A Model of Peer Learning Incorporating Scaffolding Strategies

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ABSTRACT

Peer learning is a learning strategy that enables learners to interact with others and become active participants in their learning. To design peer learning activities, a model of peer learning is necessary to provide peers with guidance. However, previous models related to peer learning have not contained systematic strategies from diagnosis to evaluation. Scaffolding is an appropriate tactic for peer learning as it includes diagnosis, specific learning strategies, and assessment procedures. Therefore, the purpose of this study was to develop and validate a model of peer learning that incorporates scaffolding strategies in order to provide a structure for designing and implementing effective peer learning, and to enhance peers' teaching skills and learners' capability to gain new knowledge. This study drew from design and development research, including model development and model revision. This process was arranged in four phases. The first phase comprised of an intensive literature review to identify related theories, the conceptualization of scaffolding, and the operationalization of scaffolding. In the second phase, the model of peer learning was developed based on the results of the literature review. The model was synthesized using the data from the literature review, which included the main elements and characteristics of scaffolding suitable for peer learning. An online education program was also developed to teach the steps in the model to peer tutors participating in a peer tutoring program, which is one type of peer learning, for the purposes of model validation. In the third phase, model validation through internal (expert review) and external (external validation interview for field evaluation) validation was implemented. Based on the outcomes of these model validation processes, in the fourth phase, guidelines for revisions were developed to

improve the proposed model. This model exhibits a synthesis of scaffolding strategies that enhance peer learning, including related theories, the conceptualization of scaffolding, and the operationalization of scaffolding. This model consists of four steps: (1) knowing each other, (2) learning together, (3) checking what you learned, and (4) finalizing peer learning. According to the results of model validation using an online education program designed for peer tutors participating in a peer tutoring program, which is one type of peer learning, this model of peer learning was useful for peers in providing structure and guidance for the design of their peer learning activities and the selection of appropriate peer learning strategies for learners who had different backgrounds and skills. This model is also applicable to various subjects and fields.

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GENERAL AUDIENCE ABSTRACT

Peer learning is a learning strategy that enables learners to interact with others and become active participants in their learning. To design effective peer learning activities, a model of peer learning is necessary to provide peers with guidance. The purpose of this study was to develop and validate a model of peer learning that incorporates scaffolding strategies in order to provide guidance for designing and implementing effective peer learning, and to enhance peers' teaching skills and learners' ability to gain new knowledge. This study was conducted through model development and model validation. For model development, previous research and books were reviewed to identify main elements of scaffolding such as related theories, the conceptualization of scaffolding, and the operationalization of scaffolding. Based on identified elements of scaffolding, the model of peer learning was developed. This model consists of four steps: (1) knowing each other, (2) learning together, (3) checking what you learned, and (4) finalizing peer learning. According to the results of model validation using an online education program designed for peer tutors participating in a peer tutoring program, which is one type of peer learning, this model of peer learning was useful for peers in providing guidance for the design of their peer learning activities and the selection of appropriate peer learning strategies for learners who had different backgrounds and skills. This model is also applicable to various subjects and fields.

Dedication

To my grandparents and mother, Jungsim An, Kwangsoo Kim, and Seonja Kim:

I always appreciate the support and encouragement you have given me throughout my life. I am so grateful and happy to be my grandparent's granddaughter and my mother's daughter.

To my uncle and aunt, Byongkwon Kim and Jakyung Kim:

Uncle, I know that you always take care of me like my own father. You taught me everything about being a researcher, and for this I will always be grateful. Aunt, thank you always for giving me information for my research. I will always remember the guidance you have given me.

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Chapter 1: Introduction

Need for the Study

Learners in traditional educational settings usually hear lectures and memorize information provided by an instructor on a given subject. Although they may ask questions, they are not given opportunities to participate in learning activities in the classroom. In other words, traditional education has focused on the transference of information from an instructor to a learner, rather than on how the learner acquires knowledge in his or her own right (Houston & Lazenbatt, 1999). The primary shortcoming of traditional education is the absence of interactivity in lectures (Wessels et al., 2007). Interactivity refers to a chance for learners to impact the flow of knowledge by actively affecting the learning procedure and taking part in the communication, rather than becoming an inactive participant (Wessels et al., 2007). Through interactivity, learners are able to actively participate in learning tasks. To overcome the limitations of traditional education and provide interactivity, the current trajectory in higher education has shifted from the transmission-oriented approach to teaching and learning and towards an interaction-oriented approach that shifts the focus onto the active role that learners play in the process (Fernandes & Flores, 2013; Murray & McDonald, 1997).

One of the learning strategies that enables learners to become active participants in this process is peer learning. To define peer learning, the meaning of "peer" must be clarified. Boud (2001) described peers as "people in a similar situation to each other who do not have a role in that situation as teacher or expert practitioner" (p. 9). He argued that peers do not have any authority over each other through the power of their roles or duties. A peer can be a teammate, an individual who is the same age, a classmate in the same class, or someone from the same course or school (Lord & Garfin, 1986). In particular, Stone et al. (2013) explained that "a peer is a

person with a comparable or slightly higher level of knowledge and experience to the learner" (p. 2). In this research, according to these definitions of a peer, peers are defined as those with advanced skills as well as experiences, and those who share equal educational status such class enrollment, program, degree, or school.

Peer learning. Peer learning has been described in various research articles. Topping (2005) generally defined peer learning as "the acquisition of knowledge and skill through active helping and supporting among status equals or matched companions" (p. 631). He argued that peer learning includes people who are not professional instructors and who have a similar social status to those they are assisting. Topping (2005) also explained that for peers to be matched with learners, they should have abilities relatively close to the abilities of those they help, so that all participants of peer learning discover cognitive tasks in their peer learning activities.

Peer tutoring, cooperative learning, and collaborative learning are typical forms of peer learning. Peer tutoring is a learning strategy in which one learner as a peer tutor teaches another learner as a peer tutee; the peer tutor is the more knowledgeable person and the peer tutee is a beginner (Topping, Buchs, Duran, & Van Keer, 2017). Cooperative learning refers to small group, highly structured learning activities designed so that all learners in the small group study together to facilitate their learning (Johnson & Johnson, 2004). In collaborative learning, more than two learners work together and share their works fairly with less structure so as to achieve their envisioned learning goals (Barkley, Major, & Cross, 2014).

Boud (2001) highlighted that peer learning is one way to stimulate significant learning so that learners participate in teaching and learning with each other. Peer learning is a system by which learners can acquire skills and knowledge—formally and informally—both from and with each other. In contrast to independent study, it acknowledges the importance of mutually

dependent study and the distribution of thoughts, experiences, and information with others. Peer learning works in both ways, through mutual learning tasks (Boud, 2001). Peer learning generates a movement from vertical (directed) education to horizontal (spread) education where learners can learn not only from their professors, but also from peers (Boud & Lee, 2005). Despite the fact that learners' status or experiences may differ, the general character of learning activity in peer learning is collegiate. Peers are partakers in a participatory learning environment in which they share their responsibilities and choices (Boud, 1999).

Peer learning leads to diverse beneficial learning outcomes and takes advantage of the results of peer interaction (Christudason, 2003; Majid et al., 2009). It is valuable in creating interactions among individuals from various cultural circumstances and in identifying peers' specific requests (Majid et al., 2009). Peer learning provides learners with opportunities to achieve a learning activity and simultaneously consider the requirements and emotions of others in their peer learning group. Therefore, peer learning is significantly useful in social interchanges (Majid et al., 2009).

Participants in this pedagogical practice learn from their peers, which requires active involvement by the learner in his/her education (Stone et al., 2013). Moreover, arguments in favor of peer learning may be understood to fall within three basic categories: (1) peer learning produces positive effects on learners' performance; (2) the use of peer learning can lighten the workload of the teaching staff; and (3) peer learning, by nature, helps to promote the development of generic skills relating to future employment (Boud et al., 2001).

Peer learning, despite its potential, presents its own challenges in educational contexts. Previous studies have shown that peers sometimes lack the needed skills or capabilities to assist in others' learning (Bensfield et al., 2008; Martin et al., 2015). Bensfield et al. (2008) argued that

while some peers will take on the responsibility to guide other learners, many are unwilling to do so, since they sense they are unprepared for their position. Peers may infrequently try to assist other learners, or they may not be able to offer adequate assistance to support others' learning (Martin et al., 2015). Peers should have content and process abilities that they can use in peer learning settings (Materniak, 1984; Wilson & Arendale, 2011). Because peers as educators are neither learner development experts nor skilled instructors, they need training to fulfill their roles adequately (Wilson & Arendale, 2011). Therefore, a structured peer learning environment should be provided to enhance the abilities of both peers and learners.

To that end, several previous studies have explored models of peer learning. First, Webb (1989) developed a model of peer interaction based on questions for diverse types of problems, elaborations, and different learning outcomes. King (1997) proposed a model for peer tutoring, a type of peer learning, that makes use of a structured question sequence for knowledge-building activities. This model contains instructions for enhancing peer tutors' supportive communication skills. Sevenhuysen et al. (2013) also presented a peer learning model including instructional tools to facilitate peer learning activities. These existing models of peer learning suggest numerous peer learning strategies, such as questioning, elaboration, and observation. Peer learning, however, involves more than just feedback; indeed, an entire peer learning procedure, from diagnosis to examining learning outcomes, that is required for effective peer learning (Wang & Chen, 2008).

A prominent puzzle in the design of peer learning is the question of how much structure can be given to the interaction among learners without imposing unwanted limitations on thinking, learning, and discussion (King et al., 1998). King et al. (1998) argued that for suitable peer interaction, a balance between autonomy and structure must be carefully preserved so that

peer interaction is structured to adequately encourage the interchange of thoughts, while learners retain autonomy so they can engage in their own thinking procedures. In other words, learners are able to improve their skills and knowledge based on well-balanced peer interactions. For designing well-balanced interaction in peer learning, "the mutual exchange of ideas, explanations, justifications, speculations, inferences, hypotheses, conclusions, and other high-level discussion[s] are provided to promote the construction of new knowledge instead of memorization" (King, 1997, p. 224). In addition, organized content, processes, roles, and ongoing, intentional advice are all part of structured peer interaction (King, 1997). Consequently, a model of appropriate peer learning design needs to include peer interactions for the construction of knowledge that use various feedback strategies and encompass the whole process of peer learning.

The more skillful peer in this study is related to what Vygotsky terms as the More Knowledgeable Other (MKO). The MKO is a crucial element of the learning process and can be clarified as "someone with more knowledge or a greater understanding of a particular task or process than the learner" (Cicconi, 2014, p. 58). This notion indicates that in addition to advanced speakers, such as professors or lecturers, peers are also suitable to become MKOs (Cicconi, 2014). Vygotsky (1978) highlighted that interaction between the learner and more knowledgeable peers could efficiently aid the development of the learner's abilities and tactics (Abdullah & Siraj, 2014). Galloway (2001) also agreed that learners' peers could act as MKOs who can support them with their more extensive experience or their advanced knowledge.

Having peers as MKOs provides learners with direct or indirect assistance to increase their competence. The MKO is a significant concept that relates to the gap between what learners can attain on their own and what learners can accomplish with instruction and support from a

more capable person (Abdullah et al., 2013). With the intention of overcoming this difference, the MKO provides learners with the support needed to expand their knowledge (Brijlall & Isaac, 2011). In other words, learners may attain a certain level of ability on their own, but their development and learning will improve beyond that level more efficiently and rapidly through interactions with an expert or other MKOs (McAllister et al., 2013). MKOs usually directly support learners as they expand their capacities, but they may also assist learners via indirect mediation (e.g., outlines developed by a specialist) (Baleghizadeh et al., 2011).

Scaffolding for peer learning. Scaffolding is a useful tactic to include in peer learning since it involves various feedback strategies, a complete learning process (from goal-setting to assessment), and a specific role for the scaffolder. The notion of scaffolding in an educational setting is derived from the metaphor of scaffolding in architecture. In construction, scaffolding is a temporary structure that assists and shields the building, and it is disassembled once construction is complete (Boblett, 2012). Though impermanent, scaffolding is vital for the successful construction of a building.

The metaphor of scaffolding was initially adapted for educational settings when Wood et al. (1976) explained how adults support children in problem-solving. They figured out that adults did not merely explain to children how to resolve a problem; instead, the adults used tactics to temporarily assist infants' attempts until they obtained adequate ability on their own (Belland et al., 2013; Wood et al., 1976). Wood et al. (1976) defined scaffolding as "a process that enables a child or novice to solve a problem, carry out a task or achieve a goal which would be beyond his unassisted efforts" (p. 90). The usage of scaffolding as a metaphor within teaching and learning represents the use of nonpermanent assistance in the accomplishment of a work that learners might not be capable of completing without aid (Van de Pol, Volman, & Beishuizen, 2010). So

that learners can focus on and master novel tasks to the best of their ability, educators have developed an important strategy: scaffolding. In this technique, a mediator guides learners in their progress as they gain increasing skill in task areas that had previously exceeded their capacities (Wood et al., 1976).

Bruner (1983) also defined scaffolding as "a process of setting up the situation to make the child's entry easy and successful and then gradually pulling back and handing the role to the child as he becomes skilled enough to manage it" (p. 60). Bruner described scaffolding as a kind of indirect support in which learners are able to achieve a higher level of understanding via instructors' guidance (Fernández et al., 2001). Bruner emphasized relationships between a parent and an infant or between a tutor and a learner (Puntambekar & Hubscher, 2005). The adult (e.g., parent, tutor) offered merely sufficient assistance based on the child's achievement on a continuing basis (Puntambekar & Hubscher, 2005).

Earlier descriptions of scaffolding emphasized interactions with peers or instructors as the main form of support, and described how a more well-informed individual can offer support in the task setting (Hogan & Pressley, 1997). This description stresses primarily that the involvement of another individual depends on what is suitable for a learner in a given situation, and what this learner can achieve as a result of this involvement (Reiser, 2004). However, the traditional definition has been considerably revised since it first emerged in child psychology studies (Boblett, 2012).

Greening (1998) extended the notion of scaffolding to encompass the entire extent of learning support aids. Broadly, scaffolding has been construed as a type of assistance used to improve learners' learning ability (Rasmussen, 2001). Scaffolding can serve as an umbrella metaphor to represent the method by which peers or instructors provide learners with the

resources required for the purposes of studying (Jacobs, 2001). Therefore, current definitions of scaffolding have emphasized its significance in improving the comprehension of texts and other subjects (Belland, 2014). For example, scaffolding can be supplied through physical instruments in a classroom setting or other learning circumstances when instructional information is provided through mobile devices for use in a museum (Davis, 2015).

According to Puntambekar and Hubscher (2005), scaffolding refers to a process through which learners receive various kinds of support aimed at enabling them to continue functioning independently once the support is taken away. They also identified three main features of scaffolding: (1) understanding shared goals for learning activities, (2) suitable guidance based on continuing diagnosis of the learners' current comprehension, and (3) fading. The scaffolder is in charge of using the characteristics of scaffolding to offer assistance sufficient for the learner to be able to accomplish a learning task (Shaman, 2014). Through peer scaffolding, a peer can develop and expand another learner's knowledge to a more advanced level via the demonstration (Williams & Burden, 2000).

