Fostering Pre-Service Teachers' Reflection in Self-Regulatory Process Through Socio-Emotional Collaborative Note-Taking in the mCSCL Environment

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Abstract

Self-regulation is an essential skill in teacher development, especially for pre-service teachers who need to develop their own self-regulated skills while simultaneously promoting self-regulation in learners. This study outlines a teacher development program in which pre-service teachers participated in a self-regulatory process in a Mobile Computer-Supported Collaborative Learning (mCSCL) online learning environment. Our aim is to fill the existing gap in this area by adding more collaborative learning processes. This study aimed to investigate the predictive effects that self-evaluation to define tasks and goals (at forethought phase) has on self-reflection, which is mediated by collaboration. Furthermore, we have drawn the possibility of embedding collaboration into the socio-emotional note-taking process by using the concept of mCSCL throughout the self-regulated learning process. Data was collected from undergraduate students, working as pre-service teachers, and studying at two institutes in Thailand (N=147), with 17 items of self-regulatory inventory obtained from the original self-regulatory inventory together with 5 other collaboration developed by the author. Structural equation modelling (SEM) analysis was used to confirm a partial mediation model via direct and indirect effects. Later the path analysis, the qualitative data is acquired to re-design the socio-emotional collaborative note-taking on mCSCL tools during the self-regulatory learning process, corresponding with the model testing phase according to the previous study by a semi-structure interview with 5 pre-service teachers. The results proved that collaboration was found to be a significant partial mediator of self-evaluation and self-reflection, in accordance with the empirical data. With our findings we were able to design a socio-emotional collaborative note-taking activity in the mCSCL setting. We proposed collaborative note-taking activities which collaboration procedure is highlighted throughout 3 phases: collaboration in pre-performance (recording ideas and planning), collaboration during the performance (sharing and brainstorming, support and seeking helps), and collaboration in post-performance (reflecting and evaluating) in which the activity was taking place between instructors and peers during supervision period.

Keywords: self-regulation, collaborative-notetaking, MCSCL, socio-emotional, teacher development

INTRODUCTION

One requirement in the pre-service teachers training is a preparation for the transition to their future working environments, during this process, they need to develop an ability to teach others. In addition, pre-service
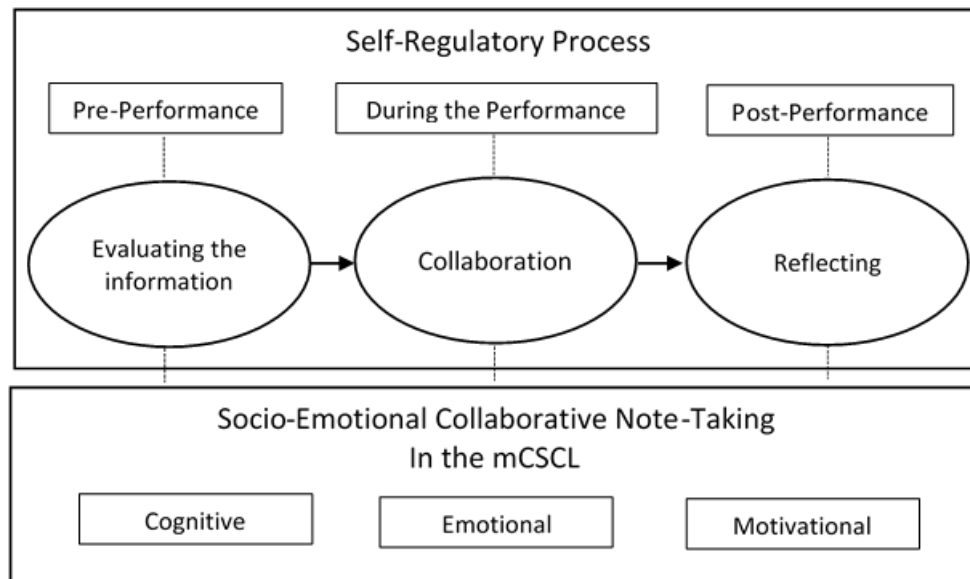
Figure 1. The Scatter Plot of Correlation Metrix

