shortcomings or blind spots. This type of learning community is purposefully created by the learners, and their choice of application and platform has significant interactive impacts. In the following, Sect. 3.1 outlines the instrument tools, including the development and measurement of questionnaires. Section 3.2 describes the conduct of this study, including the participants and data collection. For all the measures, a seven-point Likert-type scale was utilized, ranging from “strongly disagree” (1) to “strongly agree (7).”

#### 3.1 Instrument tools

Based on specific affective states, this study incorporated socioemotional factors as adjustments to determine the positive/negative effects of community interactions between group learners during collaboration. Questionnaire items to measure individuals’ positive emotional perspectives toward collaborative learning were modified from various studies including Delahunty et al., (2014), Feidakis et al., (2014), Hernández-Sellés et al., (2019), Isohätälä et al., (2020), Järvelä et al., (2016), Kwon et al., (2014), and Reis et al., (2018), while the negative emotional perspective items were modified from Bakhtiar et al., (2018), Tzafilkou et al., (2021), Siemon et al. (2019), Kwon et al., (2014), and Reis et al., (2018).

Feelings of interpersonal altruism can be predicted by a community’s overall atmosphere. A sustained communication network and repeated collaboration lead its members to better problem-solving and increase interpersonal care, concern, and willingness to share, along with other positives. Questionnaire items for this facet were also modified from those used in previous studies (Guinot et al., 2015; Panadero et al., 2015; Salam et al., 2020; Tzafilkou et al., 2021). When some members in a community have heightened expectations in terms of their ideas and opinions, while others do not invest a similar amount of effort in the learning activities, a heightened opportunistic atmosphere would be created. Items used to measure the opportunistic atmosphere were modified from previous studies (Haas et al., 2020; Salam et al., 2020).

According to SST, when people spend more time in a community group, they tend to interact with those they are most familiar with and those they view positively in terms of interpersonal altruism. Questionnaire items used to measure community interactions were modified from Bakhtiar et al., (2018), Damşa (2014), Feidakis et al., (2014), Ghazal et al., (2019), Hernández-Sellés et al., (2019), Lavoué et al., (2015) and Usluel (2016). Collaborative learning relationship performance includes learning outcomes produced during the exchange of knowledge among members, and questionnaire items for measuring the benefits obtained from maintaining relationships in the learning community were modified from previous studies (Hernández-Sellés et al., 2019; Yücel & Usluel, 2016; Xue et al., 2021). Regarding the dependent variables of teachers’ professional growth, this study did not measure teachers’ final learning performance through the completion of tests or test scores.

The questionnaire items were modified and developed from various scholars' operational definitions (Blau et al., 2020; Feidakis et al., 2014; Ghazal et al., 2019; Laux et al., 2016; Yücel & Usluel, 2016).

For the completion of the questionnaire design, we used the expert review of the research construct logic and definitions for content validity, and carried out a pilot of the questionnaire to ensure the face validity of the measurement tools. The pre-test involved 17 teachers to ensure that the participants could complete the survey within 20 min and that all survey items were not ambiguous. Upon response from the pre-test data, the Cronbach's alphas ranging from 0.770 for relationship performance to 0.969 for positive emotion suggested that the instruments used in this study were satisfactory in terms of measuring the constructs of consistency. Based on the results of the pre-test sample, no more modifications were made to the questionnaires. These 17 were subsequently excluded from the formal questionnaire survey.

### 3.2 Participants and data collection

In Taiwan, eight universities were screened to determine whether they would be included in the sample population, with the criterion that the college must have at least five departments related to business and management. The scope of the courses offered was divided into three categories: (i) courses on basic ethical concepts, (ii) courses on professional ethics in business, and (iii) comprehensive courses on ethics in information communication technologies. The selection of the learning community was based on Armour and Yelling (2007), Pyhältö et al., (2015), and Tam (2015). The teachers who were surveyed had previously joined communities for professional development focused on cyberethics or Internet ethics, and the community environment gave them the opportunity to establish contacts with like-minded peers (i.e., colleagues with similar interests, subject areas, and/or educational concepts). They could undertake informal learning, collaboration, and knowledge and idea exchanges while concurrently belonging to one or more groups that suited their needs and interests. Participants had to complete various tasks, including checking and viewing information, posting messages, replying to other participants' posts, and uploading/downloading learning materials.

Approximately 350 questionnaires were distributed in three rounds during the formal survey period. Despite reminders being issued, only 172 questionnaires were retrieved. 15 respondents who had not previously taught ICTs or cyberethics courses were also disqualified. As a result, there remained a total of 157 valid questionnaires. The gender distribution of this sample population included 87 (55.40%) males and 70 (44.60%) females. During the previous academic year, the number of relevant cyberethics courses taught ranged from 1 to 6, with an average of 2.35 (standard deviation=1.08). The eldest respondent was 63, the youngest was 32, and the average age of the sample population was 46.98 (standard deviation=7.54). The average teaching experience of the respondents was 12.03 years (standard deviation=6.52). The valid participants were analyzed in this study, as shown in Table 1.

**Table 1** Profiles of Participants (N=157)

Demographics/ Level			
		Count	Percentage
Gender			
	Male	87	55.40
	Female	70	43
Course count		Count	Percentage
	One	37	23.6
	Two	53	33.8
	Three	49	31.2
	Four	11	7.0
	Five	4	2.5
	Six	2	1.3
	Missing value	1	0.6
Age			
	mean	46.98	
	S.D.	7.02	
	Max	63	
	Min	32	
Academic teaching experiences (years)			
	mean	12.03	
	S.D.	7.54	
	Max	28	
	Min	1	

## 4 Results

The PLS method was used for model construction and data analysis, and the Smart-PLS3.0 software developed by Ringle et al., (2015) was used to measure the analytical and structural models.