In particular, conceptual scaffolding and strategic scaffolding enable learners to acknowledge important notions and strategies for their problem-solving. Conceptual scaffolding assists learners in determining what to contemplate in learning and advises them to decide which notions or concepts are important (An & Cao, 2014). The purpose of conceptual scaffolding is to encourage conceptual improvement related to specific content (Holton & Clarke, 2006). On the other hand, learners can acquire process skills through strategic scaffolding. Strategic scaffolding facilitates learners in examining their learning activities or difficulties, and it highlights alternate tactics that might prove useful (Linton, 2000; Cagiltay, 2006). It emphasizes tactics for recognizing and choosing obtainable resources, finding required information, and connecting

new information to prior experience and knowledge (Hannafin, Land, & Oliver, 1999).

Purpose of the Study

The purpose of this study was to develop and validate a model of peer learning that can be utilized to provide a structure for designing and implementing peer learning incorporating scaffolding strategies to enhance both peers' teaching skills and learners' ability to acquire new skills and knowledge. "Models" refer to "simplified representations of reality, which includes factors, structure, functions, systems, tasks, events, orders, or process" (Branch & Kopcha, 2014; Davies, 1996; Gustafson & Branch, 1997; Lee & Jang, 2014, p. 743). Models are useful in establishing guidelines for design as well as in assisting people in applying theories to their practice (Richey, 1986; Stoner & Cennamo, 2018). One type of model, the conceptual model, is defined as "a model that represents the important variables and relationships between variables in the design of instruction to provide a macro-level perspective of an instructional design task" (Lee & Jang, 2014, p. 747). The present study sought to develop a model of peer learning that represents a structured peer learning process incorporating scaffolding strategies. This model also presents tasks and procedures for selecting the appropriate scaffolding strategies for peer learning activities. Based on this model, peers can design a learning environment in which they are able to select appropriate scaffolding strategies that enable learners to achieve their goals through the suitable guidance peers provide, in an authentic process. This model of peer learning is a conceptual model, as it was developed using the characteristics of scaffolding and their relationships. In other words, this model consists of the main identified characteristics of scaffolding and synthesizes a peer learning process based on their relationships. This model is intended to help peers understand the main features and concepts of scaffolding and figure out how to use these concepts in a peer learning environment.

Research Question

The following research questions were addressed in this study:

1. What elements should be included in a model of peer learning that incorporates scaffolding strategies?
2. How can the model be developed to operationalize all elements of scaffolding?
3. How does the proposed model of peer learning impact the knowledge, skills, and practices addressed through peer learning?
4. How can this model of peer learning be improved?

Methodology

The production of the model proposed in this study involved a process of model development and model validation (Richey & Klein, 2007). This process consisted of four phases. The first phase included a comprehensive literature review exploring the related theories, characteristics, and operationalization regarding scaffolding and peer learning. The literature review provided the theoretical foundation, key components, and strategies of scaffolding for designing and implementing peer learning. In the second phase, the proposed model of peer learning was developed based on the literature review. The model was synthesized using the findings of the literature review, which included the key components and concepts of scaffolding appropriate to peer learning. An online education program was also developed in this phase to teach the steps in the model for the purpose of model validation. In the third phase, model validation was conducted by internal and external validation in a real peer learning setting. According to Richey (2005), model validation is a verifiable procedure that examines the efficiency of a model in an actual situation or offers assistance for implementing the diverse elements of the model itself. This research applied expert review as an internal validation process

to validate the components and procedures of the model of peer learning for future use. External model validation deals with the effectiveness of the use of the model, examining the instructional products themselves, as well as the influence of these products on learners, customers, and institutions (Richey, 2005). Peer tutoring is one type of peer learning to which the model can be applied. So, to conduct external model validation, peer tutors first went through the online education program to learn the model of peer learning then used this model to provide other learners with guidance in a peer tutoring setting. In this research, external validation interviews were conducted to determine the effectiveness of the model of peer learning as applied in a peer tutoring program at a public U.S. university. In particular, this research focused on the impact of the model on peers who used it. Therefore, peer tutors' perceptions of their experiences using the model of peer learning were investigated. Based on the data collected from the model validation, a list of suggested revisions to the model of peer learning is described in the fourth phase.

Significance and Potential Limitations of the Study

This study is beneficial in that the model undertakes the enhancement of both peers' teaching ability and learners' ability to benefit from this technique in higher education. In addition, this study will be useful for peers who wish to incorporate scaffolding strategies in their design of peer learning environments. The results of this study underscore the importance of scaffolding strategies for peer learning in higher education. A potential limitation of this study is that model validation was conducted in a peer tutoring program which is only one type of peer learning. However, the model of peer learning may be applicable to other types of peer learning, such as collaborative and cooperative learning, because these also focus on interactions between peers and learners.

Definitions

Peer learning. For this study, peer learning is defined as a form of learning geared towards achieving learning activities in which same-status learners (those of the same class enrollment, program, degree, or school) work with and help each other to enhance their knowledge, abilities, and interpersonal skills.

Scaffolding. In this paper, scaffolding is defined as efforts to provide support to a learner who can not otherwise solve a problem or understand the content presented. The goal of scaffolding is that learners will ultimately perform similar learning activities on their own.

Peer tutor. A peer tutor is "a more capable, knowledgeable, and experienced peer with a supportive role" (De Smet et al., 2008, p. 208). The role of the peer tutor is to "help other learners either on a one-to-one basis or in small groups by continuing classroom discussions, developing study skills, evaluating work, resolving specific problems and encouraging independent learning" (Colvin, 2007, p. 166). In this study, a peer tutor is a more skillful and experienced peer who can support other learners' endeavors.

Peer tutee. A peer tutee is "a less experienced learner receiving help from a tutor" (De Smet et al., 2008, p. 208). Peer tutees are usually seeking extra assistance from peer tutors (Salahat & Wade, 2009). Therefore, a peer tutee is a less experienced learner who receives any support from a peer tutor.

Organization of this Study

In chapter one, background information introducing the purpose of the study, research questions, significance and potential limitations, research methodology, and definitions, is provided. Chapter two contains a literature review to establish the need and background for the study. This chapter gives an overview of peer learning, laying out the different types of peer

learning and their requirements. Moreover, the relationship between peer learning and scaffolding and how scaffolding may enhance a peer learning environment are also included to explain the necessity of scaffolding strategies for the study. Chapter three details the research methodology for the study. Chapter four presents the literature review for the development of the current model, the developed model, and the related online education program. Chapter five presents the results of expert review and external validation interviews. Chapter six describes guidelines for revising the model based on the results found in chapter five and provides a summary of the study, the contributions and limitations of the study, and implications for future study.

Chapter 2: Review of the Literature

The purpose of this study was to develop and validate a model of peer learning that incorporates scaffolding strategies that draw specifically from conceptual and strategic scaffolding to enhance peers' teaching skills and learners' knowledge acquisition. This chapter presents the literature related to peer learning research and practice and introduces the use of scaffolding for peer learning in order to establish the background for the study. Additional literature related to scaffolding will be discussed in Chapter four.

Peer Learning

Many studies have found that peer learning has a positive impact on learners' academic achievement. For example, Tsaushu et al. (2012) developed and applied an instructional model involving peer learning for an introductory biology class for undergraduate students. The data from learners' performance indicated that those who participated in active-learning groups that implemented peer learning, teaching assistant tutoring, and mini conference-like lessons had significantly higher grades in the more difficult open-ended tests than did those who did not take part in active learning groups.

In another example, Dancer et al. (2015) tested out a peer-assisted study session (PASS) program in universities to help learners regulate their expectations regarding higher education and to enhance retention. The findings showed that the effects of PASS were highly significant for both international and native-born lower-achieving learners. The researchers suggested that these results were significant for organizations offering comparable peer learning programs and other institutional attempts to improve learners' retention and learning outcomes, or to assist international students more efficiently.

Chan and Leijten (2012) implemented peer learning practices, including feedback

strategies, to enhance performance among students in a welding program. They used three types of feedback for peer learning: feed up, feedback, and feed forward. These feedback techniques are intuitive for most learners and instructors, but still lead to students' improvements in both motivation and metacognition. An investigation of peer learning interactions through feedback strategies indicated that many peer groups using such strategies led to progress in participants' welding skills.

In addition, some previous studies related to peer learning have revealed that learners who participate in peer learning can improve their social skills. Hammond et al. (2010) evaluated the application of a same-year peer-assisted learning (PAL) program for first-year undergraduate students. The students took part in voluntary PAL lessons that stimulated cooperative learning with learner-directed tasks. The results of the researchers' evaluation demonstrated that most of the learners concurred that PAL enhanced their social skills; for example, by prompting them to study with others and gain different viewpoints.

Majid and Tina (2009) examined the impact of peer learning and learners' perceptions of peer learning activities. According to responses from those who participated in peer learning, their peers were well-informed, thoughtful, answerable, cooperative, and helpful, and they contributed to their peer learning activities.

Zou et al. (2012) designed a multi-layered peer learning model by combining the notion of learning from more capable peers with that of peer learning within teams, evaluating the model using assessment rubrics, focus groups, and pre- and post-tests on learners' perceptions of their abilities. The results of this study found that teamwork skills and problem-solving skills were the two areas in which learners improved most through peer group activities. Participants learned from collaborating with each other and from being questioned from different viewpoints

by peers in a collaborative problem-solving setting.

Existing research demonstrated that peer learning facilitates learning motivation by improving such aspects as self-efficacy, autonomy, and self-acceptance. Razak and See (2010) investigated the efficiency of online peer learning in stimulating learners' motivation and improving their learning outcomes. According to the findings, the experimental group that participated in peer learning expressed a significant difference in motivation, and this consequently contributed to a significant difference in learning outcome. The study demonstrated the advantages of online peer learning in promoting motivation and, in turn, improving learners' academic performance. Pålsson et al. (2017) explored the efficiency of peer learning in clinical education in improving nursing students' self-rated achievement. In their research, the experimental group participated in peer learning for two weeks, and the control group took the traditional approach and studied clinical practice based on the educator's information and experience. The outcome showed that learners in the experimental group exhibited improved self-efficacy. In addition, the significant peer interaction impact was investigated for changes over time between these two groups. The results indicated that peer learning is an effective learning strategy that increases nursing students' self-efficacy to a greater degree than traditional guidance does. Hanson et al. (2016) investigated the effectiveness of peer learning activities on improvements in psychological well-being in higher education. They argued that peer learning had a significant positive effect on learners' self-acceptance and autonomy.

Furthermore, some research has found that peer learning can provide learners with a comfortable learning environment, characterized by low anxiety and high safety. McKenna and French (2011) designed and provided a semester-long required class to examine the effects of peer teaching activities in the unit on "Education for Clinical Practice," based on the perceptions

of both junior and senior students. Generally, first-year students stated that they felt comfortable learning in a setting with senior peers, and were able to learn from their guidance. Many learners recommended that there be more chances for peer interaction and learning. Stenberg and Carlson (2015) explained how an educational model of peer learning was effective in clinical education, and compared perspectives between first-year and third-year students. Their findings assessed the peer learning activities as helpful and appropriate for learning. In particular, a feeling of safety contributed to facilitating learning. Goldsmith et al. (2006) applied a peer learning tactic to a class which included first- and third-year nursing students. When reporting on the five best benefits of the peer learning tactics, both groups highlighted their interactions with each other, including feeling comfortable in the learning relationship. In particular, first-year students emphasized the personal aspects of their third-year partners, such as their kindness and patience, rather than their peer learning skills.

Types of peer learning. According to literature related to peer learning, there are three types of peer learning: peer tutoring, cooperative learning, and collaborative learning (Hanson et al., 2016; Parr & Townsend, 2002; Sampson & Cohen, 2001; Topping, 2005; Topping et al., 2017; Zou et al., 2012).

Peer tutoring. Peer tutoring is a typical approach to peer learning based on interactions between two peers. Peer tutoring is described as "an arrangement in which two learners work together on an academic activity, with one learner providing assistance, instruction, and feedback to the other" (Darrow et al., 2005, p. 15). The purpose of peer tutoring is "the development of knowledge and skills through explicit active helping and supporting among status equals or matched companions, with the deliberate intent to help others with their learning goals" (Topping & Ehly, 2001, p. 114).

In peer tutoring, each participant assumes one of two roles—the peer tutor or the peer tutee. This type of peer tutoring usually focuses on one particular subject and specific peer communication and cooperation processes. Through such interactions, learners participate in general and/or detailed education (Topping, 2005). The most general form of peer tutoring is that in which a more capable or better-informed peer tutor leads the interaction and supervises the learning for a less knowledgeable peer tutee (Damon & Phelps, 1989; Topping et al., 2017). The status of a peer tutor is irrefutably similar to a peer tutee's status, such as the same class enrollment, program, degree, or school, which augments and reinforces mutuality to moderate the relationship (Topping et al., 2017). The role of the peer tutor is that of a facilitator, whose responsibility is to demonstrate learning tactics through developing learning tasks and procedures that encourage learners to learn actively (Marra & Litzinger, 1997; Zou et al., 2012). Therefore, peer tutees are able to understand their peer tutors' guidance more straightforwardly, leading to more impactful and personalized learning (Good & Brophy, 1997).

Through peer tutoring, both peer tutors and peer tutees have shown significant academic accomplishments in numerous subjects such as biology and mathematics (e.g., Greene et al., 2018; Munley et al., 2010; Ullah et al., 2018). Peer tutoring also stimulates better social acceptance or more optimistic interpersonal relationships among participants (e.g., Shanahan, 1998). Peer tutoring enables learners to improve their attitudes and self-concept (e.g., Parr & Townsend, 2002; Roswal et al., 1995).

For providing effective peer tutoring, continuing guidance and assistance to adjust tutoring tasks and role taking is recommended (Falchikov, 2001; Schraw et al., 2006; Topping, 1996; Topping et al., 2017). Topping et al. (2017) also argued that gatherings for peer tutors and peer tutees are essential as a channel for exchanging learners' positive or negative learning

experiences, and bringing about reciprocal learning. Peer tutoring can be effective by facilitating and assisting interaction, providing specific interactive procedures, or providing organized resources and texts (Topping et al., 2017).

Cooperative learning. Cooperative learning provides learners with peer learning activities to solve problems and develop social skills. Cooperative learning is "the instructional use of small groups so that learners work together to maximize their own and each other's learning" (Johnson & Johnson, 2004, p. 786). The main purpose of cooperative learning is to enable learners to engage with each other, and thus foster their own ways of thinking, rather than getting learners to think alike (Jacobs et al., 2006).

The defining characteristic of cooperative learning is that peer interaction is a primary activity, but instructors still select and lead topics and the construction of knowledge (Ravenscroft et al., 1999). Although an instructor designs cooperative learning activities, learners are expected to perform their learning tasks without the constant guidance of the instructor (Grisham & Molinelli, 1995). Learners in a cooperative learning group are expected to help one another find solutions to problems, rather than to look to their instructor for the solutions, to ensure that everyone in a cooperative learning group comprehends the concepts being learned (Yamarik, 2007). In cooperative learning, the relationship among learners is reciprocal. The accountabilities of the learners are comparatively similar or occupy the same position, based on their equivalent status (Topping et al., 2017). However, to the extent that cooperative learning involves a divide and conquer approach to completing a task, mutuality is reduced, since each member would work on different portions separately and individually before combining the different parts (Damon & Phelps, 1989; Topping et al., 2017).