teachers must cultivate a sense of responsibility for teaching and acting as a role model for their learners (UNESCO, 2015). Pre-service teachers should be aware of the overall importance of self-regulation in learning and teaching in order to deal with the challenges faced in 21st century education. They must take on the roles of both developing themselves as self-regulated teachers and promoting self-regulation in their learners (Kramarski & Kohen, 2017). In a teacher preparation program, the three important steps of a self-regulation process (forethought, performance, and self-reflection) (Zimmerman, Bonner, & Kovach, 2009) might be embedded in the supervision period. Supervisors, or academic advisors, might view online self-regulated in a mCSCL online learning environment learning as a process which can provide both the supervisors and learners with an opportunity to learn through collaboration. This opportunity would enable them to develop a design for a learning activity, as agreed upon under pre-determined rules of collaboration. It has been found from the longitudinal perspective of pre-service teachers' 21st-century skills that collaboration area remains at the same level. While the use of ICT increased yearly changes (Valtonen et al., 2021). Moreover, this concept has been challenged by Costa et al. (2020) who emphasized that collaborative learning teaching method is associated with mobile learning, and Su and Zou (2020) who highlighted on an active and supportive member of the community in the collaboration processes. This study is therefore demonstrating the need of collaboration in mobile computer-supported collaborative learning (mCSCL) by addressing questions about the collaboration as a partial mediator of self-evaluation and self-reflection.

In the current study, we see the potential of a self-regulated learning process being used to develop socio-emotional factors which are formed at both personal, contextual, and social aspects of learning. The group members can become aware of their own and each other's learning required for group activity (Näykki et al., 2017). By adding the collaboration perspective as a shared-regulation we proposed the use of note-taking strategy as a group cognition tool, which in this study is so called the socio-emotional collaborative note-taking. As such, we aimed to draw on the possibility of pre-service teachers using socio-emotional collaborative note-taking on mobile devices as a digital learning tool during the self-regulatory learning process. As illustrated in **Figure 1** the theoretical framework is developed to specify the key variables the concept of self-regulatory process (Brown, Miller, & Lawendowski, 1999; Järvelä et al., 2015; Zimmerman, 2000) which socio-emotional collaborative note-taking in the mCSCL setting was created as part of the design process.

Our study aimed to: 1) examine the effects of self-evaluation (searching for and evaluating information) on self-reflection while being mediated by collaboration using the quantitative data and 2) re-design the socio-emotional collaborative note-taking on mCSCL tools during the self-regulatory learning process, corresponding with the model testing phase according to the prior research (Wetcho & Na-Songkhla, 2020)

using the additional qualitative data from the semi-structure interview. We addressed two research questions as follows:

RQ 1: Does self-evaluation predict self-reflection? If yes, is the relationship mediated by collaboration in the context of online, self-regulated learning?

RQ 2: What are the components of socio-emotional collaborative note-taking on mCSCL tools during the self-regulatory learning process?

Socio-Emotional Development

A key aspect of socio-emotional demands is that they have been steadily increasing over the course of the past decade (Bughin et al., 2018). Grounded in the social learning theory, Bandura (1976) put the idea of learning through observing others and relating these observations to self-regulatory capacities, which are occasionally created from external factors. The factors include arranging the environment, generating cognitive support, producing consequences for their actions and being able to control themselves. More recent attention has focused on social and emotional skills development, which is defined as the ability to regulate one's thoughts, emotions, and behavior. Social and emotional skills put an emphasis on the way that people manage their emotions, perceive themselves and engage with others. This is instead of indicating their own ability (OECD, 2019) in a wide range of competencies, such as: emotional intelligence, social competence, and self-regulation (Jones, Bouffard, & Weissbourd, 2013). Meanwhile, socio-emotional development is now expanding into every level of education, for example, at college level (Pérez et al., 2010). In relation to this, (Sánchez Expósito et al., 2018) have reported a positive correlation between socio-emotional competencies and clinical performance in the nursing field.