### 4.1 Measurement model evaluation

Following Bagozzi & Yi (2012), three of the most frequently used indicators, as described below, were selected to evaluate the research model as are described below.

**Individual item reliability:** the load coefficients of all factors in this study were in the range of 0.649 to 0.924. They exceeded the recommended minimum value of 0.5, and were significant and in conformity with Hair et al.'s (2010) recommendation.

**Composite reliability (CR) of latent variables:** CR was used to express the internal consistency of the construct indicators. The CR values of the tested samples ranged from 0.845 to 0.951. As such, the internal consistency of the research model was deemed good based on Chin's (1998) statement that the CR value should exceed the recommended value of 0.7 when analyzing PLS data. Cronbach's alpha coefficient was used to measure the reliability of the research variables, ranging from 0.771 to 0.935. This met the general requirement of exceeding 0.7 (Nunnally & Berstein, 1994).

**Average variance extracted (AVE) of latent variables:** AVE calculates the explanatory power that a measurement variable has for a latent variable. The AVE values for the various latent variables of the tested samples were in the range of 0.523 to 0.794.

**Table 2** Reliability and validity indicators of the research model

	Cronbach's Alpha	CR	AVE
Positive emotion	0.935	0.951	0.794
Belonging	0.846	0.890	0.619
Relationship burden	0.852	0.895	0.630
Rising expectations	0.887	0.914	0.639
Interpersonal altruism	0.910	0.933	0.735
Opportunism	0.878	0.916	0.731
Community interaction	0.771	0.845	0.523
Relationship performance	0.845	0.890	0.620
Collaborative performance	0.837	0.884	0.604

They exceeded the standard AVE value of 0.5, as suggested by Fornell & Larcker (1981). The measurement model analysis results are shown in Table 2.

In this study, the rigorous discriminant validity test was also employed. The heterotrait-monotrait (HTMT) ratio of correlations for the different facets was used as the evaluation indicator. As indicated in Table 3, all the HTMT correlation coefficients fell under Henseler et al.'s (2015) threshold of 0.90.

## 4.2 Structural model analysis

The path relationships among the various factors were estimated by PLS, and the individual path values were presented using standardized coefficients. The path relationships of the research model's 13 hypotheses were verified to have reached the significance level of  $\alpha=0.05$ , and 9 hypotheses reached the significance level of  $\alpha=0.01$ . For the positive relationships in the research model, the path analysis and coefficients for members' positive emotional support of individuals' altruistic behaviors were positive emotions  $\rightarrow$  interpersonal altruism (0.273) and sense of belonging  $\rightarrow$  interpersonal altruism (0.368), while those for the effectiveness of collaborative learning were interpersonal altruism  $\rightarrow$  group interactions (0.743) and interpersonal altruism  $\rightarrow$  relationship performance (0.320), and interpersonal altruism  $\rightarrow$  collaborative performance (0.264). The relationships among the five paths were positive, significant, and supported by the empirical data.

Regarding negative aspects associated with individuals' emotions, the path analysis and coefficients that shaped a learning community's opportunistic atmosphere were relationship burden  $\rightarrow$  atmosphere of opportunism (-0.498), and rising expectations  $\rightarrow$  atmosphere of opportunism (-0.343), while those for members' opportunistic attitudes affecting the outcome indicators for group collaborative learning were atmosphere of opportunism  $\rightarrow$  group interactions (-0.113), atmosphere of opportunism  $\rightarrow$  relationship performance (-0.264), and atmosphere of opportunism  $\rightarrow$  collaborative performance (-0.169). These five path relationships were negative, significant, and supported by the empirical data.

Next were the impacts of the antecedents for group collaborative learning: group interactions  $\rightarrow$  relationship performance (0.253), group interactions  $\rightarrow$  collaborative performance (0.250), and relationship performance  $\rightarrow$  collaborative performance (0.175), based on the final variables for collaborative performance. These three variables exerted a significant effect on the learning community's performance chain. Details on the related path relationships are shown in Fig. 2.

**Table 3** HTMT discriminant validity indicator of the research model

	Positive emotion	Belonging	Relationship burden	Rising expectations	Interpersonal altruism	Opportunism	Community interaction	Relationship performance	Collaborative performance
Positive emotion									
Belonging	0.765								
Relationship burden	0.139	0.229							
Rising expectations	0.268	0.358	0.632						
Interpersonal altruism	0.558	0.617	0.132	0.153					
Opportunism	0.186	0.284	0.786	0.692	0.115				
Community interaction	0.746	0.785	0.234	0.276	0.872	0.162			
Relationship performance	0.543	0.550	0.466	0.499	0.559	0.303	0.620		
Collaborative performance	0.402	0.497	0.312	0.324	0.591	0.255	0.672	0.558	

## 5 Discussions

This research uses the socialized strategic framework to build communities for teachers' professional growth. Socialized strategies tap the atmosphere of interpersonal interaction and sharing to generate interactions among things, events, situations and the people who are participate in a community. This can be a rapid driving force for the enhancement of professional skills. The following discussions contain a summary of the study implications, practical implications, and study limits.