Much of the existing empirical research investigates the myriad effects of cooperative

learning. For example, cooperative learning activities have a tendency to stimulate higher performance than do personal or competitive learning environments (e.g., Grisham & Molinelli, 1995; Johnson et al., 2000; Tran, 2014; Zakaria et al., 2010). Cooperative learning also has positive impacts on social relationships, by improving teamwork skills and social and cognitive interpersonal abilities (e.g., Baghcheghi et al., 2011; Cavalier et al., 1995; Gömleksi˙ z, 2007). According to Smith et al. (2005), a meta-analysis of cooperative learning shows that it leads to encouraging higher self-esteem and affirmative attitudes toward the topic, learning, and the school.

Johnson and Johnson (1994) suggest five vital components for effective cooperative learning: (1) obviously apparent optimistic interdependence, (2) substantial promoted interaction, (3) obviously apparent personal answerability and individual duty to accomplish a group's objectives; (4) recurrent usage of social and teamwork skills, and (5) recurrent and consistent group procedures to increase the group's future results.

Collaborative learning. Collaborative learning is a peer learning strategy to build new knowledge with other learners. Collaborative learning is "two or more learners laboring together and sharing the workload equitably as they progress toward intended learning outcomes" (Barkley et al., p. 4). The purpose of collaborative discussion is not only to stimulate the rebuilding of learners' existing knowledge structures but to invigorate them to build new ones in collaboration (Marttunen et al., 2005; Scardamalia & Bereiter, 1999). Collaborative learning also aims to assist learners with testing the depth and applicability of their knowledge by attempting to convey their understanding to their peers (Bruffee, 1981).

With collaborative learning, the main focus is on mutual learning—both *with* and *from* one another, as well as learners taking independent action and responsibility to manage their own

academic outcomes (Sampson & Cohen, 2001). In a collaborative learning environment, learners have the chance to communicate with their peers, propose and argue their thoughts, exchange various opinions, ask others about conceptual frameworks, and become enthusiastically involved (Srinivas, 2011). Learners are confronted both emotionally and socially when they pay attention to diverse viewpoints, and are expected to explain and defend their thoughts (Laal & Laal, 2012). In this way, they are able to generate their own distinctive conceptual frameworks rather than depend on an instructor's or a script's framework (Laal & Laal, 2012). Collaborative learning is based on a mutual relationship among learners. A crucial component of the collaborative learning setting is that learners are not separated because of supposed capability, interests, accomplishments, or any other attribute (Chung, 1991). Such diverse group structures are fairly dissimilar to the ability grouping that is typical of the traditional education system (Chung, 1991).

Collaborative learning provides learners with learning opportunities to enhance their critical thinking by means of explanations of opinions, arguments, and assessment of others' opinions (e.g., Gokhale, 1995; Hosseini, 2009; Simpson, 2010). Collaborative learning is also helpful in enhancing learning performance (e.g., Ai et al., 2010; Huang et al., 2012; Terenzini et al., 2001). Some empirical studies have mentioned that learners may enhance their problem-solving skills through collaborative learning (e.g., Cooper et al., 2008; Lazakidou & Retalis, 2010; Uribe et al., 2003).

An effective collaborative learning group provides each learner with a chance (1) to identify the essence of their intrapersonal learning conflicts with existing versus new thoughts and (2) to explain this inner struggle in an environment in which each learner can receive assistance from trusted peers to confront the internal limits of individual presumptions and

perspectives rather than defend against critiques by other learners (McKinley, 1983).

Requirements for peer learning. Trusting relationships, communication skills, and cooperative skills are prerequisite abilities for peer learning. For the implementation of peer learning, five principles are presented: constructive peer interaction, structuring, cognitive challenge, affective support, and personalized feedback. These requirements, based on the results of the literature review, were summarized in Figure 1 and are discussed below.

Prerequisite abilities for peer learning		
Trusting relationship (McLuckie & Topping, 2005; Topping, 2005)	Communication skill (King, 1997; Topping, 2005; Verba, 1994)	Cooperative skill (Johnson et al., 1998; Johnson et al., 2007; Zou & Mickleborough, 2012)

Principles of peer learning	**Specific strategies**
1. Constructive peer interaction	▪ Sharing their original perceptions ▪ Solving different viewpoints by way of argumentation ▪ Elucidating one's opinion about a phenomenon ▪ Suggesting critiques ▪ Contemplating others' tactics ▪ Listening to statements (Barron, 2003)
2. Structuring	▪ Strategic Questioning ▪ Observational process (Lincoln & McAllister, 1993)
3. Cognitive challenging	▪ Recognizing learners' present state of knowledge ▪ Providing learners with opposing information ▪ Assessing the degree of cognitive change (Limón, 2001)
4. Affective support	▪ Humor ▪ Relaxation ▪ Self-encouragement (Ehrman & Oxford, 1990)
5. Personalized feedback	▪ Performance feedback ▪ Informative feedback (Okita & Jamalian, 2011)

Figure 1. Principles for peer learning.

Prerequisite abilities of peer learning.

Trusting relationships. A trusting relationship between participants is essential for successful peer learning. Peer learning activities are advantageous, as learners form trust-based, nonhierarchical relations with their peers and are therefore able to reveal to them many cognitive complications and misapprehensions that are usually uncomfortable to disclose to an instructor (McLuckie & Topping, 2005). Specifically, a trusting relationship between peers who do not have different levels of authority promotes self-disclosure of misunderstandings and inexperience, allowing for subsequent diagnosis and improvement (Topping, 2005). Some empirical studies have demonstrated that trust creates an ideal learning environment for peer learning. For example, Glynn et al. (2006) evaluated a learning procedure to identify the importance of peer learning. They explained that when trusting relationships and confidence are established, an ideal environment for learning is formed. This finding is evidence that peer learning is a procedure of interchange based on trusting relationships and is perceived as such by both learners and peers. Zhang and Hamilton (2010) studied the formation of trusting relationships for effective peer-learning and found that an uncompetitive learning environment is beneficial, as the learners more readily disclose their learning problems and requests. Their finding indicates that building trusting relationships enables learners to increase their courage and enhance their abilities by means of the information and networking embedded in peer learning.

Communication skills. Communication skills are also crucial for learning activities with peers. Communication skills enable learners to state thoughts and intentions and to elucidate and defend them to their peers, so as to prevent or resolve misapprehensions (Verba, 1994). According to Topping (2005), peer learning assumes a symbiotic relationship between the

communication skills of both learners and peers, one in which both parties play essential roles. This mutually complementary relationship ensures that such skills are further enhanced. King (1997) also claimed that encouraging communication skills facilitates peer tutoring, one type of peer learning. He suggested that listening carefully, supplying sufficient space for thought, and providing comments and encouragement are key communication skills that peer tutors should use to assist the peer tutoring procedure. Appropriate communication skills encourage learners to perform well in peer tutoring. King et al. (1998) examined the effects of encouraging communication skills on peer tutoring. When peer tutors underwent training to improve their encouragement skills, learners noticed the improvements in these skills and noted that their peer tutors utilized them often. Although it is not obvious what characteristics of this encouragement played an important role in peer tutoring, King et al. (1998) found that learners who participated in peer tutoring containing sequenced questions plus clarification and encouraging communication skills performed better than those engaged in other kinds of communication, such as clarification only and question only. Soller (2001) proposed communication skills to improve active learning including explanation, encouragement, justification, and elaboration; these are the essential communication activities of successful peer learning. The data from this study brought to light that the active learners who participated in the peer learning process and used their communication skills for active learning performed better than did the passive learners.

Cooperative skills. Cooperative skills are required to achieve shared learning goals in peer learning. Peer learning happens when individual learners work interdependently to attain shared learning objectives (Johnson et al., 2007). As an individual learner realizes that one's accomplishments rely on the performance of others, each learner actively takes part in learning

tasks that support one another's achievement, including aiding, supporting, praising, and respecting one another's endeavors (Johnson et al., 1998; Zou & Mickleborough, 2012). In other words, the cooperative relationship offers a setting to contemplate and respect other learners' thoughts, rather than disregard them or attempt to find a better idea for the sake of competition (Johnson & Johnson, 1994).

Cooperative environments have a positive effect on peer relationships. Roseth et al. (2008) reviewed 148 studies to compare the relative effects of competitive, individualistic, and cooperative learning environments in encouraging learners' accomplishments and positive peer interactions. The results indicated that higher accomplishment and more optimistic peer interactions were more closely related with cooperative settings than with personal or competitive learning environments. This research also suggested that cooperative learning environments were related to a positive relationship between accomplishment and positive peer interactions.

Madrid et al. (2007) implemented three instructional interventions in a peer tutoring setting, which is one type of peer learning: (1) a competitive peer tutoring group, (2) a cooperative peer tutoring group, and (3) teacher-led education. The results of the study uncovered that, though competitive and cooperative peer tutoring groups led to higher instances of correct answers than did teacher-led education, the cooperative peer tutoring group showed the highest rate of correct answering. The finding indicates that instructors and peer tutors should provide learning opportunities for cooperative peer learning to enable all learners to achieve their learning goals.

Principles for peer learning.

Constructive peer interaction. Peer interaction is a key element for the construction of

knowledge in a peer learning setting. Peer interactions, through conversation and argument, are utilized to achieve learning goals and assist cognitive alteration more efficiently than independent, personal learning (De Lisi & Golbeck, 1999). In particular, constructive peer interaction is significant for facilitating learning. The concept of constructive interaction was introduced by Miyake (1986). Her study demonstrated that peers who are paired together to discuss a topic and to do collaborative work towards a solution bring to the surface much about their own presuppositions, mental models, and understandings.

Through constructive peer interaction, individuals experience learning by building their knowledge structures as they communicate together and attain agreement or disagreement (Boud, 2001). During constructive peer interaction, (1) each learner's difficulty clarification and resolution paths are associated with each learner's prior knowledge, (2) peer collaboration offers different viewpoints via both peers' feedback and self-criticisms, and (3) the teacher or monitor of their task engagement sees the situation from a slightly oblique angle, contributing to the variety in perspectives (Miyake & Shirouzu, 2002).

According to Baker (1999), there are two ways for peer interaction to be constructive. First, peer interaction is constructive if it exactly prompts the building or construction of something—value, comprehension, resolutions to problems, and occasionally knowledge. Secondly, peer interaction can be constructive if it plays some part in engaging with cooperative goal-oriented learning tasks. These constructive peer interactions have a positive impact on peer learning activities. For instance, Webb, Troper, and Fall (1995) investigated the circumstances necessary for assistance received to be useful for peer learning activities. The findings showed that constructive peer interaction was action that assisted learners in understanding how to resolve their problems in the peer learning setting. They also found that the level of constructive

peer interaction that learners took part in was interrelated with the level of assistance they received. To facilitate constructive peer interaction, learners can share their original perceptions, solve different viewpoints by way of argumentation, elucidate an opinion about a phenomenon, suggest critiques, contemplate others' tactics, and listen to statements (Barron, 2003).

Structuring. Structured peer learning provides specific peer learning procedures for learners. Structured peer learning refers to prearranged and formalized learning tasks, which are processes established to use the identified advantages of the peer learning procedures (Lincoln & McAllister, 1993). Structured peer learning is beneficial when the learning activity includes factual recollection, comprehension of the related materials, or implementation of processes and conceptions in a comparatively routine way (Cohen, 1994). Cohen (1994) noted that peer interaction must be structured in order to stimulate the form of high-level conversation necessary for peer intermediation of creative learning and problem-solving. A structure, however, needs to be sufficiently accommodating to provide learners with the autonomy to adjust those conversation skills and forms to their specific activity demands and group requests (O'Donnell & King, 1999). There is some evidence that structured peer learning is more effective than unstructured peer learning for learners. For instance, Saleh et al. (2007) examined whether a structured collaboration including group directions and ground rules for aiding learning activities might be helpful in overcoming participation inequity. The results indicated the greater positive impacts of structured peer collaboration on average-ability learners' accomplishment, motivation, and involvement with the peer interaction than did those of unstructured peer collaboration. Another positive result was that structured peer collaboration did not lower the grades of the low and high-ability learners. King (2002) suggested that question-and-answer tactics for structured learning to take place at advanced cognitive levels in peer-driven scenarios.

Such tactics include strategic questioning, in which a series of inquiries efficiently guides group problem-solving (King, 2002). Structured peer learning also contains an observational procedure. When learners discuss their observations with the other learners they observe, they are able to gather data on their interactions and provide specific feedback regarding the learning from this observation (Lincoln & McAllister, 1993).

Cognitive challenge. Learners face cognitive challenges when adjusting their viewpoints. According to Falchikov (2001) and Goh (2006), cognitive challenges can take place when learners vigorously engage with the resources on their own and study by themselves, but they are promoted with more certainty and made more meticulous via interactive participation with peers. Therefore, cognitive challenges and conflict are potentially included in peer learning. In peer learning settings, learners tend to argue about conflicting solutions to a shared problem. This cognitive conflict works as “a mediator between peer interaction and cognitive reorganization" (Forman & Cazden, 1985, p. 339). Peers offer a compelling resource for cognitive challenges, particularly because their communication reflects their equal status, typically with a directness that seems relatively non-threatening (DiPardo & Freedman, 1988). Because peer feedback is taken seriously by learners, peer disagreements willingly induce both social and cognitive challenges, which forces peers to notice viewpoints other than their own, to reconsider the rationality of their own perceptions, and to learn to defend their thoughts and discuss them with others (DiPardo & Freedman, 1988).

Cognitive challenge in peer learning has a significant impact on learning outcomes. Howe and Durr (1982) assigned learning tasks to facilitate reasoning skills by prompting cognitive challenges so as to enhance learners’ motivation. Their results indicated that structured peer interaction, in conjunction with cognitive challenge, improved learners’ scores in a

chemistry class. Cognitive challenge is offered by (1) recognizing learners' present state of knowledge, (2) providing learners with opposing information, typically stated via scripts or questioners who lead the discussion with peers, and (3) assessing the degree of cognitive change between learners' prior knowledge or views and a post-evaluation following the instructional involvement (Limón, 2001).

Affective support. Affective support is also a consideration within peer learning that provides learners with emotional support. As learning with peers occurs, learners face cognitive and social challenges and conflicts during the peer interaction. Thus, affective support is important for controlling emotions and perspectives, as well as for handling possible conflict (Goh, 2006). The affective area consists of learners' motivations, their emotional reaction and attention to learning, and the worth ascribed to learning (Schroeder, 2008). Through affective support, learners are able to experience positive emotions, high levels of confidence for attaining goals, and answerability to peers as well as to the cognitive learning goals (Akasah & Alias, 2010). In addition, learners are able to understand their knowledge and abilities as appreciated by peers as they also start to respect those characteristics in others (Schroeder, 2008).

Issroff et al. (1997) identified affective implications in two peer learning settings. Their results demonstrated that, in the situation where a pair of peers shared their materials under a type of collaborative learning structure, the moral aspect was more significant than learning outcomes, and the learners put more effort towards helping each other. Learners in their study also said that their reciprocal relationship was more valuable than finding the correct solutions, their own achievement, and their group achievement in peer learning. To provide affective support in peer learning, Goh (2006) argued that learners must have social skills in order to ensure that their studying is not hindered by negative emotions and suboptimal interpersonal

approaches. Specifically, learners are able to use "humor, relaxation, and self-encouragement to counter frustration and stimulate greater risk-taking" (Ehrman & Oxford, 1990, p. 319).