mCSCL in Learning

CSCL is becoming normal in higher education settings, many institutions have implemented cooperative and collaborative learning in their curricula. Learners' roles are now changing from passive to active, which means that they are required to take responsibility for their learning and share their experiences with others. The new learning paradigm of CSCL is focusing on a surface characteristic in the learning environment, for example, the optimal group size, students' collaborative efforts in different environments (synchronous, asynchronous, and shared workspaces) via various educational strategies such as: case-based, problem-based and project-based (Kirschner, Martens, & Strijbos, 2004). One positive aspect of the CSCL is that an approach aids learner in engaging in more collaboration. When viewing collaborative learning in more detail, it can be categorized into both formal and informal formats, as well as small group sizes and large-scale groups (more than 5 people) (Baloch, Abdul Rahman, & A Ihad, 2012) in which collaborative learning is developed through interactions (Goggins & Jahnke, 2013). After the rise of mobile technology, mobile computer-supported collaborative learning (mCSCL) was introduced as the students using mobile devices to enhance collaborative and cooperative learning to maximize their own and others' learning (Sung, Yang, & Lee, 2017). Hsu and Ching (2013) stated four major types of mCSCL, including: assigning learning tasks, facilitating communication and interaction, providing feedback for group learning and instructor teaching, managing and regulating interaction process. To date mCSSCL is more viewed as a socio-digital participation of intersubjective (interactions) and inter-objective (networks of learners, tools, artifacts and practices) (Stahl & Hakkarainen, 2021). Therefore, collaboration between the technical and more socially oriented has appeared infrequently within the field of research (Hmelo-Silver & Jeong, 2021).

Self-Regulated Learning

An essential part of learners regulating their behavior has been uncovered in past research, is to achieve goals of cognitive strategies and emotions. Many researchers provided an overview of the self-regulatory process, for example, Brown et al. (1999) have explained the seven-step model of self-regulation consisting of receiving relevant information, evaluating the information and comparing it to norms, triggering change, searching for options, formulating a plan, implementing the plan, and assessing the plan's effectiveness. Later, Zimmerman (2000) identified the three self-regulatory processes, which are: forethought,

performance, and self-reflection. In online settings, Barnard-Brak, Lan, and Paton (2010) have identified sub-elements of self-regulation in an online learning environment, as follows: environment structuring, goal setting, time management, help-seeking, task strategies, and self-evaluation. In addition to this, Zheng and Yu (2016) issued the steps of establishing goals, making plans, enacting strategies, monitoring and controlling, reflecting and evaluating, and adapting metacognition.

From the existing theories, it has been found that every model specifies a task analysis using self-evaluation as the important component in the self-regulated learning process when formulating a plan for learners' goals. Self-reflection is becoming another important step after performance to help students reflect on their practice experience. Therefore, we draw on an integral part of self-regulated learning in which collaborations in learning will fill the gap of two components. In relation to the CSCL, Järvelä and Hadwin (2013) worked on three types of regulation which contributed towards a successful collaboration in CSCL contexts, these consist of self-regulation (regulating their own learning), co-regulation (supporting fellow members), and socially shared regulation (collectively regulating learning processes together). Our study extends these concepts by investigating the predictive effects of self-evaluation on self-reflection which takes place through collaboration in mCSCL. In which this might be an another opportunity for pre-service professional in learning together through experience (Orchard, 2021).

Socio-Emotional Collaborative Note-Taking

Note-taking is a valuable skill for individuals in both academic and non-academic settings. Instructors should encourage learners to take notes during classes as note-taking can eventually increase recollection, facilitate comprehension by encoding or making connections to prior knowledge, and increase cognitive effort or engagement in academic performance (Friedman, 2014). Over time, classrooms and note-taking technologies have evolved, recent research has demonstrated the potential of digital note-taking via notebooks or laptops (Morehead, Dunlosky, & Rawson, 2019), tablet/stylus systems and smart pens that allowed long-hand note-taking (Mueller & Oppenheimer, 2016), and it has become evident that students who recorded notes digitally received higher scores than ones using more conventional methods (Sun & Li, 2019). The Learning Strategies Center (2001) proposed use of the Cornell note-taking system for lectures and reading. This system is comprised of 6 processes: recording, questioning, reciting, reflecting, recapitulating, and reviewing tasks, completing all of these tasks in note-taking might include note creation, note management (editing and organizing), note use (as a reference and sharing to others) (Kim, Turner, & Pérez-Quiñones, 2009). However, there are a variety of factors to consider such as the way lectures are presented, how notes are taken, and individual differences in cognitive abilities (Jansen, Lakens, & Ijsselsteijn, 2017) when looking at how to make note-taking a successful process. Online collaborative note-taking is a new strategy, made available to comprehend texts, and more particularly for clarifying and reflecting by oneself, or with peers, in order to construct new knowledge (Yang & Lin, 2015). As a result, the concept of real-time collaborative writing tools has now created new opportunities for collaboration (Hynninen, 2018). Taken together, the concept of socio-emotional development which also highlighted the importance of arranging the environment, providing cognitive support, and the controlling of themselves on their actions can be combined with a collaborative note-taking tool during a self-regulatory process. For this procedure, students' reflections could be supported by new technologies like web 2.0, integration into work group, and developing students' awareness of themselves, their tasks and others (Augustsson, 2010).