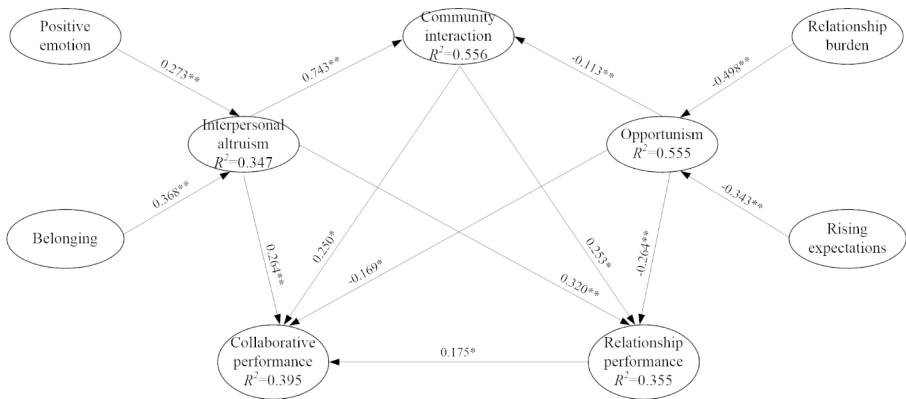
### 5.1 Academic implications

This study drew from SST to construct the members' perceptions of positive and negative factors as operated by the professional collaborative community. It can help promote the collaborative learning performance chain. In this study, learners' collaborative learning performance was directly measured by scales instrument because that is an important component reflecting the integration of learning experiences within the community and the community's professional growth (Abdigapbarova & Zhiyenbayeva 2022; Özüdođru, 2022; Ping et al., 2018; Tzanavaris et al., 2021; Zalavra & Papanikolaou, 2022). This research expands the mobile professional community of collaborative learning to integrate positive and negative perspectives, supports teachers' teaching activities and collaborative learning of new domain knowledge, and provides new approaches to teachers' professional knowledge growth.

A sense of belonging and positive emotions are fundamental motivations for people to engage in collaborative learning that are antecedent variables, which enhance the altruism of interpersonal relationships and strengthens members' interactions. Awareness of fellow group members' positive emotions and participants' sense of belonging can help participants establish the intention and willingness to share knowledge, leading to relationships characterized by interpersonal altruism (Hernández-Sellés et al., 2019; Kelly & Antonio, 2016; Linnenbrink-Garcia et al., 2011). Intra-group interactions allow members to provide continuous support to each other and maintain motivation through positive emotions. Consequently, learners become more willing to care for and help their fellow group members, thereby increasing their willingness to share knowledge content and jointly solve problems. These research findings are consistent with those of other scholars (Macià & García, 2016; Visser et al., 2014).

In contrast, the impact of negative aspects in collaborative learning includes incomplete task structure, procrastination, and information asymmetry. The consistent pace within the team rapidly increases the relationship burdens between community members and raises the expectations for collaborative learning. This research finding is consistent with that of others (Haas et al., 2020; Kwon et al., 2014; Reis et al., 2018; Stafford & Hillyer, 2012). When individuals are unfamiliar with the new knowledge and dependent on other members to provide learning resources and tools, continuous consumption of group members' trust and investment in learning material, as well as participants' rising expectations for the other members, increase the likelihood of developing an atmosphere of opportunism when it pertains to the activities of collaborative learning. In contrast, when participants compensate for opportunism and shortcomings, which are transformed into positive emotions of col-





**Fig. 2** Path coefficient results

laborative learning, the collaborative performance improves significantly (Blau et al., 2020; Ghazal et al., 2019; Hod & Katz, 2018; Nguyen et al., 2022; Pyhältö et al., 2015; Tsiotakis & Jimoyiannis, 2016; Yücel & Usluel, 2016).

Interpersonal altruism promotes continuous interactions among group members and the building of professional knowledge. Scholars have pointed out that learning communities are more appropriate for establishing “interactions” (Blau et al., 2020; Carpenter & Krutka, 2015; vanOostveen et al., 2019; Salam & Farooq, 2020; Zalavra & Papanikolaou, 2022) rather than merely “dialogues” for knowledge exchange (Haas et al., 2020; Agrawal & Krishna, 2021). Individuals’ interpersonal altruism is essential for maintaining the desire for community relations, while altruistic interactions increase psychological intimacy or closeness, thereby leading to the sustenance of relationships and the maintenance of collaborative learning performance (Nguyen et al., 2022; Özüdoğru, et al., 2022). Such interactive and collaborative activities indicate that in-depth participation and absorption affect partners’ relationships and collaborative performance. This finding is consistent with previous results (see Burden & Kearney 2017; Guinot et al., 2015; Habibi et al., 2018; Panadero et al., 2015; Tzanavaris et al., 2021; Zhao et al., 2020).

Moreover, some members enthusiastically post new information and browse through the posts on the learning community’s platform, while others rarely and passively respond to other people’s comments. This atmosphere creates an atmosphere of opportunism for collaborative learning and knowledge-contributing activities, restricts interaction with other members, and hinders the development of further interactive relationships. The empirical data obtained in this study is consistent with other scholars’ research findings (Goodyear et al., 2014; Nguyen et al., 2022; Özüdoğru, et al., 2022; Park et al., 2016). When there is an obligation to respond to activities and disseminate knowledge, members will not actively participate in any in-depth and meaningful learning tasks, resulting in poor performance in terms of group collaboration. This is consistent with the research results of Siemon et al., (2019), Nguyen et al., (2022), Park et al., (2016) and Salam an Farooq(2020). An opportunistic atmosphere and social distance formed in participants’ interactions will increase the ICT tools use and more meaningless dialogue, which will, in turn, reduce individuals’

learning quality and extend completion time. These may also become burdensome for social capital and relationship maintenance within the group. These results reflect those obtained by Haas et al., (2020), King and Areepattamannil(2014), Özüdoğru, et al.(2022), Park et al., (2016), vanOostveen et al., (2019), and Xue et al., (2021).