Personalized feedback. Personalized feedback from peers enables learners to recognize and correct their misunderstandings. Learners in peer learning are responsible for providing one another with feedback as to how they are achieving their goals and finishing their learning activities using peer interaction (Johnson et al., 1995). Personalized feedback from peers that allows learners to match their performance to criteria is particularly significant in attitude and behavior modification in peer learning (Goh, 2006). In other words, providing personalized feedback can aid learners as they ascertain their imperfections by the standard they choose, and realize their potential misinterpretations of the learning goals (Lai & Hwang, 2015). Moreover, Smith (1995) emphasized that personalized feedback from peers improves performance to a greater extent than impersonal feedback. When learners receive diverse perceptions or personalized feedback and questions from peers about their elucidations, they find gaps in knowledge and enthusiastically try to find new information to fill in the gaps (Choi et al., 2005).

Personalized feedback also promotes learners' motivation in peer learning. For instance, Himes and Ravert (2012) examined the effect of situated peer learning on learners' satisfaction, perspectives of learning, and self-assessment in the fundamental skills laboratory. They found that learners respected the personalized feedback related to peer learning and expressed strong self-regulation and motivation in their learning.

For personalized feedback for peer learning, two types of feedback—performance feedback and informative feedback—are proposed. According to Okita and Jamalian (2011), performance feedback represents whether learning behaviors are correct or incorrect while offering no information on how to find the correct solution. Learners could identify how their

learning is adjusting, find out what they know and comprehend, and what they need to know by way of performance feedback (Cator & Adams, 2012). On the other hand, informative feedback offers guidance on how to correct a situation (Okita & Jamalian, 2011). Informative feedback is direct procedural correction that gives learners better ways to solve problems, or detailed feedback that clarifies why certain tasks are required to find correct solutions (Okita & Jamalian, 2011). When peers provide performance and informative feedback, learners' characteristics and current status are considered. Economides (2005) pointed out that personalized feedback is based on the learner's emotional, cognitive, and conative conditions so as to encourage positive feelings about the learning taking place, as well as the learning itself.

Summary. Previous research indicates that peer learning is a useful tactic by which learners can improve their academic performance and interpersonal skills. Some research has found that peer learning enables learners to enhance their motivation, self-efficacy, autonomy, and self-acceptance. Peer learning also offers comfortable, low-anxiety learning settings that feel safe.

Peer tutoring, cooperative learning, and collaborative learning are types of peer learning. Peer tutoring is an academic activity through which participants take on roles as a peer tutor or peer tutee. Cooperative learning is instruction using small groups to foster learners' own ways of thinking. Collaborative learning helps learners build their new knowledge structures in collaboration with more than two learners.

To implement peer learning, trusting relationships, communication skills, and cooperative skills are all needed as prerequisites. Constructive peer interaction, structuring, cognitive challenging, affective support, and personalized feedback are fundamental principles for designing peer learning.

Previous Models of Peer Learning

Peer learning such as peer tutoring, cooperative learning, and collaborative learning are useful in improving learners' academic performance and interpersonal skills, as well as in enhancing their motivation. To design and implement peer learning, it is necessary for learners to become aware of learning that includes detailed peer learning strategies through models of peer learning.

Webb (1989) proposed a model of peer interaction through which the learners in a small group devoted to peer learning may focus on problem-solving activities. This model outlines questions for diverse types of problems and different learning outcomes. The model includes three phases: level of question, level of elaboration, and level of achievement. For learners who have substantial difficulties in problem-solving, high-level elaboration is provided to help them complete problem-solving during group activities and on the exam. In contrast, low-level elaboration is suitable for problem-solving when learners have questions about specific information. If learners do not need to make corrections or ask questions, they may or may not solve the problem appropriately without any elaboration. This model assumes that the level of elaboration corresponds to the level of achievement: When learners receive comprehensive explanations and descriptions from their fellow group members, their learning performance tends to increase, but receiving a high level of elaboration addressing errors and questions does not produce the same results; and, finally, less elaboration (for example, being simply given the answer in response to a mistake or question, or being given no reply in response to a request for information) correlates negatively with achievement.

The model King (1997) put forward is designed for structured peer tutoring, a type of peer learning, in which the peer tutor and peer tutee have reciprocal and clearly delineated roles.

The model uses a structured question sequence for knowledge-building activities and seeks to facilitate peer tutoring behaviors that are identified as effective. Under this model, peer tutors use "review questions, thinking questions, probing questions, hint questions, and self-monitoring questions" (p. 229). Peer tutors ask review questions to begin peer tutoring. They then ask more specific thinking questions, hinting questions, and probing questions during peer learning activities. Peer tutors also ask self-monitoring questions to facilitate learners' metacognitive abilities as necessary. This model also includes instructions for enhancing peer tutors' supportive communication skills related to encouraging, questioning, and answering. Peer tutors provide learners with supportive communication through listening to learners' responses attentively using gesture and eye contact, allowing five seconds for peer tutees to consider their answers to peer tutors' questions, then offering accurate feedback on learners' questions, encouraging learners with positive comments.

Sevenhuysen et al. (2013) developed a peer learning model to assist learners' peer interaction, observation of accomplishments, risk confirmation and modification, and commenting and teaching. They also suggested tools for peer learning activities, such as feedback booklets for peers and educators, a form for peer observation, a verbal comment set, and a matrix of complexity-risk to assist clinical instructors and learners applying the model in a clinical setting. To design appropriate peer learning activities, clinical instructors choose developed tools and activities based on suggested criteria: applicability to a health care environment, possibility to offer meaningful learning opportunities, suitability to form well-matched peer learning teams, and the ease of use for learners.

Existing models of peer learning are valuable for facilitating peer learning using various strategies such as explanation, elaboration, and observation. However, these models focus on

feedback strategies to facilitate peer learning. Although Webb (1989) presented relationships between feedback and achievement, no specific evaluation process was included. Therefore, a model for peer learning including a whole process encompassing diagnosis, feedback strategies, and examining learning outcomes is needed to improve the design of peer learning.

Scaffolding in Peer Learning

Several studies have indicated that scaffolding with peers is an effective instructional element for enhancing learners' academic engagement and outcomes in higher education. In an experimental study by Sabet et al. (2013), research participants were randomly assigned into a control group and an experimental group. Learners in the control group wrote argumentative papers by themselves. In contrast, learners in the experimental group wrote their papers using a procedural approach while a skillful author suggested scaffolding to less skillful learners. The writing ability reflected in the papers pre- and post-test showed that both skillful and less skillful writers in the experimental group enhanced their writing ability. Nguyen (2013) investigated learners' benefits when foreign language (EFL) learners engaged in peer scaffolding during cooperative speech activity. The results of the content analysis of the data proposed six kinds of peer scaffolding activities among the learners: technical assistance, peer response, task sharing, combining opinions and resources, emotional assistance, and assistance in responding to the listeners' inquiries. The results indicated that cooperative peer activities form learning circumstances wherein peers offer reciprocated assistance. Pifarre and Cobos (2010) conducted research into the improvement of learners' metacognitive procedures when enthusiastically involved in peer scaffolding activities called KnowCat. The learners complied with a pedagogical procedure through the scaffolding features of KnowCat to assist and enhance their interactive procedures, particularly peer learning procedures. The study found that the

instructional use of the KnowCat system facilitated improvement of metacognitive learning procedures.

Some studies have indicated that scaffolding has a positive impact on peer tutoring programs, one type of peer learning in higher education. For example, Thompson (2009) conducted research using microanalysis to recognize and illustrate three kinds of peer tutoring tactics: straight teaching, motivational scaffolding, and cognitive scaffolding. Accompanied by oral demonstrations of scaffolding, this research also examined the peer tutor's hand motions—subject signs, which conduct cognitive scaffolding and teaching, and interactive motions, which implement motivational scaffolding. According to the analysis, teaching is the most straightforward of the three tactics and includes telling. In addition, motivational scaffolding suggests offering feedback and assisting learners in concentrating on their work and motivation, while cognitive scaffolding and directive teaching assists and leads the learners in producing precise and helpful answers. Barnard and Campbell (2005) suggested diverse types of peer tutor scaffolding for an academic abilities program in the university, and the data demonstrated how learners in this program could study together to co-construct manuscripts and scaffold each other's work. Diverse types of peer tutor scaffolding include six principles of scaffolding: "contextual support, continuity, intersubjectivity, flow, contingency, and handover" (Barnard & Campbell, 2005). This research found that the successful writing procedure could be accomplished in a comparatively short, intensive EAP (English for Academic Purposes) class, as opposed to a lengthy course.

The role of scaffolding for peer learning. Several empirical studies have highlighted the importance of scaffolding in peer learning (De Guerrero & Villamil, 2000; Lin & Samuel, 2013; Morcom, 2016; Nguyen, 2013; Park & Jang, 2008). Three tasks are recognized to explain

the important role of scaffolding in peer learning in higher education.

Providing support strategies. Scaffolding in a peer learning setting is used to offer learners appropriate learning strategies. Scaffolding is the accumulative endeavor among learners of lesser or greater ability so that they can assist each other not only by giving them materials to facilitate different perceptions but also by stimulating their peers' thoughts (Aryal & Zollman, 2007). Lin and Samuel (2013) observed that modifying learners' inaccuracies and using inquiries are effectively used forms of scaffolding in peer learning environments. They found that these supports offered by the peer in adjusting for mistakes are well-received as a learning procedure for all the learners. Through continued mutual learning, they are able to utilize the grammatical notions and principles they learned to enhance their writing skills in a course. The usage of queries is also stimulating, and advising the less capable learners to practice their reasoning abilities so as to correct their own mistakes and accomplish their goals at an advanced level is effective (Lin & Samuel, 2013). Cotterall (1990) found that four types of processes help novice learners. First, learners are acquainted with general or specific modeling from a knowledgeable person; second, they are given hints to learn new tactics; third, they have abundant chances to argue and perform the new approaches, and finally, they receive prompt advice about their learning activities. These strategies effectively lessen the learning load for class participants as they take part in unfamiliar and thought-provoking activities (Cotterall & Cohen, 2003).

Building a mutual relationship. Scaffolding for peer learning provides learners with an opportunity to build mutual relationships with each other. De Guerrero and Villamil (2000) found that the effectiveness of scaffolding in peer learning is reciprocal. They argued that the learning together in such reciprocal relationships imparted substantial lessons and new knowledge as participants extended support and regulated tasks in a more symmetrical manner.

Similarly, Chowdhury et al. (2014) revealed that through scaffolding, learners are content and eager to discuss their ideas and tasks with each other. In their research, peers willingly cooperate with each other, criticize their ideas and concepts, and share knowledge with each other using materials one may try to find. Morcom (2016) designed the concept of whole-class scaffolding to utilize the shared information of the peer interaction and build reciprocal respect to lessen antisocial actions. The findings indicated that scaffolding promotes peer interaction to form positive rapport and reciprocal respect in peer learning environments.

Facilitating the problem-solving process. Scaffolding helps learners enhance problem-solving skills in peer learning. Scaffolding is presented to explain the learning situation in which a peer helps another learner to achieve a learning task or resolve a problem that he/she is not able to complete alone (Rahmani et al., 2013; Sharma & Hannafin, 2007; Wertsch et al., 1991; Wood et al., 1976). Scaffolding is a valuable learning strategy since peer-interaction assists learners' in enhancing problem-solving abilities as well as sharing information, and perceptions of the problem (Park & Jang, 2008; Scardamalia & Bereiter, 1996). For example, Lee and Choi (2006) identified dissimilarities in the rate of occurrence and tactics of scaffolding by parents, an instructor, and a peer. The findings revealed that 86% of peer-scaffoldings are suitable for effective problem-solving. Xun and Land (2004) studied that the effectiveness of peer learning and question prompts to scaffold college learners' problem-solving procedures. The results showed that question prompts have significantly positive impacts on learners' problem-solving activities, and peer learning promotes metacognitive abilities and cognitive reasoning for problem-solving. Park and Jang (2008) investigated patterns of peer-scaffolding for four stages of problem-solving activities in web-based learning. They argued that scaffolding through providing hints is used more frequently than other peer-scaffolding strategies in problem-solving

activities. Therefore, they highlighted that scaffolding, by providing hints, should be considered an important element in developing problem-solving activities.

Summary. Scaffolding is an effective pedagogical strategy for offering supportive tactics, forming reciprocal relationships, and assisting problem-solving in peer learning settings. Some research indicates that scaffolding for peer learning enhances learning engagement and results in better education outcomes. In peer learning programs in higher education, several studies found that scaffolding sharpens learners' focus on their learning tasks and on finding suitable answers to given questions. Scaffolding is also effective for learners in group activities in a peer learning setting. Despite numerous studies on scaffolding, most research focuses on metacognitive or motivational scaffolding to enhance a learner's metacognitive skills and engagement (e.g., Pifarre & Cobos, 2010; Reingold et al., 2008; Thompson, 2009; Tuckman, 2007). Some researchers also state that scaffolding includes cues, feedback, and explanations (e.g., Blanton et al., 2003; Chotirat & Teosakul, 2017). However, strategic and conceptual scaffolding in higher education has scarcely been researched (e.g., Nguyen, 2013). This study fills a void in the literature by developing and validating a model of peer learning that incorporates scaffolding strategies specifically focused on conceptual and strategic scaffolding. As such, this study will provide structured guidelines for peer learning environments.

Chapter 3: Research Methodology

This chapter describes the research methodology that was applied in this study. The purpose of this study was to develop and validate a model of peer learning incorporating scaffolding strategies to enhance the skills of both peers and learners. This study drew from design and development research, including model development and model revision. This process was arranged in four phases. The first phase comprised of an intensive literature review to identify related theories, the conceptualization of scaffolding, and the operationalization of scaffolding. In the second phase, the model of peer learning was developed based on the results of the literature review. The model was synthesized using the data from the literature review, which included the main elements and characteristics of scaffolding as suitable for peer learning. An online education program was also developed to teach the steps in the model to peer tutors who participate in a peer tutoring program, which is one type of peer learning, for the purposes of model validation. In the third phase, model validation through internal (expert review) and external (external validation interview for field evaluation) validation was implemented. Based on the outcomes of these model validation processes, in the fourth phase, guidelines for revisions were developed to improve the proposed model.

Through this design and development research, the following research questions have been addressed:

1. What elements should be included in a model of peer learning that incorporates scaffolding strategies?
2. How can the model be developed to operationalize all elements of scaffolding?
3. How does the proposed model of peer learning impact the knowledge, skills, and practices addressed through peer learning?

4. How can this model of peer learning be improved?

Table 1 shows the data collection and analysis procedure to answer the research questions.

Table 1

Data collection and analysis procedure

Research question	**Data collection**	**Data analysis**
1. What elements should be included in a model of peer learning that incorporates scaffolding strategies?	▪ 57 articles and 16 books related to scaffolding and peer learning	The synthesis tables were created to find common patterns related to three areas: related theories, the conceptualization of scaffolding, and the operationalization of scaffolding.
2. How can the model be developed to operationalize all elements of scaffolding?	▪ The results of the literature review: related theories, the conceptualization of scaffolding, and the operationalization of scaffolding	A model of peer learning was developed based on the synthesis of the results of literature review
3. How does the proposed model of peer learning impact the knowledge, skills, and practices addressed through peer learning?	▪ Written feedback from three experts ▪ Transcripts of external validation interviews with peer tutors	The following data analysis procedure was utilized. Data preparation → Open-coding → Categories creation → Data summaries → Checklist matrix summary tables creation → Conclusion drawing → Validation
4. How can this model of peer learning be improved?		