METHODS

Participants and Procedure

This research included 117 pre-service teachers from 2 institutions in Bangkok (Faculty of Education, Chulalongkorn University; research university context (n=40) and Dhonburi Rajabhat University; university for Thais' local development (n=77) with a purposive selection of students who were teaching in schools during the academic year of 2019 which is under the requirement as part of their coursework. The participants were asked to complete a questionnaire which was comprised of the demographics of the students, the uses of online tools, evaluative information and reflection on self-regulatory process to

Table 1. CFA Results Summary for the self-report questionnaire

Subscale	Cronbach's α	χ2	df	CFI	RMSEA	SRMR	P
Reflection	.91	15.58	17	1	.00	.02	.55
Evaluation	.86	36.78	21	.99	.04	.04	.15
Collaboration	.87	.69	4	1	.00	.00	.95

*p < .05

determine whether collaboration is a significant mediator in the model. After the data analysis, when the overall model had been compared with the empirical data, the SEM model was used to re-design collaborative note-taking as a mobile computer-supported collaborative learning tool in self-regulatory learning process. Then the qualitative data is acquired to re-design the socio-emotional collaborative note-taking on mCSCL tools during the self-regulatory learning process, corresponding with the model testing phase according to the previous study by a semi-structure interview with 5 pre-service teachers and was manually coded by researchers.

Measurements

In order to measure the significant mediators in the model, a self-reporting version of the Self-Regulation Questionnaire (SRQ) was used in the survey. The original self-regulatory inventory was developed by (Brown et al., 1999). In this study, 17 items from two indicators, the evaluating (self-evaluation) and assessing (self-reflection) stages, were adopted from the original questionnaire. Instruments similar to the original one was used and validated widely in previous research e.g. (Jakešová, Kalenda, & Gavora, 2015; Nosratinia & Deris, 2015; Pichardo et al., 2014; Potgieter & Botha, 2009). Other 5 collaboration items used for the partial mediation model were additionally developed by the author. The sample questions are "I share what I have learned about teaching and learning design with others" and "I work closely with others to help improve the way I design teaching and learning". A 5-point Likert scale was used which ranged from 1 (Strongly disagree) to 5 (strongly agree). The total testing time covered approximately 20 mins. We used the confirmatory factor analysis to report the model fit in which cronbach's α, chi-square (χ2), χ2/df, comparative fit index (CFI), comparative fit index (CFI), root mean square of error approximation (RMSEA), and standardized root-mean-square residual (SRMR) were reported. The CFA for the self-report questionnaire are as below.

Data Analysis

This research used descriptive statistical analysis to reveal the demographics and their relationship with the "evaluation", "collaboration", and "reflection" variables by using frequency, percentage, and the Pearson correlation coefficients technique (with SPSS version 22). Then, the Structural equation modelling approach was employed to evaluate the mediation model and test the relationship mediated by collaboration in the context of pre-service teaching (LISREL 8.72). After that, the model was evaluated with acceptable goodness-of-fit indices, then we adopted the mediation model to draw the possibility of bringing socio-emotional collaborative note-taking by using the concept of mCSCL into the self-regulatory learning process, which prior research has reported to be a proposed learning design blueprint. Five pre-service teachers were interviewed with the question to identify a collaborative note-taking tools for the following steps.

<div align="center">

RESULTS

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Research Results

The results were divided into 2 parts including the results of the relationship according to three variables as well as the significant mediators of the model, and the results of re-designing socio-emotional collaborative note-taking into a self-regulatory learning process between instructors and peers. By the end of the survey period, data had been collected from 147 individuals (37 male, 110 female) who were teaching in schools during the academic year of 2019. In this study, most of the pre-service teachers were using online tools in the reflection (84.4%), evaluation (80.3%), and collaboration (83.7%) processes.