Individual learners take the initiative to build and create meaningful knowledge representations based on the combination of their previous experiences and new information. Effectively community interactions are dependent on constant activity and content exchanges between learning community members and participants. This increases collaborative learning performance, which is consistent with the results stated in the existing literature (e.g., Abdigapbarova & Zhiyenbayeva 2022; Tsiotakis & Jimoyiannis, 2016; Frei-Landau et al., 2022; vanOostveen et al., 2019; Yücel & Usluel, 2016; Zalavra & Papanikolaou, 2022).

The collaborative learning community environment allows members to share information, exchange ideas, provide feedback, and engage in community interactions. The more the community interactions, the more satisfying their relationship performance. The empirical study supported this hypothesis in the existing literature (e.g., Isohäätä et al., 2020; King & Areepattamannil, 2014; Laux et al., 2016; Neli-markka et al., 2021; Nguyen et al., 2022; Siemon et al., 2019; Tour, 2017; Yücel & Usluel, 2016). In the CSCL feedback process (learners' contributions toward team collaboration), maintaining the learning collaboration relationship allows the collaborative community platform to help the learning group set and achieve learning goals. These enhance learners' performance during collaborative learning (Nguyen et al., 2022; Reis et al., 2018; Prestridge, 2019). When learners proactively seek help from their team members or administrators, the emotional ties between them drive the frequency of connections between members and the quality of knowledge sharing. The performance of the online collaborative knowledge-building process should be promoted, the strength and cohesiveness of relationships among community members should be improved, and community members' knowledge contributions arising from community relationships should be strengthened.

## 5.2 Practical implications

Previous research mostly focused thematically on positive factors (e.g., Butz et al., 2016; Guinot et al., 2015; Visser et al., 2014), which reduce the cost of certain inputs in the exchange process within the community. When peers form a community during the learning process, the learning activities lead the individuals to spontaneously communicate with and respond to each other, and they tend to do so repeatedly and in a sustained manner. The incentive effect produced by the psychological mechanism promotes collaborative learning. Learners should be encouraged to make contributions and give appropriate replies to their collaborators' comments, which will foster or form unique arguments and contribute to knowledge. Teachers gain opportunities to learn new and innovative teaching strategies, which they can successfully apply to classroom practice. Through collaboration and cooperation in online communities, teachers can use the social network of the communities, further increasing the level of their participation and correspondingly enhancing the experience of accumulating professional knowledge.

When an atmosphere of opportunism was formed, the collaborative learning activities require that the members create and construct the knowledge and keep entering into new collaborations, their enthusiasm to share knowledge and content will be curbed. Administrators should organize and coordinate knowledge activity rules within the learning community to resolve an opportunistic atmosphere. These activity functionalities rules facilitate various informal and formal communication and dialogues for professional learning purposes, thereby establishing good community knowledge sharing rules and clarifying responsibilities. Furthermore, following community rules can ensure that individuals do not exaggerate their knowledge contributions or blame one another, which reduces the extent to which participants' raise their expectations for their peers and the associated relationship burden.

The respondents stated that their relationship performance within the group and the complexity of their perceptions strengthened intra-group connectivity and relationship-based interactions. The feedback and interactions between members in the community, and the good relationship performance among them will further expand users' learning capabilities, allowing them to have even closer peer relationships. Therefore, group members should be encouraged to enhance their personal abilities through the promotion of creativity, collaborative thinking, and independent work in online management and collaborative environment. It is important to maintain the group's relationship performance, which has a positive effect on learners' knowledge building and on the group's collaborative relationships. When a good structure of knowledge framework is provided, there will be an increase in the number of online collaborative dialogues and interactions among learners. Teachers can enhance their thinking about personal knowledge development and cyberethics education through case discussions, combine these with their experiences with cyberethics in the changing environment, and shape their understanding of cyberethics knowledge and skills through long-term meaningful communication or interactions.

### 5.3 Study Limitations

There are several limitations associated with this study. Some teachers who are members of an online community may still have offline personal interactions during the collaborative learning activities. However, this study did not examine whether offline interactions were related to the teachers' learning behaviors in online communities. Due to the limited number of samples, in-depth interactions between group members could not be comparatively examined through self-reporting questionnaires and messages posted on the platform. Future research should mount an in-depth exploration and verification of this aspect.

Based on SST, the surveyed members were expected to maintain contact with a selected group of network members they felt closest to. As differences emerged over time, individuals would selectively narrow the scope of their network activities. However, each respondent was only surveyed at one point in time instead of tracked over time. Under the conditions of an absolute scale and the composition of social networks in each age group, it is difficult to explain the way that the frequency of interaction with network members created connections. To address this issue, future

researchers can conduct longitudinal studies using multiple small-scale online learning communities, and compare their results with those obtained in this study.

Teachers with rich professional knowledge and high interpersonal altruism will usually provide other teachers with richer insights and greater quantities of online learning materials and content. This study used an anonymous self-reporting questionnaire survey that did not distinguish between enthusiastic teachers who submitted questions and text responses or video clips and those who were more passive. Since the difference in collaborative participation and performance between these two categories of members is an important topic, further exploration and verification are recommended.