Research Design

Rationale for design and development research. Design and development research was selected to develop and validate the model of peer learning incorporating the theory and practice of scaffolding. Design and development research is "the systematic study of design, development and evaluation processes with the aim of establishing an empirical basis for the creating of instructional and non-instructional products and tools, as well as new or enhanced

models that govern their development" (Richey & Klein, 2007, p. 1). The main purpose of design and developmental research is to determine the models and concepts that offer the best guidance for the design, development, and evaluation processes applied in creating programs and products (Richey, 1997). For design and development research, research questions derive from new technologies, authentic educational practice and institutions, or theoretical queries found within previous research (Ross et al., 2008; Stoner & Cennamo, 2018). It is a practical type of research that suggests a method to assess theories whose validity has merely been taken for granted and to validate implementation that has been prolonged basically by means of unquestioned precedent (Richey, Klein, & Nelson, 2004). In addition, design and developmental researchers have the task of either creating context-specific information that is useful for problem-solving, or producing conclusions that are generalizable (Richey et al., 2004). Well-considered design and developmental research can generate information on the many needs for research in compliance with the requests of practitioners, and, moreover, is prescriptive (Richey, 1997).

Design and development research is a suitable type of research for this study because the model of peer learning was developed to guide the design, development, and evaluation procedures for peer learning programs. Although some previous researchers have developed models of peer learning, there is no existing model that includes the whole process, including diagnosis, feedback, and evaluation procedures. The model of peer learning developed in this research will be useful for peers who wish to design peer learning activities by incorporating scaffolding strategies and will provide systematical guidance from diagnosis to evaluation. This research was a practical type of research to test and validate related theories as well as scaffolding strategies in the real peer learning environment. This model of peer learning has been

developed to suggest scaffolding strategies be applicable in all peer learning environments.

Model research. Among two types of design and development research—product and tool research and model research—model research was adopted in the present study. Model research undertakes to gauge the validity or effect of a previously or recently created development model, technique, or procedure (Richey & Klein, 2007). The primary objective of this type of research is "the production of new knowledge in the form of a new (or an enhanced) design or development model" (Richey et al., 2011, p. 11). Model research typically focuses on providing guidelines instead of the actual invention of an educational program or product (Richey, 1997). Such studies are inclined to concentrate on the more general usage of development procedures, proposing suggestions for any design, development, or evaluation task (Richey & Klein, 2007). In other words, model research addresses forming data-based principles for application in various design and development tasks (Richey, 1997). The fruit of model research is new design and development models or processes, as well as settings which facilitate the application of new models or processes (Richey et al., 2004). Because the model of peer learning was developed and validated to provide guidance for design, development, and evaluation for any peer learning program, model research was an appropriate type of design and development research to use. Indeed, the present model of peer learning focused on instructions for designing a peer learning environment rather than creating a particular peer learning product or program.

According to Richey and Klein (2007), there are three types of model research: model development research, model validation research, and model use research. In this study, model development research and model validation research were used. Model development research addresses the development of improved or new models to provide guidance for the instructional

design procedure (Richey & Klein, 2007). “Case study, delphi, in-depth interview, literature review, survey, and think-aloud methods” can be employed as research methods for model development research (Richey & Klein, 2007, p. 40). Model validation research conducts a procedure to assess the validity and effectiveness of a model (Richey & Klein, 2014). Suitable research methods for model validation are “experimental, expert review, and in-depth interview” (Richey & Klein, 2007, p. 40). To develop and validate the proposed peer learning model, these two types of model research are essential. Through model development research and model validation research, an effective model of peer learning can be provided for peers and learners. In particular, this study was comprised of four phases for model development and validation: (1) literature review to identify model components, (2) model development, (3) expert review and external validation interviews for model validation, and (4) revision. Figure 2 represents the four phases of this research.

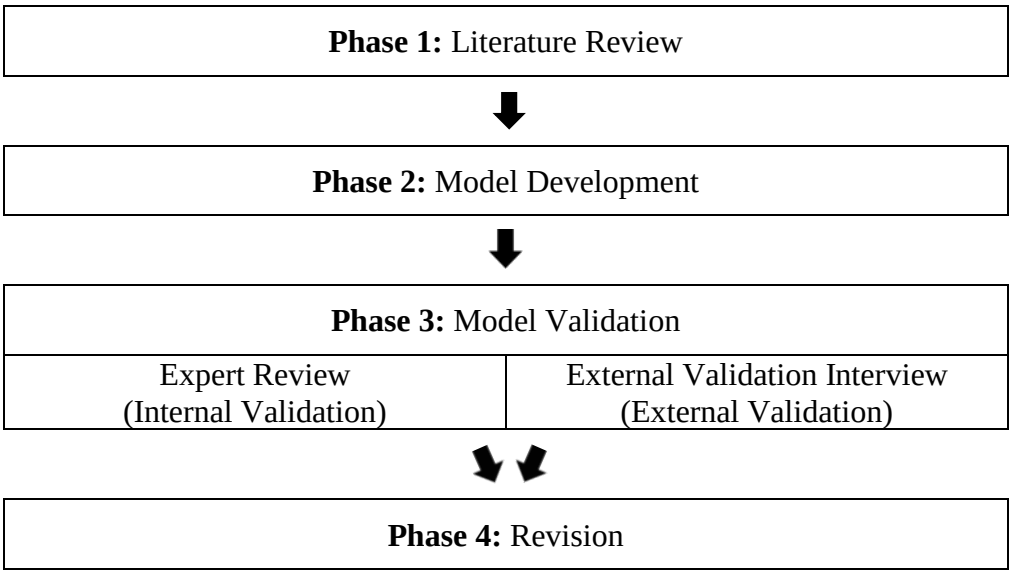

Figure 2. Model research design (Richey & Klein, 2007).

Phase 1: Literature Review

In phase one, an intensive literature review was implemented in order to tailor the model to the application of scaffolding strategies in a peer learning environment. According to Richey

and Klein (2007), literature review is a recommended method for model development. Literature review is "the selection of available documents on the topic, which contain information, ideas, data and evidence written from a particular standpoint to fulfil certain aims or express certain views on the nature of the topic and how it is to be investigated, and the effective evaluation of these documents in relation to the research being proposed." (Hart, 1998, p. 13). In addition, a literature review is an impartial, rigorous exploration of the research related to a given subject from a critical point of view (Cronin et al., 2008; Hart, 1998).

For literature reviews, Cronin et al. (2008)'s five steps were adopted: (1) choosing a topic for review, (2) exploring the literature, (3) analyzing and synthesizing the literature, (4) writing the results of the review, and (5) writing references. Review topics consisted of related theories, the characteristics of scaffolding, factors related to scaffolding, the concept of scaffolding, and scaffolding for peer learning. These topics were searched through Google Scholar, ERIC, and JSTOR. The search terms were scaffolding and theory, the concept of scaffolding, scaffolding and peer learning, and the characteristics of scaffolding.

When the literature was searched by topic, peer-reviewed articles and books were considered. Non-peer reviewed articles, magazines, and non-official articles were excluded. After searching for articles and books based on the standards exclusive to the literature search, a total of 57 articles and 16 books were selected to develop the model. Of these total articles and books, 24 articles and 10 books focused on related theories, 15 articles and four books addressed the concept of scaffolding, and 25 articles and four books addressed the operationalization of scaffolding. When articles or books discussed more than two categories, these books and articles were incorporated into both relevant categories. For example, if an article included both related theories and the conceptualization of scaffolding, it was adopted for inclusion in both categories.

Based on the search results, related theories, the conceptualization of scaffolding, the operationalization of scaffolding were analyzed and synthesized for the development of the proposed model of peer learning. The full results of the literature review are presented in chapter four. References are listed at the end of this study.

Phase 2: Model Development

Following the results of the literature review, in phase two, a model of peer learning was developed so as to incorporate scaffolding strategies. The results of the literature review were synthesized to serve as a foundation for model development and provide evidence derived from previous research. This process also confirmed that the model was developed in accordance with the theoretical roots of scaffolding and its main principles.

In order to identify the essential elements of incorporating scaffolding strategies for peer learning, the literature was reviewed and analyzed to identify patterns related to three areas of scaffolding: related theories, the conceptualization of scaffolding, and the operationalization of scaffolding. To find patterns related to these areas, after searching for previous research related to scaffolding, all articles and books were reviewed, summarized, and categorized into three areas. The synthesis table was created using Microsoft Word to record the author(s), type of research (book or article), research year, titles, and identified patterns related to the established categories. Based on the first synthesis table, the following three synthesis tables were created to reorganize and group all literature into three areas (e.g. a table for related theories, a table for the conceptualization of scaffolding, and a table for the operationalization of scaffolding). Then, all patterns in each synthesis table were compared to find common patterns so as to determine components essential for the development of the model. The main findings of each category are listed in Figure 3.

57 articles and 16 books were analyzed and summarized.

Related theories	**The conceptualization of scaffolding**	**The operationalization of scaffolding**
1. Sociocultural theory 2. The Zone of Proximal Development (ZPD)	1. Diagnosis and sharing goals 2. Providing scaffolding strategies 3. Ongoing diagnosis and calibrated support 4. Fading	1. Level of scaffolding - High-level scaffolding - Low-level scaffolding 2. Type of scaffolding - Conceptual scaffolding - Strategic scaffolding 3. Scaffolding methods - Direct instruction - Indirect instruction

Category	**The model of peer learning**			
	Step 1	**Step 2**	**Step 3**	**Step 4**
Related theories	Sociocultural theory			
	The actual development level (ZPD)			The potential development level (ZPD)
The conceptualization of scaffolding	Diagnosis and Sharing goals	Providing scaffolding strategies	Ongoing diagnosis and calibrated support	Fading
The operationalization of scaffolding		1. The level of scaffolding 2. The type of scaffolding 3. Scaffolding methods		

Figure 3. Model development process.

To develop the model of peer learning, four steps were created to provide structured guidance for designing and implementing peer learning activities including scaffolding strategies: (1) knowing each other, (2) learning together, (3) checking what you learned, and (4) finalizing peer learning. These steps were established through the synthesis of the results of the literature review (see Figure 3). The results of the literature review in the three categories

included the process of scaffolding as well as specific teaching and learning strategies for peer learning. For example, related theories, such as sociocultural theory and ZPD, represented theoretical foundations, the main principles for implementing the entirety of scaffolding strategies. The findings related to the conceptualization of scaffolding, such as diagnosis, sharing goals, and so on, indicated specific processes of scaffolding for peer learning. Both categories were adapted to implement peer learning activities from analysis to finalizing peer learning activities. On the other hand, the components of the operationalization of scaffolding focused on teaching and learning strategies between learners and peers. Therefore, these components were adopted to provide appropriate strategies during peer learning activities in step two. Specific guidelines for each step are described in Chapter four.

In order to validate the model in a field evaluation, the model of peer learning was incorporated into an online education program to provide peers with guidelines to design peer learning curricula. Online education is a suitable delivery method for teaching a model of peer learning incorporating scaffolding strategies. In online education, all the education sessions can be subdivided to provide between-session exercises, and learners from diverse locations can take the training merely by accessing it on their devices (Puspitasari et al., 2013). Online learning also gives learners the chance to study during their preferred learning periods, to concentrate on particular content, and to learn at their own speed (Kaslon et al., 2005). Therefore, in this study, the online education program was developed to provide with learners with a model of peer learning that allows for a range of scaffolding strategies.

Phase 3: Model Validation

The model of peer learning was validated through internal and external validation processes in phase three. Model validation is “a carefully planned process of collecting and

analyzing empirical data to demonstrate the effectiveness of a model's use in the workplace or to provide support for the various components of the model itself" (Richey, 2005, p. 736). Model validation consists of internal and external validation (Richey, 2005; Tracey & Richey, 2007). Internal validation is to verify the elements and procedures of a model (Tracey & Richey, 2007). Internal validation offers data to confirm each element of the model, as well as the correlation between the elements and the procedures included (Richey, 2005). "Expert review, usability documentation, component investigation" are typical methods for internal validation (Richey, 2005, p. 739). In contrast, external validation is a confirmation of the influence of the inventions stemming from the model usage (Richey, 2005; Tracey & Richey, 2007). To determine whether a model is efficacious, researchers employ external model validation. This process evaluates both instructional products as well as how they affect the learners, consumers, and institutions that use them (Richey, 2005). External validation is accomplished through methods such as field evaluation and controlled testing (Richey, 2005).

Expert review (internal validation). This research fulfilled the internal validation process using expert review to assess the components and procedures of the model of peer learning for future use. Experts are those who do not need to consider all possibilities or contemplate how to complete their work; they have deep comprehension of how to do and what to do (Dreyfus & Dreyfus, 2005). In model research, expert review is a process by which specialists examine a developed model with regard to its entire structure, its components, as well as future use (Tracey & Richey, 2007). Expert review is a recurring process of model review and critique with respect to predetermined standards (Richey, 2005). Once model review has been completed, researchers revise their models according to the feedback they have received (Richey, 2005). Use of expert review in this research was appropriate to confirm the effectiveness of the

model of peer learning as well as to provide data for revising the model of peer learning to enhance its validity.

Participants. Three experts were recruited to examine whether or not all the components and procedures of the model of peer learning are appropriate for peers to use to design effective peer learning environments. The experts were recruited from three related areas for triangulation: scaffolding, peer learning, and instructional design. Selection criteria for the ideal expert reviewers included: (1) a Ph.D. degree in education, (2) expertise related to scaffolding or peer learning or instructional design, and (3) work experience in higher education. Three invitation emails were sent to the selected experts to request their participation in this research. They agreed to participate in expert review.

Three experts regarding scaffolding, peer learning, and instructional design and technology were recruited for expert reviews. The scaffolding expert was the director of a Center for Excellence in Teaching and Learning at a public university with a Ph.D. in educational psychology. The second expert, in peer learning, was a director of a Faculty Professional Development Center at a university who holds a Ph.D. in instructional design and technology. The instructional design and technology expert was a visiting assistant professor at a public university, also with a Ph.D. degree in instructional design and technology. Table 2 shows the demographic information of these experts.

Table 2

The demographic information of the experts

Expert	**Gender**	**Degree**	**Major**	**Field of Expertise**	**Affiliations**
1	Female	Ph.D.	Curriculum and Instruction (Educational Psychology focus)	▪ Scaffolding ▪ Peer review and learning ▪ Cognitive processes	Director of a Center for Excellence in Teaching and Learning at a university

2	Female	Ph.D.	Instructional Design and Technology	▪ Peer learning ▪ Instructional design ▪ In-person and online instructional development, implementation, and evaluation	Director of a Faculty Professional Development Center at a university
3	Female	Ph.D.	Curriculum and Instruction (Instructional Design and Technology focus)	▪ Scaffolding in online courses ▪ Peer learning	Visiting Assistant Professor at a university

Instrument. The results of the literature review, the developed model of peer learning, and the online education program were provided to the experts. They were asked to answer questions regarding the model in order to verify the related theories and components of the model. The primary data-collection instrument for expert review in this research was open-ended questions. Open-ended questions have no limitations on answer length, instead providing research participants the opportunity to fully describe their experiences, situations, or emotions (Mack et al., 2005). Because expert review usually involves diverse specialists commenting on the model under examination (Saroyan & Geis, 1988), open-ended questions were employed to discover experts' experiences and opinions about a given model of peer learning. For this expert review research, each expert received five questions (see Appendix D). These questions asked about (1) how the model of peer learning enhances peers' teaching skills and learners' learning skills, (2) the strengths and weaknesses of the model of peer learning, (3) suggestions for improving the model of peer learning, (4) the influence of the model on peer learning, scaffolding, or instructional design. Experts also answered demographic questions regarding gender, expertise, and the highest levels of education. Based on their expertise, professional experience, and research experience, experts also wrote their additional general comments regarding the model of peer learning.