Table 2. Pre-Service Teachers use of online self-regulation tools

Baseline characteristic	Yes		No	
	n	%	n	%
Used for online reflection	124	84.4	23	15.6
Used for online evaluation	118	80.3	29	19.7
Used for online collaboration	123	83.7	24	16.3

Table 3. Pearson correlation coefficients values between online reflection, online evaluation, and online collaboration

	n	M	SD	1	2	3
Reflection	147	3.96	.62	1		
Evaluation	147	3.94	.57	.76**	1	
Collaboration	147	4.02	.66	.63**	.73**	1

**. Correlation is significant at the 0.01 level (2-tailed)
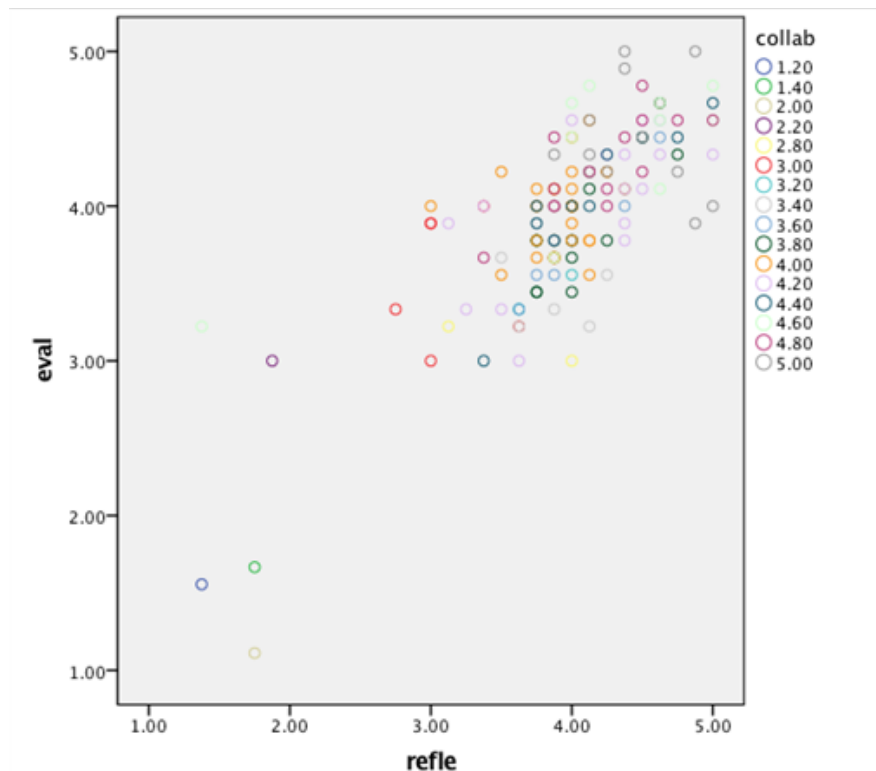
Figure 2. The Scatter Plot of Correlation Matrix

In the next session of the survey, the data revealed the pre-service teachers' scores on the different scales the self-regulation from the self-regulation questionnaire (SRQ) and collaboration and the correlation between online reflection, online evaluation, and online collaboration see **Table 3**.

Based on the survey results seen in **Table 3**, the pre-service teachers' scores on the online collaboration was highest among three variables (M=4.02, SD=.66), followed by online self-reflection and online evaluation respectively (M=3.96, 3.94, SD=.62, .57). The correlation between reflection, evaluation, and collaboration was found to be statistically significant (p < .01, two-tailed). Reflection consistently correlated with evaluation (r=.76), and gaining online collaboration correlated positively with reflection and evaluation (r=.63, .73), respectively. As can be seen on the scatter plotted in **Figure 2**, collaboration was found to be a potent predictor of evaluation and reflection in an online setting.

The results find that an acceptable model fit was revealed through further analysis of Structural Equation Modelling (SEM). The overall goodness-of-fit for the model is statistically significant according to characteristics of different fit indices (Hair et al., 2014) with chi-square goodness-of-fit indices (χ2 = 3.80,
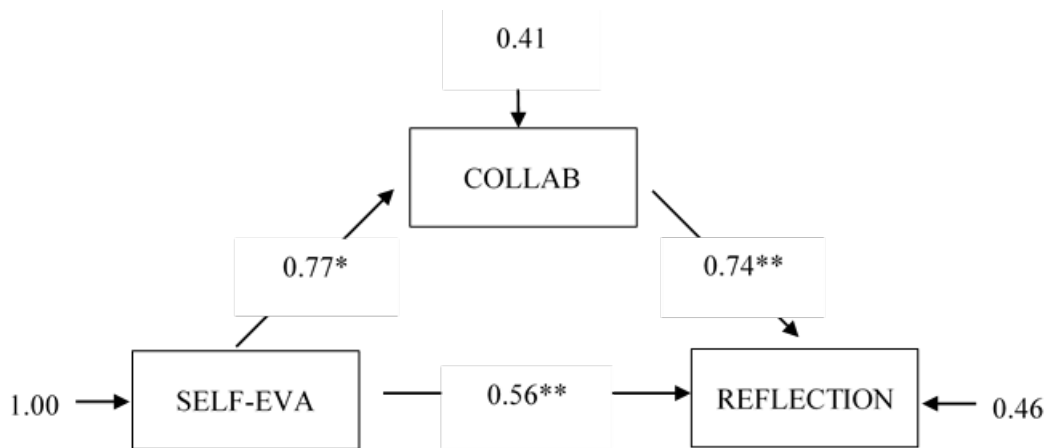
Figure 3. The Partial Mediation Model of Collaboration from Self-Evaluation to Self-Reflection