## 6 Conclusion

Knowledge building is a collaborative process that deals with the co-production and improvement of knowledge under specific circumstances. Learners regard the acquisition of new knowledge or information as a means of professional growth. This study developed a measurement tool for a teacher-based collaborative learning chain (group interaction, relationship performance, and collaborative performance). The collaborative learning chain was then transformed into a results-oriented quality evaluation tool within a learning community, which the community used to self-detect its learning outcomes and evaluate individuals within the community who aspired toward continuous improvement. Taking into consideration the positive and negative perspectives of emotional states and/or socioemotional factors, communities must learn how to build meaningful knowledge, as well as undertake knowledge co-production and various facilitating techniques and strategies. Doing so can improve learning methods and CSCL learners' motivation. When the field of collaborative learning is extended to teacher communities, the benefits of community interactions will allow them to achieve more in various learning tasks with less effort. This is essential for the sustainable development of learning-based knowledge communities.

## 7 Appendix A

Construct	Measurement item	Pre-test Cronbach's Alpha	Mean	SD
Positive emotion	I am often in an excited state when learning in the group.	0.969	5.057	1.189
	I am often in a happy state when learning in the group.		5.019	1.168
	I am often in an active state when learning in the group.		4.917	1.209
	Learning in the group gives me a positive attitude.		4.752	1.264
	Learning in the group gives me the feeling of actively solving problems.		5.064	1.239

Construct	Measurement item	Pre-test Cronbach's Alpha	Mean	SD
Belonging	My group members provide constructive solutions to the problems that I face.	0.808	5.146	1.073
	My group members agree with my approach to problem solving.		5.102	0.982
	My group members believe that I have the ability to solve my own problems.		5.032	1.046
	My group members feel that I am their partner.		4.694	1.048
	My group members feel that working together is the correct choice.		4.904	1.067
Interpersonal altruism	I am willing to help my partners solve their problems.	0.865	5.618	1.016
	I am willing to help those partners who are overwhelmed with work.		5.465	1.065
	I am willing to help my partners, so that we can grow together.		5.439	1.058
	I am willing to help new partners who join the group get used to the community activities.		5.287	1.080
Relationship burden	I am willing to share useful information with my partners.	0.853	5.427	1.001
	When I am too close to my partners, both parties feel pressured.		4.127	1.501
	My partners and I often face problems with our allocation of time.		4.395	1.440
	My partners may risk being unable to complete our tasks due to complacency.		4.274	1.412
	My partners and I do not invest resources, manpower, or equipment in community relationships.		3.885	1.432
	When I am too close to my partners, there are problems with our arrangements for daily life.		3.981	1.452
Rising expectations	I expect my partners to perform at a higher standard.	0.897	4.096	1.449
	My standards for collaborating with my partners are stricter than in real life.		3.885	1.511
	My expectations of my partners keep rising.		4.338	1.417
	I expect my partners to prioritize resolving the problems I face.		4.236	1.410
	I expect my partners not to make any mistakes during the collaborative period.		4.045	1.537
Opportunism	I expect my partners not to refuse any of my requests.	0.945	4.280	1.353
	When my partners make mistakes, they often blame one another.		4.301	1.412
	My partners often do not comply with existing rules set by the group.		4.083	1.301
	My group partners often exaggerate their individual contributions to get what they want.		4.146	1.501
	My group partners are often unwilling to undertake and accept responsibility.		4.229	1.454

Construct	Measurement item	Pre-test Cronbach's Alpha	Mean	SD
Community interaction	My partners in the group continue communicating and interacting in a fair and equal manner.	0.779	5.494	1.075
	During group interactions, I am strongly drawn to the professional knowledge content being shared.		5.293	1.099
	I am willing to make suggestions in any form to improve the group's various modes of operation.		5.140	1.168
	I am very happy to communicate and participate in activities with my partners.		5.127	1.114
	I am very happy that I participated in learning activities with my partners.		5.263	1.084
Relationship performance	Maintaining relationships with my group partners improves the quality of our professional learning.	0.770	4.777	1.147
	Maintaining relationships with my group partners reduces our response time to professional problems.		4.962	1.120
	Maintaining relationships with my group partners shortens the time that we need to complete learning activities.		4.981	1.152
	Maintaining relationships with my group partners leads to greater benefits in terms of our professional knowledge.		4.684	1.086
	Maintaining relationships with my group partners leads to smoother exchanges of professional knowledge.		5.083	1.171
Collaborative performance	My partners/team and I have made substantial contributions to the collaborative knowledge content.	0.771	5.013	1.209
	My partners/team and I build and assemble collaborative knowledge content rapidly.		5.318	1.230
	My partners/team and I produce high-quality professional content.		5.287	1.220
	My partners/team and I share long-term collaborative goals.		4.892	1.357
	My partners/team and I value the group's overall professional knowledge and performance.		4.994	1.222

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**Data Availability** The datasets generated by the survey and analyzed during the current study are available from the corresponding author on reasonable request. Dataset can be provided upon request, this due to securing the participants' anonymity.

## Compliance with Ethical Standards

**Ethics statement** The study research procedures were carried out in accordance with the ethical standards of the 1964 Helsinki declaration and its later amendments or comparable ethical standards. There is no ethical external approval required for an anonymous questionnaire study under Taiwan's law. The exemption of this study was because the data of this questionnaire were anonymous and there is no way for readers to be able to identify the participants. There are no name lists that correspond to the respondents of the

questionnaire, and the names of the participant schools were not mentioned. Following Taiwan's ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. All of the subjects were informed about the research and all of the participants who were enrolled in the study provided informed consent.