Data collection procedure. To begin expert review, invitation emails were sent to three experts. When they agreed to be expert reviewers for this research, an IRB consent form, instructions for expert review, the results of the literature review, the developed model of peer learning, the online education program, and the review questions were sent via email. Recruited experts signed an online IRB consent form before their review (see Appendix B). For their review, although the experts were able to control their review schedule, when they received all the review materials, they were expected to send written feedback, including the results of their review, via email within one week. To confirm the review schedule and answer questions regarding the review procedure, each expert received a follow-up email after two days. All experts submitted their reviews within one or two weeks after receiving the review questions and materials.

External validation interview (external validation). The online education program was developed for external validation of the model. The purpose of the online education program is to learn and practice the four steps of the model in peer learning environment. In particular, this online education program was developed to teach the steps to peer tutors who participated in peer tutoring program, a type of peer learning, for external validation. Peer tutors took online modules to learn the model and designed their peer learning activities using the model. After finalizing their own peer learning experiences, they were asked to explain the effects of the model or suggestions for its improvement.

All the content presumed that learners in the online education program will participate in peer tutoring, which is one type of peer learning, as a peer and provide appropriate guidance for learners to solve their problems. All of the elements of the model of peer learning were guided specifically using video explanations and demonstrations, a graphic flow chart, and electronic

materials, rather than providing simple descriptions. Figure 4 shows the main page of the online education program.

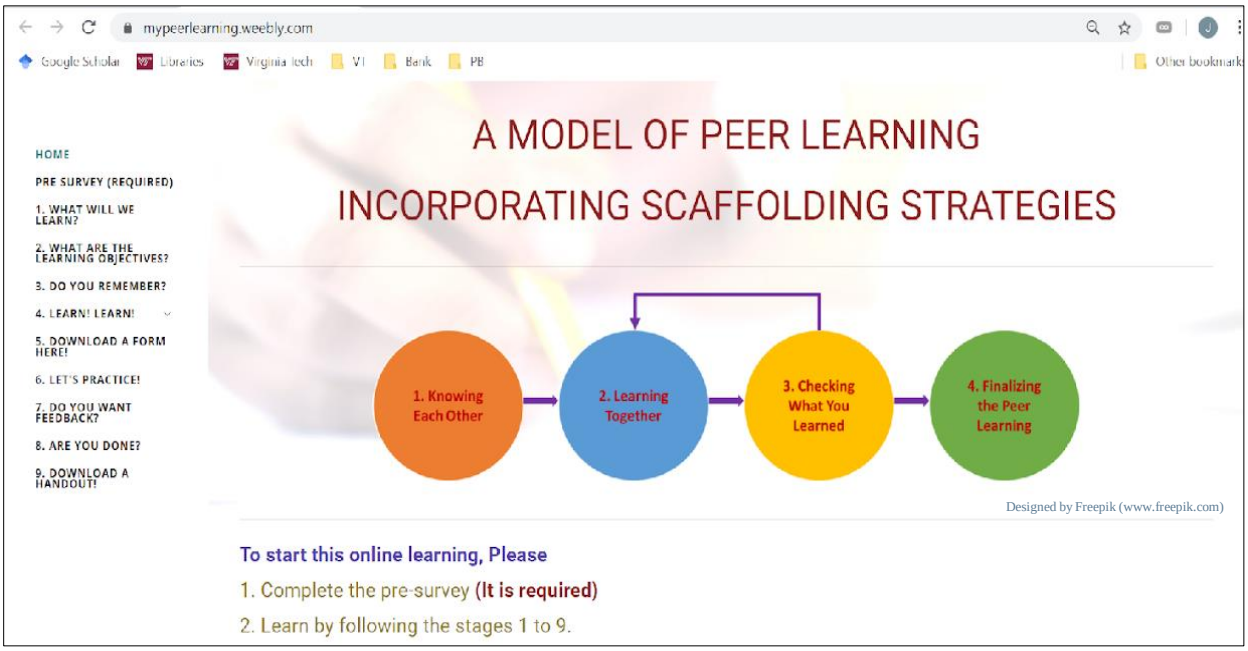

Figure 4. The online education program for the model of peer learning.

The external validation interview was the method used for the field evaluation to investigate the effectiveness of the use of the model of peer learning and the influence of the model on peer tutors who provide peer tutoring activities, one of three types of peer learning. Qualitative interviewing is “a research technique that involves conducting intensive individual interviews with a small number of respondents to explore their perspectives on a particular idea, program, or situation” (Boyce & Neale, 2006, p. 3). In external validation interviews, interviewees are encouraged to speak extensively about the research topic under examination without the researcher's use of pre-specified, intensive, short-answer inquiries (Cook, 2008). Through external validation interviews, peer tutors explained their experiences with the model in the real peer tutoring setting. The aims of the external validation interview in this study were (1) to describe the views of peer tutors related to their experience of utilizing the model in their peer tutoring setting, (2) to figure out difficulties impeding learners’ peer learning activities and the

advantages of the model of peer learning, and (3) to identify how the model of peer learning can be improved for future use.

Participants. The interviewees were peer tutors in the peer tutoring program at the Virginia Polytechnic Institute and State University. In the peer tutoring program, peer tutors were full-time undergraduate students who had a high cumulative GPA (above 3.2), and who had already taken the courses they tutored. They provided individual peer learning activities for various subjects, such as mathematics, biology, chemistry, physics, and so on, based on their major. Before beginning peer learning activities with peer tutees, all peer tutors had to take an online education program including the model of peer learning as a part of the requirements of their job.

Among the peer tutors working in the peer tutoring program during the 2019 fall semester, eight experienced peer tutors and five newly hired peer tutors were selected for this study. To select interviewees, purposive sampling was utilized. Purposive sampling aims to select participants who are rich in both information and experience and who also share some common ground (Morgan, 1988; Patton, 1990). In purposive sampling, participants are involved based upon particular standards recognized by the researchers as most appropriate to the research questions (Brotherson, 1994). In this study, three criteria were adopted for recruiting research participants: (1) participants were undergraduates or graduate students in a higher education setting, (2) participants were participating in peer tutoring, one of three types of peer learning (e.g. peer tutoring, collaborative learning, or cooperative learning), (3) participants' roles were as peers with advanced skills who could assist other learners, (4) all participants were in the same school, degree, program, or class. Based on these criteria, peer tutors were recruited for this research because they were undergraduate students and participated in peer tutoring activities, in

a peer tutoring program in higher education to assist learners based on their advanced skills and experience.

For external validation interviews, thirteen peer tutors were recruited from the peer tutoring program at the public U.S. university. Among these thirteen peer tutors, eight were hired before 2019 and five were hired in 2019. Nine of the peer tutors were females and four were males. Peer tutors were seniors (N=8) or juniors (N=5). Most were aged above twenty (N=12), while one was nineteen years old. Most were majoring in fields in the College of Engineering and the College of Science, such as mechanical engineering, electrical engineering, aerospace engineering, animal science, biochemistry, and physics. Two peer tutors were studying business and one was majoring in German. Many taught science subjects, such as chemistry, physics, genetics, and microbiology, in the peer tutoring program. Three were teaching mathematics courses and another three, statistics. Two peer tutors provided tutoring regarding business and accounting. Only one peer tutor taught a foreign language (German). Figure 5 below presents the demographic information of the peer tutors as discussed.

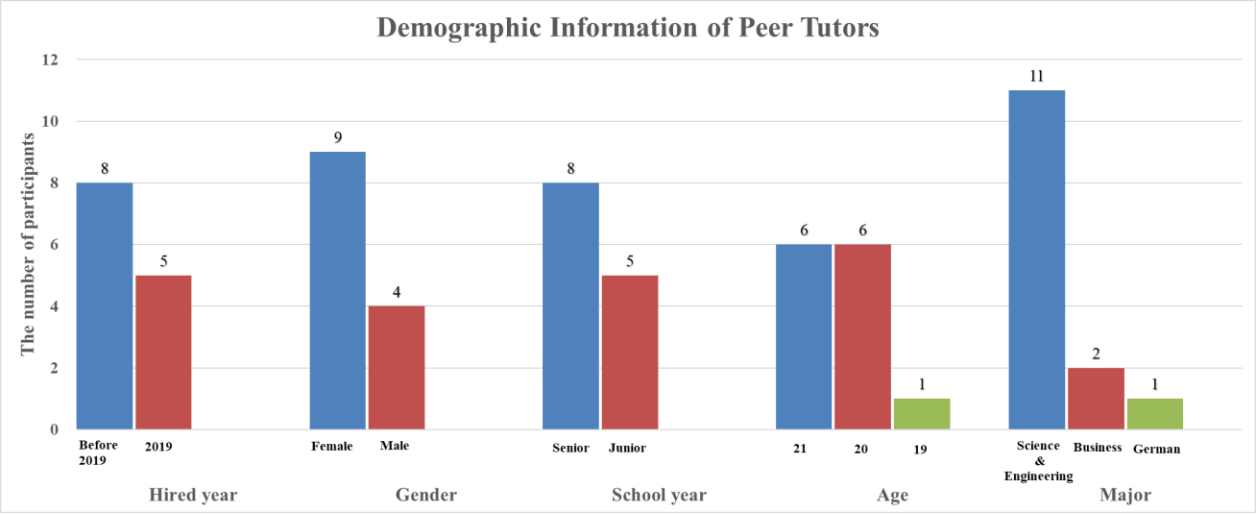

Figure 5. The demographic information of the peer tutors.

Instrument. For external validation interviews with peer tutors, an interview protocol was created. As in the expert review, open-ended questions were utilized since open-ended

questions enable the interviewees to profoundly explain their emotions and opinions on a specific topic (Guion, 2009). Through open-ended questions, peer tutors explained their perceptions and experiences regarding the model of peer learning as operationalized in the online education program for peer tutors.

The interview protocol was developed based on the research questions and the aims of the external validation interview (see Appendix E). Twenty questions were designed to ask about demographic information, prior experience regarding peer tutoring strategies, perception of the model of peer learning, and optional questions about their perceptions of the online education program about peer tutoring. According to Patton's (1990) question options, most interview questions were opinion and experience questions so that the interviewees could explain their peer tutoring experiences and their opinions regarding the model of peer learning as they learned in the online education program for peer tutors. Some demographic questions were also introduced to identify the characteristics of the peer tutors (Patton, 1990).

Data collection procedure. Peer tutors signed an IRB consent form (see Appendix C) to agree to participate in an external validation interview. Before the external validation interview, eight experienced peer tutors and five newly hired peer tutors completed the online education program to learn how to plan their peer tutoring using the model of peer learning. After they completed the online education program, they utilized the model of peer learning in the peer tutoring program during the fall 2019 semester. Peer tutors provided each peer tutee with individual peer tutoring for an hour-long period using the model of peer learning.

As they were practicing the model of peer learning in their peer tutoring activities during the 2019 fall semester, the external validation interview was conducted with each peer tutor using the interview protocol, as revised after review by committee members. All the peer tutors

in this study completed their interviews in September and October 2019 through face-to-face meetings. All of the interviews were recorded using a voice recorder. The length of each interview was approximately 40 - 50 minutes.

Data analysis for expert reviews and external validation interviews. The results of expert reviews and external validation interviews were analyzed to search for generalized findings related to the research questions through classification and interpretation. Qualitative data analysis examines the relationship between raw data and its interpretation and organization to produce novel discoveries (Caudle, 2004; Patton, 2002). The purpose of qualitative data analysis is to find significant interpretations, themes, or patterns in what the researcher has perceived as responses to the research questions (Merriam & Tisdell, 2016; Ruona, 2005). Qualitative data analysis produces findings about material reality through the examination and explication of linguistic statements, allowing researchers to gain new insights into the structures, both latent and manifest, that characterize how meaning is made in this world (Flick, 2013). Data analysis consists of integrating, narrowing, and inferring from what research participants have stated and what the researcher has heard or read for meaning making (Merriam & Tisdell, 2016).

For data analysis in this research, an inductive analysis was adopted to analyze the results of the expert reviews and external validation interviews. An inductive approach refers to "understanding the nature of the intervention emerging from direct interviews with participants" (Patton, 2002, p. 56). Inductive analyses do not validate or invalidate assumptions before beginning the research through evidence or data; rather, the perceptions are constructed as the data are gathered (Bogdan & Biklen, 2003). In other words, the significant dimensions of the analysis are revealed from patterns found in a study, as the analysis is not conducted with assumptions of what the significant dimensions will be (Patton, 2002). Because both experts' and

peer tutors' perceptions were described to explain how the model of peer learning impacts real peer learning activities, there was no hypothesis presented in this study. Therefore, inductive analysis was suitable for finding patterns in experts' and peer tutors' perceptions of the impact of the model of peer learning.

The data analysis procedures recommended by Miles and Huberman (1994) and Creswell (2014) were applied to analyze data from the expert review and the external validation interview in this research. According to Miles and Huberman (1994), the data analysis procedure consists of three-steps: "(1) data reduction, (2) data display, and (3) conclusion drawing and verification" (p. 10). Creswell (2014) proposed a similar but specific data analysis procedure. He suggested the following six steps and a validation process: "(1) organizing and preparing the data for analysis, (2) reading and looking at all the data, (3) starting coding all of the data, (4) using the coding process to generate a description of the setting or people as well as categories or themes for analysis, (5) advancing how the description and themes will be represented in the qualitative narrative, (6) making an interpretation in qualitative research of the findings or results, and validating the accuracy of the information" (p. 197). Table 3 represents the data analysis process derived from Creswell (2014), Miles and Huberman (1994), and the computer software utilized.

Table 3

Data analysis procedure

Data analysis procedure	**Mile and Huberman' (1994) steps**	**Creswell' (2014) steps**	**Software**
Data preparation: External validation interviews were transcribed and written feedback from experts was prepared.	1. Data reduction	1. Organizing and preparing the data	Word processor

Open-coding: Individual statements were coded to find interesting parts related to the research questions		2. Reading and looking at all data	Word processor
Categories creation: Categories and sub-categories were created based on the results of open coding. The codebook was created.		3. Starting coding all of the data	NVivo
Data summaries: Patterns and themes in each case were decided and summarized.	2. Data display	4. Generalizing a description	NVivo Word processor
Checklist matrix summary tables creation: Tables were created to compare the five cases.		5. Advancing how the description and theme will be presented	Word processor
Conclusion drawing: Final results were determined and written.	3. Conclusion drawing and verification	6. Making interpretation	Word processor
Validation: Credibility, transferability, dependability, and confirmability were verified.		Validating the accuracy of information	Word processor

Data reduction. Data reduction was conducted with data preparation, open-coding, and categories creation as the initial steps. Data reduction refers to the procedure of choosing, concentrating, shortening, conceptualizing, and altering the data (Miles & Huberman, 1994). Reducing the data is the initial step that lets the researchers present their data material, so they can then examine and understand it (Wolcott, 1994).

Data preparation was implemented for convenience and personal information protection. According to Ruona (2005), before data analysis begins, the data must be arranged in such a way that researchers can easily use it. She argues that researchers need to utilize pseudonyms and delete names and other private information to protect research participants' identifying

information. Therefore, in this study, recorded interviews were transcribed using a word processor. The written feedback from experts was also prepared with a word processor. All personal information regarding interview participants and experts was removed. Pseudonyms were used during data analysis and when drawing conclusions.