p=.051, χ2/df = 3.80, comparative fit index (CFI)= .987 (was greater than 0.97), root mean square error of approximation (RMSEA) = .0139 (was less than 0.5), standardized root mean Residual (SRMR)= .028 (approaching 0) see **Figure 3**. We have found that there was a significant, positive and direct path from self-evaluation to reflection (β = .56, p < .01), as well as an indirect path from the self-evaluation to the reflection through the collaboration (β = .77, p < .05). In addition, collaboration was found to have a direct effect on reflection (β = .74, p < .01). Our results confirmed that collaboration was a partial mediator of self-evaluation and self-reflection (**Figure 2**).

Following the results in part 1, we used the following mediation model to demonstrate the possibility of embedding socio-emotional note-taking process by using the concept of mCSCL starting with self-evaluation to define tasks and goals (at forethought phase) throughout the self-regulated learning process mediated by collaboration using social-emotional note-taking. In this study, we classified three phases of collaborative note-taking based upon the self-regulatory process and regulation targets in collaborative learning Järvelä et al. (2015) as follows, collaboration in the forethought phase (regarding the evaluating and planning), collaboration during the performance, and collaboration after the performance (regarding the self-reflection). Later the quantitative study, we interviewed five pre-service teachers to re-design the blue print according to the previous study with the question "What collaborative note-taking tools can you use in the following steps? The results are showed in **Table 4**.

Table 4. The Design of Socio-Emotional Collaborative Note-Taking

Self-Regulatory Process	Regulation Target	Suggested Activity	Collaborative Note-Taking Tools (Instructor, Peers)
Pre-Performance			
Recording Ideas and Planning	Cognitive	Evaluating the information Collecting Ideas	Record, Question, Recite, Reflect, Recapitulate, Review Note-taking
	Motivational	Goal Setting Strategic Planning	Socially-Shared Regulation
During the Performance			
Sharing and Brainstorming	Cognitive	Sharing of Ideas Brainstorming Group Discussion	Shared-Note
	Emotional	Sharing of Emotions	Expressive Writing
Support-Seeking	Cognitive	Seek-Helps from Others	Collaborative Writing
	Emotional Motivational	Support Others	Expressive Writing
Post-Performance			
Reflecting	Cognitive	Assessing the Plan's Effectiveness	E-Portfolio
	Cognitive Motivational Emotional	Self-Reflection Peer-Evaluation	Reflective Writing Peer-Evaluation

DISCUSSION

The results of SEM analysis of the empirical data (RQ1) confirmed the partial mediation model with both direct and indirect paths from online self-evaluation (forethought phase) to online self-reflection when mediated by collaboration. As such, collaboration becomes an essential factor in the self-regulatory process. This result is consistent with previous studies, which reflection process plays an important focus used for the formative assessment and feedback process in education to develop the capability for self-regulation and problem solving (Sargeant et al., 2009; Xiao & Yang, 2019), and Willegems et al. (2018) who stated that pre-service teachers who participated in collaborative teacher research were presented with opportunities to experience a form of teaching which incorporates extended professionalism. The abilities of students to learn with peers were clearly evident and were found to have a positive effect on academic achievement, along with learners' SRL strategies in blended learning courses (Lim et al., 2020).