**Conflict of interest** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## References

- Abdigapbarova, U., & Zhiyenbayeva, N. (2022). Organization of student-centered learning within the professional training of a future teacher in a digital environment. *Education and Information Technologies*. <https://doi.org/10.1007/s10639-022-11159-5>
- Agrawal, S., & Krishna, S. M. (2021). Communication apprehension and psychological well-being of students in online learning. *Behavioral Sciences*, *11*(11), 145
- Aldosemani, T. I. (2020). Towards ethically responsive online education: Variables and strategies from educators' perspective. *Journal of Education and Learning*, *9*(1), 79–86
- Al-Samarraie, H., & Saeed, N. (2018). A systematic review of cloud computing tools for collaborative learning: Opportunities and challenges to the blended-learning environment. *Computers & Education*, *124*, 77–91
- Aubusson, P., & Schuck, S. (2013). Teacher education futures: today's trends, tomorrow's expectations. *Teacher Development*, *17*(3), 322–333
- Avry, S., Chanel, G., Bétrancourt, M., & Molinari, G. (2020). Achievement appraisals, emotions and socio-cognitive processes: How they interplay in collaborative problem-solving?. *Computers in Human Behavior*, *106267*
- Azevedo, R., & Gašević, D. (2019). Analyzing multimodal multichannel data about self-regulated learning with advanced learning technologies: Issues and challenges. *Computers in Human Behavior*, *96*, 207–210
- Bagozzi, R. P., & Yi, Y. (2012). Specification, evaluation, and interpretation of structural equation models. *Journal of the Academy of Marketing Science*, *40*(1), 8–34
- Bakhtiar, A., Webster, E. A., & Hadwin, A. F. (2018). Regulation and socio-emotional interactions in a positive and a negative group climate. *Metacognition and Learning*, *13*(1), 57–90
- Bannert, M., & Reimann, P. (2012). Supporting self-regulated hypermedia learning through prompts. *Instructional Science*, *40*(1), 193–211
- Blau, I., Shamir-Inbal, T., & Avdiel, O. (2020). How does the pedagogical design of a technology-enhanced collaborative academic course promote digital literacies, self-regulation, and perceived learning of students? *The Internet and Higher Education*, *45*, 100722
- Burden, K. J., & Kearney, M. (2017). Investigating and critiquing teacher educators' mobile learning practices. *Interactive Technology and Smart Education*, *14*(2), 110–125
- Butz, N. T., Stupnisky, R. H., Pekrun, R., Jensen, J. L., & Harsell, D. M. (2016). The impact of emotions on student achievement in synchronous hybrid business and public administration programs: A longitudinal test of control-value theory. *Decision Sciences Journal of Innovative Education*, *14*(4), 441–474
- Carpenter, J. P., & Krutka, D. G. (2015). Engagement through microblogging: Educator professional development via Twitter. *Professional Development in Education*, *41*(4), 707–728
- Carstensen, L. L. (1995). Evidence for a life-span theory of socioemotional selectivity. *Current Directions in Psychological Science*, *4*(5), 151–156
- Carstensen, L. L. (2006). The influence of a sense of time on human development. *Science*, *312*(5782), 1913–1915
- Cheng, J. C. (2014). An exploratory study of emotional affordance of a massive open online course. *European Journal of Open Distance and E-learning*, *17*(1), 43–55
- Chin, W. W. (1998). The partial least squares approach to structural equation Modeling. In G. A. Marcoulides, & Mahwah (Eds.), *Modern Business Research Methods* (pp. 295–336). NJ: Lawrence Erlbaum Associates



- Chuang, H. H. (2016). Leveraging CRT awareness in creating web-based projects through use of online collaborative learning for pre-service teachers. *Educational Technology Research and Development*, 64(4), 857–876
- Cleveland, S., & Block, G. (2017). Toward knowledge technology synchronicity framework for asynchronous environment. *International Journal of Knowledge Society Research (JKSR)*, 8(4), 23–33
- Damşa, C. I. (2014). The multi-layered nature of small-group learning: Productive interactions in object-oriented collaboration. *International Journal of Computer-Supported Collaborative Learning*, 9(3), 247–281
- Delahunty, J., Verenikina, I., & Jones, P. (2014). Socio-emotional connections: Identity, belonging and learning in online interactions. A literature review. *Technology Pedagogy and Education*, 23(2), 243–265
- Dohn, N. B. (2009). Web 2.0: Inherent tensions and evident challenges for education. *International Journal of Computer-Supported Collaborative Learning*, 4(3), 343–363
- Feidakis, M., Caballé, S., Daradoumis, T., Jiménez, D. G., & Conesa, J. (2014). Providing emotion awareness and affective feedback to virtualised collaborative learning scenarios. *International Journal of Continuing Engineering Education and Life Long Learning*, 6(2), 141–167. 24
- Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18, 39–50
- Frei-Landau, R., Muchnik-Rozanov, Y., & Avidov-Ungar, O. (2022). Using Rogers' diffusion of innovation theory to conceptualize the mobile-learning adoption process in teacher education in the COVID-19 era. *Education and Information Technologies*. <https://doi.org/10.1007/s10639-022-11148-8>
- García, M. B. (2021). Cooperative learning in computer programming: A quasi-experimental evaluation of Jigsaw teaching strategy with novice programmers. *Education and Information Technologies*, 26(4), 4839–4856
- Ghazal, S., Al-Samarraie, H., & Wright, B. (2019). A conceptualization of factors affecting collaborative knowledge building in online environments. *Online Information Review*. DOI: <https://doi.org/10.1108/OIR-02-2019-0046>
- Goodyear, P., Jones, C., & Thompson, K. (2014). Computer-supported collaborative learning: Instructional approaches, group processes and educational designs. *Handbook of Research on Educational Communications and Technology* (pp. 439–451). New York, NY: Springer
- Guinot, J., Chiva, R., & Mallén, F. (2015). The effects of altruism and relationship conflict on organizational learning. *International Journal of Conflict Management*, 26(1), 85–112
- Haas, A., Abonneau, D., Borzillo, S., & Guillaume, L. P. (2020). Afraid of engagement? Towards an understanding of engagement in virtual communities of practice. *Knowledge Management Research & Practice*, 1–12
- Habibi, A., Mukminin, A., Riyanto, Y., Prasojo, L. D., Sulistiyo, U., Sofwan, M., & Saudagar, F. (2018). Building an online community: Student teachers' perceptions on the advantages of using social networking services in a teacher education program. *Turkish Online Journal of Distance Education*, 19(1), 46–61
- Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate Data Analysis: A Global Perspective* (7th ed.). New York: Macmillan
- Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, 43(1), 115–135
- Hernández-Sellés, N., Muñoz-Carril, P. C., & González-Sanmamed, M. (2019). Computer-supported collaborative learning: An analysis of the relationship between interaction, emotional support and online collaborative tools. *Computers & Education*, 138, 1–12
- Hod, Y., & Katz, S. (2020). Fostering highly engaged knowledge building communities in socioemotional and sociocognitive hybrid learning spaces. *British Journal of Educational Technology*, 51(4), 1117–1135
- Hutchison, A., & Colwell, J. (2012). Using a wiki to facilitate an online professional learning community for induction and mentoring teachers. *Education and Information Technologies*, 17(3), 273–289
- Isohätälä, J., Näykki, P., & Järvelä, S. (2020). Cognitive and socio-emotional interaction in collaborative learning: Exploring fluctuations in students' participation. *Scandinavian Journal of Educational Research*, 64(6), 831–851
- Järvelä, S., & Bannert, M. (2019). Temporal and adaptive processes of regulated learning-What can multimodal data tell?. *Learning and Instruction*, 101268