After preparing the data, the researcher in this study read interview transcripts and written feedback for open-coding. During such a review, the researchers should make comments on what they find in their data, and establish tentative concepts regarding constructing categories and identifying their relationship (Maxwell, 2005). Because the researchers are identifying any items of interest during their reading of the data materials, this procedure of coding is regarded as open coding (Merriam & Tisdell, 2016). The researchers must read written data materials with an open mind, and let the text guide them to points of significance and interest (Seidman, 1998). For open coding in this research, the researcher read interview transcripts and experts' written feedback and marked interesting passages or words related to the research questions. The researcher also wrote comments in the margins of the transcripts and written feedback to generate ideas about creating categories. Figure 6 shows a screen shot presenting the open coding process.

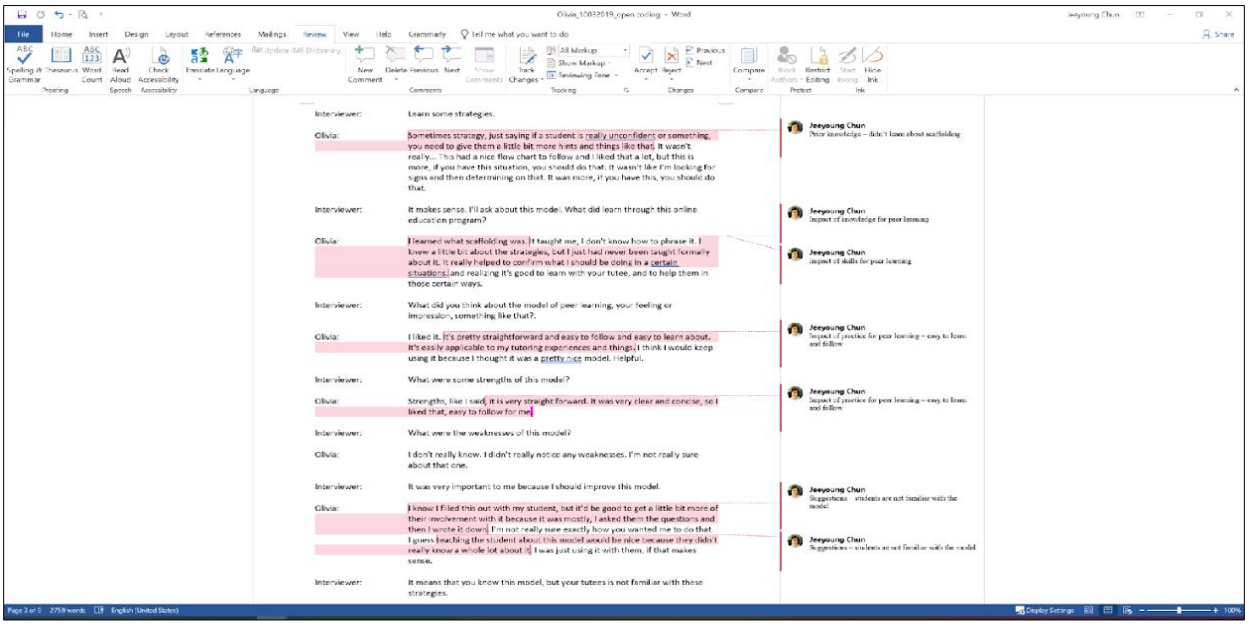

Figure 6. Screen shot of open coding in Microsoft word.

Categories and subcategories were created based on the results of open coding. Categories are conceptual components that encompass pieces of the data or numerous individual cases the researcher formerly recognized (Merriam & Tisdell, 2016). Category analysis initiates the recognition of parts or pieces of data based on the researcher's prior thoughts regarding what is significant (Maxwell, 2005). After completing open coding of the entire transcripts and written feedback, the researcher reviews the comments in the margins of the documents and attempts to generate categories to form groups using those comments, through mixing and matching or merging (LeCompte, 2000; Merriam & Tisdell, 2016). Because categories consist of responses to the research questions (Merriam, 1998), they were created based on the research questions. Subcategories included answers to each category. To organize categories and subcategories, the researcher reviewed all comments, marked words or sentences in each transcript and piece of written feedback and found similarities among them. When the researcher found similarities, five cases were created: (1) Expert 1, (2) Expert 2, (3) Expert 3, (4) newly hired peer tutors, and (5) experienced peer tutors. Each case consisted of common categories related to the research questions, and different or similar subcategories to answer the research questions. NVivo was utilized to create categories and subcategories. Through NVivo, five cases including common categories were created in node and then subcategories and related texts were linked to the five cases' categories. Figure 7 presents a screen shot showing category creation using NVivo.

After generating categories and subcategories, a codebook was created using NVivo (see Appendix H). To code the data, researchers employ a series of prearranged codes presented in a table; a codebook, in other words. (Creswell, 2014). The aim of creating a codebook is to present definitions of codes and to maximize consistency amongst them (Creswell, 2014). A codebook is

composed of code names, their definitions, and examples (DeCuir-Gunby, Marshall, & McCulloch, 2011). A codebook in this research was created based on categories and subcategories generated by NVivo. The codebook included category names, subcategory names, and full description and examples of the five cases. This codebook was utilized to summarize each case and find similarities and differences among the five.

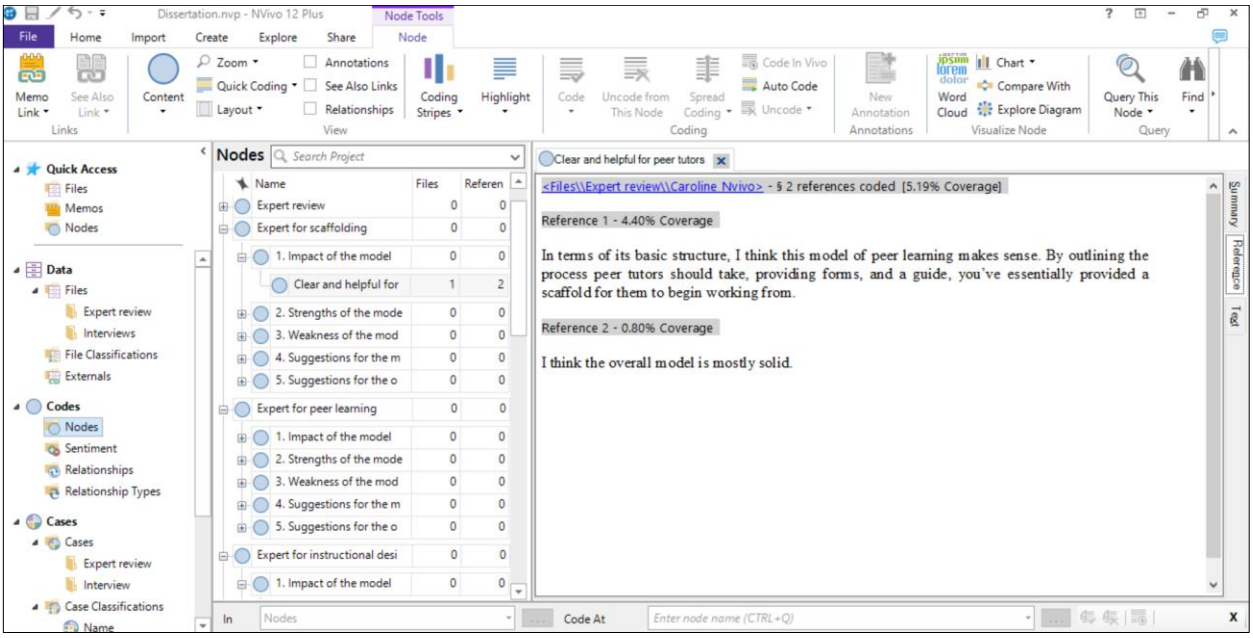

Figure 7. Screen shot of categories creation in NVivo.

Data display. Analyzed data was displayed through narrative passages and checklist matrix summary tables for further analysis and conclusion drawing. Data display refers to arranged, summarized information used to draw conclusions (Miles & Huberman, 1994). One benefit of this method is that it lays out the approaches and interconnections within one data set straightforwardly, which makes the information subject to critical examination or validation. It can also prompt recognition of previously unclear relationships or facilitate novel explanations of the data set (Caudle, 2004). Through examining the data display, themes or patterns can be exposed, which can necessitate additional analytic procedures (De Wet & Erasmus, 2005; Miles & Huberman, 1994). Data display has been demonstrated as worthwhile for constructing data

analysis processes, clarifying results, and verifying relations among data sets (De Wet & Erasmus, 2005).

Narrative descriptions were presented to explain the patterns or themes of the five cases in this study. Themes were identified for each personal case, as well as between them, and this allowed the researcher to formulate a general description (Creswell, 2014). Narrative descriptions are the most general way to show the results of the data analysis (Creswell, 2014). In this research, themes or patterns were determined by summarizing the subcategories of the five cases, because these subcategories included common answers to the research questions. Direct quotes from the research participants are accompanied by narrative descriptions to prove accuracy. Narrative descriptions of the five cases are presented in chapter five.

Checklist matrix summary tables were used to compare the five cases and generalize common findings in order to draw conclusions regarding the data. A matrix presents a fixed number of terms in a table of rows and columns (Averill, 2002; Miles & Agnes, 2000). A matrix is organized with regards to the research questions, as well as the themes and categories of the data; in this way, they can facilitate the presentation and deeper development of the results of categorizing analysis (Maxwell, 2005). In particular, a checklist matrix summary table illustrates categories or themes and indicates the frequency with which categories or themes appear to reveal the importance of each category or theme (Williamson & Long, 2005). It also ascertains patterns of disagreement or agreement among research participants and proves the emerging results (Williamson & Long, 2005). In this research, four checklist matrix summary tables were created to compare the five cases and find common or important answers to the research questions. The two checklist matrix summary tables include three cases related to expert reviews or two cases related to external validation interviews in columns and all categories related to the

impacts of the model of peer learning on the knowledge, skills, and practices of peer learning in rows. The other two checklist matrix summary tables consist of three cases related to expert reviews or two cases related to external validation interviews arranged in columns and all related categories regarding suggestions for improving the model of peer learning in rows. These tables elaborated on emerging significant findings related to the research questions and drew final conclusions. These four tables are presented in chapter five.

Conclusion drawing and verification. Final conclusions were determined and validated to answer the research questions and provide implications for this study. Conclusion drawing/verification consists of describing meaning from data and developing a logical pattern of reference (Darke, Shanks, & Broadbent, 1998). Conclusions include a study's primary intentions, exclude alternate descriptions, and then present the essential parts of what the data expose (Caudle, 2004).

Significant and important findings related to the research questions were determined through reviewing matrices. The goal of data analysis is to answer the research questions (Merriam & Tisdell, 2016). Therefore, conclusions contain themes or findings to answer the research questions. During conclusion drawing/verification, researchers analyze the matrices they created to discern the various meanings arising from the data, noticing similarities and differences through interpretation (Austin, Fisher Liu, & Jin, 2012). To draw conclusions in this research, the four checklist matrix summary tables were reviewed to identify and interpret significant findings relevant to the research questions.

To assess whether the conclusion was accurate and credible, validity and reliability were verified. Qualitative validity aims to prove the accuracy of the conclusion through using certain processes, whereas qualitative reliability entails that the tactics employed by the researcher are

consistently in evidence across multiple studies (Creswell, 2014; Gibbs, 2007). To verify validity and reliability in such qualitative research, "credibility, transferability, dependability, and confirmability" are broadly utilized (Lincoln & Guba, 1985; Merriam & Tisdell, 2016; Seidman, 1998, p. 23).

Credibility indicates the accuracy of the research participants' viewpoints of the data and their descriptions and interpretations of it (Cope, 2014; Polit & Beck, 2012). It inquires how the results of data analysis match actuality (Merriam & Tisdell, 2016). Questions of credibility are answered through "prolonged engagement in the field, triangulation, negative case analysis, checking interpretations against raw data, peer debriefing, and member checking" (Lincoln & Guba, 1985; Zhang & Wildemuth, 2009, p. 6). In this study, credibility was verified by triangulation using two types of data and peer review. For internal validation, three experts from related areas, such as scaffolding, peer learning, and instructional design, submitted their written feedback about the model of peer learning. Newly hired peer tutors and experienced peer tutors presented their experiences regarding the model of peer learning for external validation. Data from the three experts, newly hired peer tutors, and experienced peer tutors was compared and cross-checked to increase the credibility of the findings of model validation. The findings were also reviewed by my academic advisor, an experienced peer. Based on her comments, the analysis procedures and findings were revised.

Transferability indicates results can be applicable in other situations or to other participants (Cope, 2014; Houghton, Casey, Shaw, & Murphy, 2013). Transferability is fulfilled by thick description, which includes all the research procedures, from the data collection process and settings to the creation of the results and purposeful sampling (Anney, 2014; Merriam & Tisdell, 2016). In this study, all data collection procedures and specific contexts for

implementing the model of peer learning were described to enhance transferability. In addition, using purposive sampling, peer tutors were selected because they participated in peer tutoring, one type of peer learning, in higher education to assist other learners' problem-solving activities with their more advanced skills. Three experts were also recruited based on the three fields related to the proposed model of peer learning.

Dependability indicates the consistency of the data over analogous circumstances (Anney, 2014). The dependability of the research is addressed by triangulation and a step-by-step audit trail that provides sufficient details so that the study may be repeated by other researchers (Mabuza et al., 2014). In this research, data collection and analysis were conducted rigorously through step-by-step processes. Specific data collection and analysis procedures were described so that any future researcher could use the same procedures. For triangulation, research participants who had different perspectives participated in model validation.

Confirmability indicates the researcher's objectivity in terms of data collection and publishing (Mabuza et al., 2014). Confirmability is established through explaining how the findings and interpretations were determined, and illustrating through examples to show that the results derive from the data directly (Cope, 2014). Confirmability can be shown by describing rich quotes from the research participants that reveal emerging themes (Cope, 2014). In this study, all data analysis procedures are described to show how significant themes were decided in order to draw conclusions. Conclusions, including significant themes, are stated with quotes from peer tutors and experts.

Phase 4: Revision

In phase four, a list of revisions for improvement was developed based on the results of model validation. According to Tracey and Richey (2007), internal validation procedures are

regarded as a formative evaluation. Formative evaluation is a procedure for data collection designed to make the products as effective as possible and to revise the instructional resources (Dick & Carey, 1996). Thus, model revision was essential to improve the effectiveness of the model after analyzing the results of expert reviews. On the other hand, external validation can be viewed as a summative evaluation of the model (Richey, 2005). Summative evaluation is done to validate and determine the efficiency and value of the instructional material (Russell & Blake, 1988). Although external validation as a summative evaluation is valuable for gauging and describing the effectiveness of instructional material, revision is also possible based on the results of external validation. Russell and Blake (1988) argued that if an evaluation (i.e., the summative evaluation for the learner) shows that a learner did not learn something, it reveals to the designer that the instructional resources must be revised (formative evaluation for the product). Through external validation interviews with peer tutors, the effectiveness of the model of peer learning was determined for future usage. To create a basis for model revision, common themes across both the internal and external validation processes were investigated.

For model revision, a list of revisions of the model of peer learning is presented. This list was determined based on the results of data analysis regarding external validation interviews and expert reviews. The elements of the list were generated when the experts recommended revisions based on their expertise and when newly hired or experienced peer tutors provided common limitations and suggestions for improvement. A list of suggested revisions to the model of peer learning is presented in chapter five and chapter six.