We therefore have extended the previous study (RQ 2), so that a re-design of the concept of socio-emotional collaborative note-taking tools can be completed in accordance with relevant theories and findings on the mobile computer-supported collaborative learning and self-regulatory learning in the context of an online learning environment. In this study we propose collaboration in note-taking activities through 3 phases: pre-performance (recording ideas and planning), collaboration during performance (sharing and brainstorming, support and seeking help), and collaboration in post-performance (reflecting and evaluating) in agreement with Zalli, Nordin, and Awang Hashim (2020), who defined the factors to be included when improving self-regulated, online learning. This would include goal setting, environment structuring for pre-performance, task strategies, time management, help-seeking for performance, and self-evaluation in post-performance. The findings of the re-design activity collaborate with the early findings of Järvelä et al. (2015) in a previous study of target of regulation in collaborative learning task. Which students generated their regulation of collaboration by using CSCL tools when they encountered an unfamiliar situation (Splichal, Oshima, & Oshima, 2018). Moreover, previous study has showed that CSCL also helps students improve their awareness in collaborative skills such as interpersonal, inquiry, and group management skills (Iinuma, 2016). This study looked at the cognitive development dimension, as well as in the socioemotional dimension with technological system perspective (on CSCL environments) and finally the social system to increase social

interaction through three factors of target regulation. The targets include cognitive (Task, content, understanding, strategies, behavior), motivational (Goals, interests, beliefs, expectations), and emotional regulation (social interaction, trust, sense of community in group processes).

Furthermore, we also encourage the uses of collaborative note-taking on mCSCL which, in accordance with the results, might explain the reason for the evolution of note-taking technology. Current students use technology-based tools to take notes more frequently than in the past (Witherby & Tauber, 2019). This was especially true when it came to the use of digital pens for handwritten notes, this was done via collaborative learning on web-based notes sharing and helped to enhance students' thinking abilities (Miura, 2017). Although longhand note-taking might be superior, there are some arguments that performance may not see consistent improvement in all areas, when compared with other types (Morehead et al., 2019). Previous research reported that laptop note-takers recorded more idea units and words, while longhand note-takers recorded more visual notes, signals, and images (Luo et al., 2018) and tablet computer can be used to cover subject matter (Drozdek et al., 2020). Currently, using collaborative note-taking in online setting has become commonplace and has helped in reducing work restrictions which occurred in the past. This strategy creates benefits derived from reflection in both learning contexts and the collaborative learning (Harbin, 2020; Popescu, Ilie, & Stefan, 2021).

Beginning with the pre-performance phase, which targeted the development of cognition and motivation, we proposed the use of collaborative note-taking to record ideas. This was also done to analyze tasks within the six-steps of the note-taking activity and the socially-shared regulation process. Next, collaboration during performance targeted every aspect (cognitive, motivational, and emotional). In this step, we suggested groups engage in the note sharing activity, which consisted of shared-notetaking, resulting in shared information and improved academic performance (Chiu, Wu, & Cheng, 2013). Another activity is to share emotions with others through the use of an expressive writing technique, this comes from the possible adaption of social-biofeedback model. This exercise helps to build self-awareness and to regulate self-control of emotion-related experiences, physiological responses, and behaviors (György & Watson, 1999; Lepore, Greenberg, & Bruno, 2002; Robertson et al., 2020). Next, collaborative writing tasks in brainstorming activities and group discussions could help learners to take both the roles of supporter and help-seeker to complete individuals or group tasks. This corresponded with previous research which stated that collaborative writing facilitates learners' development of knowledge construction, writing, and social skills through interactions with their peers. Researchers (Yong Mei, 2010) and learners perceived value in peer assistance and group friendships as major factors that shape students' attitudes towards this activity (Chen & Yu, 2019).