- Järvelä, S., Kirschner, P. A., Hadwin, A., Järvenoja, H., Malmberg, J., Miller, M., & Laru, J. (2016). Socially shared regulation of learning in CSCL: Understanding and prompting individual-and group-level shared regulatory activities. *International Journal of Computer-Supported Collaborative Learning*, 11(3), 263–280
- Järvelä, S., Lehtinen, E., & Salonen, P. (2000). Socio-emotional orientation as a mediating variable in the teaching-learning interaction: Implications for instructional design. *Scandinavian Journal of Educational Research*, 44(3), 293–306
- Kelly, N., & Antonio, A. (2016). Teacher peer support in social network sites. *Teaching and Teacher Education*, 56, 138–149
- King, R. B., & Areepattamannil, S. (2014). What students feel in school influences the strategies they use for learning: Academic emotions and cognitive/meta-cognitive strategies. *Journal of Pacific Rim Psychology*, 8(1), 18–27
- Kutsyrubba, B., & Kovalchuk, S. (2015). Stated or actual change in policy terrain? Review of the literature on the Bologna process implementation within the context of teacher education in Ukraine. *Journal of Ukrainian Politics and Society*, 1(1), 33–57
- Kwon, K., Liu, Y. H., & Johnson, L. P. (2014). Group regulation and social-emotional interactions observed in computer supported collaborative learning: Comparison between good vs. poor collaborators. *Computers & Education*, 78, 185–200
- Laux, D., Luse, A., & Mennecke, B. E. (2016). Collaboration, connectedness, and community: An examination of the factors influencing student persistence in virtual communities. *Computers in Human Behavior*, 57, 452–464
- Lavoué, É., Molinari, G., Prié, Y., & Khezami, S. (2015). Reflection-in-action markers for reflection-on-action in computer-supported collaborative learning settings. *Computers & Education*, 88, 129–142
- Linnenbrink-Garcia, L., Rogat, T. K., & Koskey, K. L. (2011). Affect and engagement during small group instruction. *Contemporary Educational Psychology*, 36(1), 13–24
- Macià, M., & Garcia, I. (2016). Informal online communities and networks as a source of teacher professional development: A review. *Teaching and Teacher Education*, 55, 291–307
- Nelimarkka, M., Leinonen, T., Durall, E., & Dean, P. (2021). Facebook is not a silver bullet for teachers' professional development: Anatomy of an eight-year-old social-media community. *Computers & Education*, 173, 104269
- Ng, P. M., Chan, J. K., & Lit, K. K. (2022). Student learning performance in online collaborative learning. *Education and Information Technologies*. <https://doi.org/10.1007/s10639-022-10923-x>
- Nguyen, G. N., Bower, M., & Stevenson, M. (2022). The discourse of design: Patterns of TPACK contribution during pre-service teacher learning design conversations. *Education and Information Technologies*. <https://doi.org/10.1007/s10639-022-10932-w>
- Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory* (3rd.). New York: McGraw-Hill
- Özudođru, M. (2022). A structural equation modelling in distance education teacher training classroom environments. *Education and Information Technologies*, 27, 5103–5127
- Panadero, E., Kirschner, P. A., Järvelä, S., Malmberg, J., & Järvenoja, H. (2015). How individual self-regulation affects group regulation and performance: A shared regulation intervention. *Small Group Research*, 46(4), 431–454
- Paris, C., Colineau, N., Nepal, S., Bista, S. K., & Beschoner, G. (2013). Ethical considerations in an online community: The balancing act. *Ethics and Information Technology*, 15(4), 301–316
- Park, N., Lee, S., & Chung, J. E. (2016). Uses of cellphone texting: An integration of motivations, usage patterns, and psychological outcomes. *Computers in Human Behavior*, 62, 712–719
- Pavo, M. Á. H., & Rodrigo, J. C. (2015). Interaction analysis of a blog/journal of teaching practice. *The Internet and Higher Education*, 27, 32–43
- Ping, C., Schellings, G., & Beijgaard, D. (2018). Teacher educators' professional learning: A literature review. *Teaching and Teacher Education*, 75, 93–104
- Prestridge, S. (2019). Categorising teachers' use of social media for their professional learning: A self-generating professional learning paradigm. *Computers & Education*, 129, 143–158
- Pusey, P., & Sadera, W. A. (2011). Cyberethics, cybersafety, and cybersecurity: Preservice teacher knowledge, preparedness, and the need for teacher education to make a difference. *Journal of Digital Learning in Teacher Education*, 28(2), 82–85
- Pyhältö, K., Pietarinen, J., & Soini, T. (2015). Teachers' professional agency and learning—from adaption to active modification in the teacher community. *Teachers and Teaching*, 21(7), 811–830