Finally, collaboration in post-performance focused on all three regulation targets. There is evidence of using note-taking being used as formative assessment and summative assessment, e.g. using e-portfolios, reflective writing, peer evaluation. The highlight of group collaboration reflection can support socially shared metacognitive regulation (De Backer, Van Keer, & Valcke, 2020) and critical reflection on one's own group generates the perceived of self-efficacy (Sekerdej & Szwed, 2021). In order to facilitate reflection and encourage documentation of growth in teaching, e-portfolio can be used as a tool to facilitate the reflection (Chye et al., 2019). With self-reflection, learners can increase the clarity of learning goals relevant to the monitoring of self-controlled learning processes, as well as the assessment of effective plans, strengths and weakness (Panadero, Jonsson, & Botella, 2017; Siegesmund, 2017). Pre-service teacher can do the dual reflection both in teacher and leaner roles in teaching autonomy (Kazeni, 2020). Then peer reflection and evaluation will helps to generate the value of reflective experience and deliberate more performance in professional (Panadero & Alqassab, 2019; Trede & Jackson, 2019) such as on cooperative learning (Cañabate et al., 2019). See **Figure 4** for the re-design of socio-emotional collaborative note-taking model in self-regulatory process.
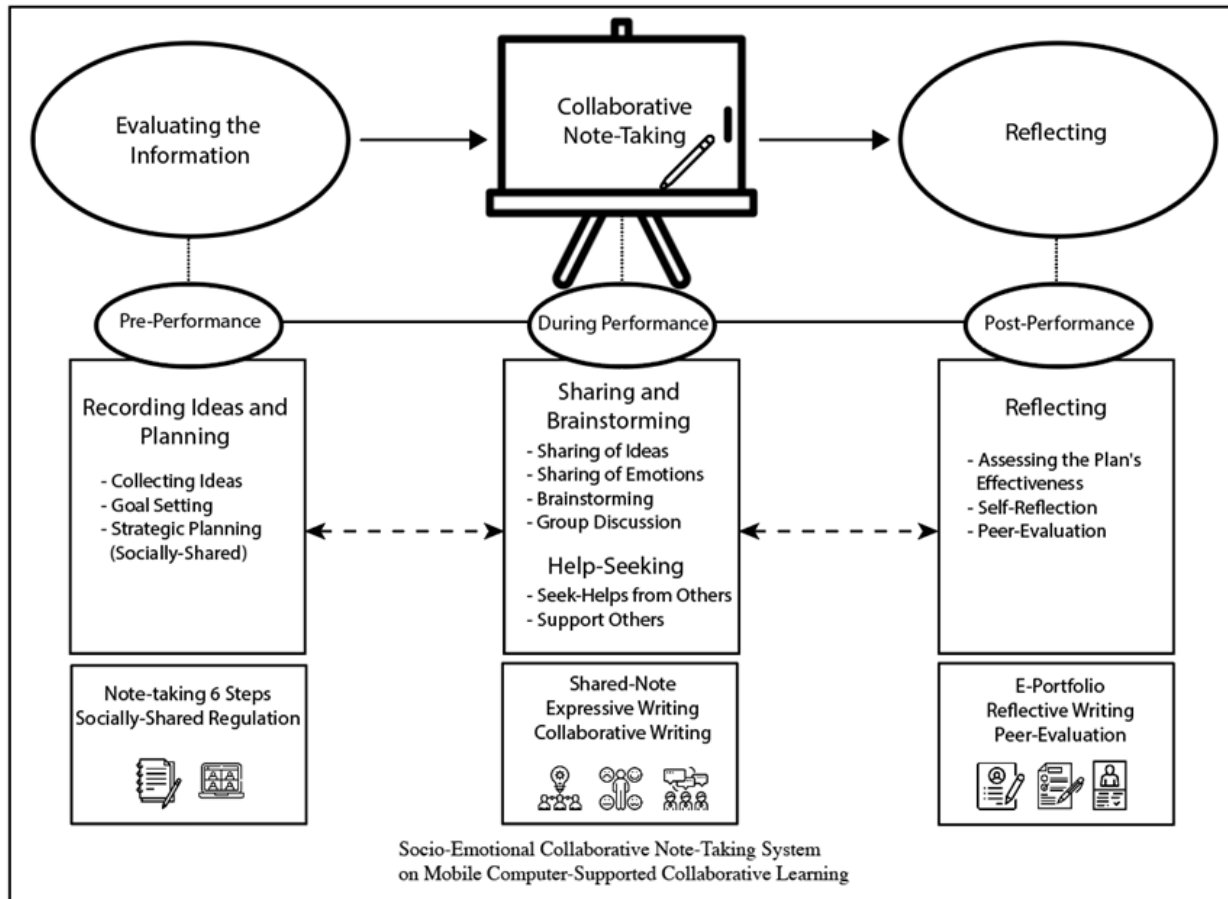
Figure 4. The Socio-Emotional Collaborative Note-Taking Model

CONCLUSION

The present study was designed to fill a gap by adding more collaboration to the learning process and investigating the predictive effects of self-evaluation (forethought phase) on self-reflection mediated by collaboration. Our study intends to suggest the re-design of collaborative activities using socio-emotional collaborative note-taking on mobile devices. This would be done through the self-regulatory learning process. The importance of embedding collaboration into every step of self-regulated the learning process was revealed, namely, pre-performance, during the performance, and post-performance. An implication of this is the possibility of bringing these concepts into to digital learning design which will close the gap aimed in the field of educational technology between modern and traditional types of digital note-taking. These findings provided insights to be used in conjunction with future trials and research, which could lead towards contributions to the progressive development of future studies in this area.

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