- Reis, R. C. D., Isotani, S., Rodriguez, C. L., Lyra, K. T., Jaques, P. A., & Bittencourt, I. I. (2018). Affective states in computer-supported collaborative learning: Studying the past to drive the future. *Computers & Education, 120*, 29–50
- Ringle, C. M., Wende, S., & Becker, J. M. (2015). *SmartPLS 3* [computer software]. Retrieved from <http://www.smartpls.com>
- Salam, M., & Farooq, M. S. (2020). Does sociability quality of web-based collaborative learning information system influence students' satisfaction and system usage? *International Journal of Educational Technology in Higher Education, 17*, 1–39
- Sanger, M. N., & Osguthorpe, R. D. (2011). Teacher education, preservice teacher beliefs, and the moral work of teaching. *Teaching and Teacher Education, 27*(3), 569–578
- Schuck, S., Aubusson, P., Kearney, M., & Burden, K. (2013). Mobilising teacher education: A study of a professional learning community. *Teacher Development, 17*(1), 1–18
- Shek, M. M. P., Leung, K. C., & To, P. Y. L. (2021). Using a video annotation tool to enhance student-teachers' reflective practices and communication competence in consultation practices through a collaborative learning community. *Education and Information Technologies, 26*(4), 4329–4352
- Siemon, D., Becker, F., Eckardt, L., & Robra-Bissantz, S. (2019). One for all and all for one-towards a framework for collaboration support systems. *Education and Information Technologies, 24*(2), 1837–1861
- Stafford, L., & Hillyer, J. D. (2012). Information and communication technologies in personal relationships. *Review of Communication, 12*(4), 290–312
- Tam, A. C. F. (2015). The role of a professional learning community in teacher change: A perspective from beliefs and practices. *Teachers and Teaching, 21*(1), 22–43
- Tirado, R., Hernando, Á., & Aguaded, J. I. (2015). The effect of centralization and cohesion on the social construction of knowledge in discussion forums. *Interactive Learning Environments, 23*(3), 293–316
- Tour, E. (2017). Teachers' self-initiated professional learning through personal learning networks. *Technology Pedagogy and Education, 26*(2), 179–192
- Tsiotakis, P., & Jimoyiannis, A. (2016). Critical factors towards analysing teachers' presence in on-line learning communities. *The Internet and Higher Education, 28*, 45–58
- Tzafilkou, K., Perifanou, M., & Economides, A. A. (2021). Negative emotions, cognitive load, acceptance, and self-perceived learning outcome in emergency remote education during COVID-19. *Education and Information Technologies, 26*(6), 7497–7521
- Tzanavaris, S., Nikiforos, S., Mouratidis, D., & Kermanidis, K. L. (2021). Virtual Learning Communities (VLCs) rethinking: From negotiation and conflict to prompting and inspiring. *Education and Information Technologies, 26*(1), 257–278
- van den Bergh, L., Ros, A., & Beijaard, D. (2015). Teacher learning in the context of a continuing professional development programme: A case study. *Teaching and Teacher Education, 47*, 142–150
- vanOostveen, R., Desjardins, F., & Bullock, S. (2019). Professional development learning environments (PDLEs) embedded in a collaborative online learning environment (COLE): Moving towards a new conception of online professional learning. *Education and information technologies, 24*(2), 1863–1900
- Visser, R. D., Evering, L. C., & Barrett, D. E. (2014). # TwitterforTeachers: The implications of Twitter as a self-directed professional development tool for K–12 teachers. *Journal of Research on Technology in Education, 46*(4), 396–413
- Warnick, B. R., & Silverman, S. K. (2011). A framework for professional ethics courses in teacher education. *Journal of Teacher Education, 62*(3), 273–285
- Xue, S., Hu, X., Chi, X., & Zhang, J. (2021). Building an online community of practice through WeChat for teacher professional learning. *Professional Development in Education, 47*(4), 613–637
- Yadegaridehkordi, E., Shuib, L., Nilashi, M., & Asadi, S. (2019). Decision to adopt online collaborative learning tools in higher education: A case of top Malaysian universities. *Education and Information Technologies, 24*(1), 79–102
- Yücel, Ü. A., & Usluel, Y. K. (2016). Knowledge building and the quantity, content and quality of the interaction and participation of students in an online collaborative learning environment. *Computers & Education, 97*, 31–48
- Zalavra, E., & Papanikolaou, K. (2022). A wiki-based framework for collaborative learning design in teacher education. *Education and Information Technologies, 27*, 6407–6435
- Zhao, Y., Wang, A., & Sun, Y. (2020). Technological environment, virtual experience, and MOOC continuance: A stimulus–organism–response perspective. *Computers & Education, 144*, 103721

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