Chapter 4: The Results of Model Development

Chapter four presents the process of model development. An intensive literature review was conducted for the development of the model of peer learning incorporating scaffolding strategies to enhance peers' teaching skills and learners' knowledge acquisition. This literature review consists of summaries and analyses of theories related to scaffolding, including its characteristics, conceptualization, operationalization. The results of the literature review derive from common themes or patterns within the related literature regarding the theories, characteristics, and concepts of scaffolding. Based on the findings of the literature review, the synthesized model of peer learning was developed and described. The development of this model of peer learning is proposed to help peers design their peer learning environments using scaffolding strategies and to facilitate interactions between peers and learners.

The Theoretical Underpinning of Scaffolding

Sociocultural theory. Sociocultural theory highlights social and cultural interactions to facilitate a learner's cognitive development (Donato & McCormick, 1994). The conception of the notion of scaffolding is characterized by three central features of sociocultural theory: social procedure, mediation, and appropriation (Turner & Berkowitz, 2005).

A social process is essential to providing scaffolding to learners, so that they may attain a high level of capability through their interactions with others. Sociocultural theory perceives human growth as societal rather than personal (Gibbons, 2002). Vygotsky highlights that social interaction preexists the expansion of knowledge and capability (Walqui, 2006). A person's development is therefore to an important extent an outcome, not a precondition, of education—the outcome of individual's historical, societal and cultural practices (Gibbons, 2002). Sociocultural theory insists that studying, considering, and comprehending are relationships

among persons that arise from a culturally and socially organized field and that they interact with, act in, and arise from a culturally and socially organized field (Wang, 2007). Learning is entrenched within social phenomena, and social interaction plays an essential part in the development of learning (Wang, 2007). Its conversion from a social to an individual resource is not a just duplication, but a transformation of what had been studied by means of interaction into individual worth (Turuk, 2008). Vygotsky (1978) states that the learner obtains knowledge via interactions and connections with other persons in the first stage (interpsychological plane), then later internalizes and integrates this knowledge into a perception of individual worth (intrapsychological plane). In other words, learners first achieve success in completing a novel task with the assistance of another individual, and then internalize this newfound skill so that they can do it without help (Turuk, 2008). This model recognizes the active nature of interactions with people, as well as individual actions, and views learning as arising from relations with others (Turuk, 2008). Thus, learning is not only transformed, but also mutually shaped by members in an organized discussion in which the more proficient participant encourages learning by those less experienced or knowledgeable by constructing, and steadily dismantling, a scaffold within which the learner is able to make progress towards a higher degree of capability (Barnard & Campbell, 2005).

Mediation through human interaction and its accompanying symbols is a collaborative interaction through which to conduct scaffolding. According to Lantolf (2000a), one of the important assumptions undergirding sociocultural theory is the assertion that the human mind is intermediated. Higher varieties of human intellectual activity—multifaceted mental activities such as problem-solving, logical thinking, intentional memory, and intended attention—are intermediated (Boblett, 2012; Lantolf, 2000b). Mediation is also the foundation for learning.

When learning, cognitive development arises indirectly rather than directly from action; learning procedures depend on interpersonal interactions and the use of mediating instruments, and only then can learners advance cognitively (Hall, 2007). According to Kozulin (2002), mediators are one of two types: human or symbolic. With reference to human mediators, Vygotsky (1978) argues that mediation is performed by other important individuals in the learners' lives, individuals who improve their learning by choosing and shaping the learning activities demonstrated to them. If the learning situation exhibits an appropriate quantity of assistance from other people, then the learner can attain mastery in their new instruments as they study to utilize them in this circumstance (Hall, 2007). This process requires more than merely the existence of other more mature individuals: these persons must be able to support the learners so as to improve and develop the specific necessary psychological implements, and apply them only when these learners are prepared for the next level of improvement (Hall, 2007). On the other hand, people utilize physical, psychological, and cultural implements to study and adjust their actions (Barnard, & Campbell, 2005). Signals, symbols, or instruments are all products formed by humans under particular historical and cultural (culture-specific) situations, and as such they carry with them the features of the culture in question (Turuk, 2008). They are utilized as assistance to solve problems that cannot be resolved by the same method in their absence (Turuk, 2008). Among intermediary implements, the most important sociocultural implement is language (Hall, 2007). Vygotsky (1978) claims that language and thinking emerge distinctly but that when language enters the scene, thought and speaking mingle and combine, and in so doing convert one another so that both become completely dissimilar as an outcome of their combination (Walqui, 2006). Mediation is a cooperative and interactive social exercise in which problem-solving is completed, much like the cooperative interaction defined in scaffolding (Boblett, 2012;

Woods et al., 1976).

Appropriation is related to transferring responsibilities, which is the main function of scaffolding. According to Aljaafreh and Lantolf (1994), appropriation is a procedure of transformation from intermental to intramental working, "an active procedure of rebuilding and qualitative adjustment in which the beginner and the specialist cooperate in building a reciprocal action frame" (p. 467). Appropriation is not an entirely unsociable procedure (Wozniak & Fischer, 1993). It occurs as individuals, frequently with others and constantly in settings of sociocultural movement, figure out how to deal with new circumstances based on their personal and shared history, so as to achieve individual and common goals, through non-spoken, spoken, and emotional connections representing different conditions (Rogoff, 1993). Learning merely takes place when this comprehension is appropriated by the person (Barnard & Campbell, 2005). The channel for this procedure of internalization is typically referred to as personal speaking, which may irregularly be perceptible as an individual vocalizing a mental process (Barnard & Campbell, 2005). In other words, appropriation indicates, through the following methods, that "what is first said to the children is later spoken by the child" (Boblett, 2012, p. 5). However, this does not mean that what learners appropriate is a precise demonstration of what has been revealed regarding their social status in the minds of others; what learners internalize varies depending on their own developing character and in the setting of particular, distinctive social actions (Boblett, 2012). Once the conception is appropriated, it becomes the person's private comprehension (Barnard & Campbell, 2005). The notion of appropriation is revealed through the elimination of scaffolding as learners effectively progress through a learning activity (Boblett, 2012).

The zone of proximal development. The concept of the zone of proximal development

(ZPD) is considered the theoretical underpinning of scaffolding (Belland, 2014; Berk, 2002; Boblett, 2012; Pea, 2004; Shabani, Khatib, & Ebadi, 2010; Verenikina, 2004). Wells (1999) describes scaffolding as "a way of operationalizing Vygotsky's concept of working in the zone of proximal development" (p. 127). The primary purpose of scaffolding in a teaching context is to produce a ZPD appropriate to transferring responsibility for completion of a task to the learner (Mercer & Fisher, 1992).

The concept of ZPD was first introduced by Vygotsky. He (1978) defined the ZPD as "the distance between the actual development level as determined by independent problem-solving and the level of potential development as determined through problem-solving under adult guidance or in collaboration with more capable peer[s]" (p. 86). In the Vygotskian view, the primary purpose of an educational setting is to maintain learners' ZPDs to the greatest possible extent by providing them with significant opportunities for study and problem-solving in exciting and culturally relevant ways (Vygotsky, 1978). These activities are more challenging than those they can complete independently, such that they will require learning collaboratively with either a more capable peer or an instructor (Roosevelt, 2008, Shabani et al., 2010). As the learner completes the mission, his or her ZPD, or the distance between what the learner is able to do alone and what the learner can achieve with support, decreases (Campbell, 2008). After finishing the activity (with assistance), the learner can likely accomplish an identical task independently in the future. This process is then replicated at a higher stage of difficulty (Shabani et al., 2010). In the procedure of ZPD, the activity should not merely include a more knowledgeable individual providing support to a person who is less skilled (Boblett, 2012). If the provided support is over or under the learner's ZPD, improvement will not take place (Boblett, 2012). Thus, educators should approach their task as one not only of providing information to be

integrated, but also as a tool that learners can initially grasp to acquire additional organizational features, and then use to move from stage to stage (Yaroshevsky, 1989).

In the ZPD, the learner is an active participant in studying. The definition of the ZPD posits that education is the "co-construction of knowledge" is a mutually beneficial process that occurs between instructors and learners, and emphasizes the transfer of this new knowledge into the learner's own set of skills and capacities (Goldstein, 1999, p. 648). Therefore, within the ZPD the learner is not a submissive receiver of adult instruction, and neither does the adult merely represent a specialist in effective behavior. Instead, the adult-youth dyad engages in a cooperative problem-solving task in which they each share responsibility and exchange information (Wells, 1999).

The concept of the ZPD is the foundation for operating scaffolding. ZPD highlights that humans attain advanced cognitive stages when more highly-skilled people assist the learner in closing the gaps in their thinking and problem-solving (Peer & McClendon, 2002). Scaffolding is the representational structure of this assistance (Fani & Ghaemi, 2011; Peer & McClendon, 2002). It is a pedagogical process that allows learners to solve their problems, perform an activity, or attain a goal that would be beyond their unaided endeavors, thereby advancing their ZPD (Palincsar, 1986; Palincsar & Brown 1984; Xun & Land, 2004). Mercer and Fisher (1992) regard transmission of responsibility to the learner within a ZPD as the main purpose of scaffolding in teaching contexts. Scaffolding operates most efficiently when it is adapted to the learner, adjusted, and finally removed according to the learner's maturation (Fani & Ghaemi, 2011; Lantolf & Aljaafreh, 1996). If scaffolding is fruitful, the ZPD will recede as the learner becomes capable of accomplishing an activity without assistance (Belland, 2014).

The Conceptualization of Scaffolding

The characteristics of scaffolding. Scaffolding may have many diverse definitions, but they share some common features: intersubjectivity, the role of the scaffolder, ongoing diagnosis and calibrated support, and fading (Davis, 2015; Pea, 2004; Puntambekar & Hubscher, 2005; Stone, 1998; Van de Pol et al., 2010).

Intersubjectivity refers to a temporary, commonly shared comprehension or framework among participants in learning activities (Bonk & Cunningham, 1998). As learners discover their shared background (Rogoff, 1990) or commonly held opinions (Levine & Moreland, 1991), they can more comfortably discuss their views, negotiate discussed meanings, and construct new knowledge (Bonk & Cunningham, 1998). Intersubjectivity is obtained when the teacher and learner collaboratively outline the activity again to obtain mutual ownership of the it, at which time the learner should display an understanding of the objective (Puntambekar & Hubscher, 2005). In order to gain the learner's attention, the task should be sufficient to the learner's comprehension, and there should be initial common understanding of the work conditions, however restricted it may be with regards to the perception of the work to be accomplished (Stone, 1998). In other words, initial and continuing cooperative participation is crucial, though the activity assigns different tasks to each participant (Stone, 1998). The parent or expert's responsibility is to ensure that the learner is participating in the activity as well as to provide motivation, making it meaningful for the learner to take risks necessary to reach the next stage (Wood et al., 1976).

The scaffolder must recognize where the learner is having difficulties and then offer assistance (Bull et al., 1999). Therefore, assistance should be based on the present level of the learner's ability, while the scaffolder should have knowledge either at a similar or a slightly

advanced level as that of the learner (Van de Pol et al., 2010). This requires that the adult have a clear idea not only of the learner's abilities but also of the activity and the specific objectives it aims to complete (Puntambekar & Hubscher, 2005). In effective scaffolding, scaffolders assist, encourage, and facilitate learners' task levels (Granott, 2005). The scaffolder draws from a repertoire of tactics to offer assistance, continually adjusting the assistance offered according to the learner's changing abilities and understanding (Puntambekar & Hubscher, 2005).

The ongoing diagnosis promotes a cautious calibration of assistance so that the instructor is able to supply graduated support (Puntambekar & Hubscher, 2005; Stone, 1998). It is the collaborative and dialogic feature of scaffolded education that makes this ongoing diagnosis and adjustment possible (Puntambekar & Hubscher, 2005). The interlocutory interactions enable the instructor to conduct a constant evaluation of the learner's comprehension and enable the learner to take part in negotiating the collaborations (Puntambekar & Hubscher, 2005; Reid, 1998).

Fading refers to adjustments in the role, level, or extent of assistance being offered, allowing the learner to take ownership of the activity (Davis, 2015). The instructor fades scaffolding for learners based on personalized calibration and assessment (Davis, 2015). The degree of fading depends on the learner's level of improvement and capability (Van de Pol et al., 2010). When the learner comprehends the specific task, the expert diminishes (or fades) his or her involvement, offering only restricted cues, modifications, and responses to the learner, who gradually reaches the goal through a smooth performance (Pea, 2004). Through fading, responsibility for the activity is progressively shifted to the learner (Van de Pol et al., 2010). Responsibility is defined as learners' metacognitive or cognitive tasks, or their affect (Van de Pol et al., 2010). According to Wood et al. (1976), an essential aspect of the transfer of responsibility is that the learner not only arrives at an understanding of how to complete a particular activity,

but also abstracts the procedure into general comprehension, in order to apply the knowledge to similar activities.

The concept of scaffolding. Based on the results of the literature review regarding the characteristics or scaffolding, the concept of scaffolding was synthesized as illustrated in Figure 8. To conduct a scaffolding process, the scaffolder and the learner figure out their common goals and the learner's current and potential abilities through an initial diagnosis. ZPD is utilized to examine learners' current and intended capabilities for scaffolding. Based on this first diagnosis, the scaffolder begins problem-solving by helping the learner ascertain the objective structure of the problem (Bull et al., 1999). To solve the problem, the scaffolder and the learner set learning goals that they can agree on and share.

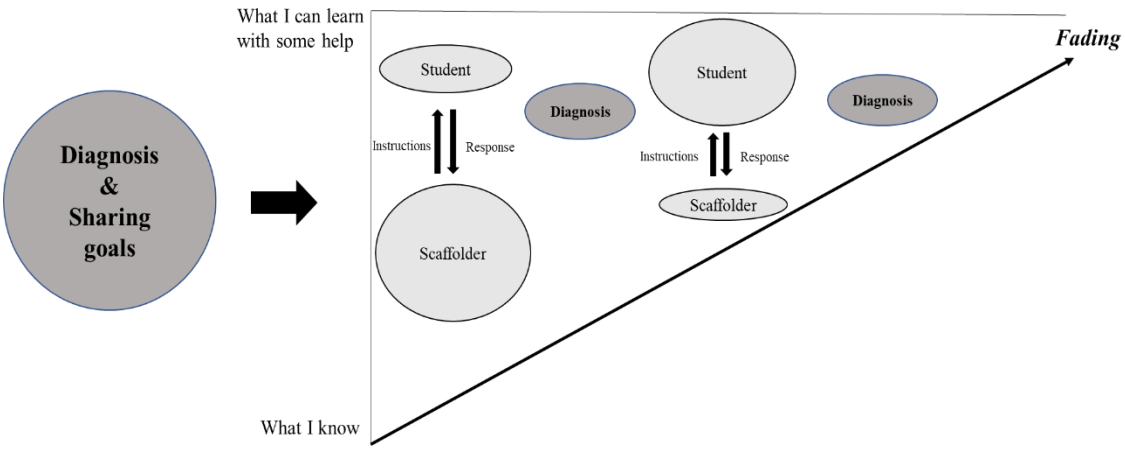

Figure 8. The concept of scaffolding.

The scaffolder provides scaffolding instructions to assist learners' problem-solving activities. The scaffolder should attempt to estimate a suitable phase so that the learner is studying simply and carrying a low cognitive load (Bull et al., 1999). The scaffolder explains the best resolutions or offers clarifications, provides descriptions, and demonstrates expected performance, all of which invite involvement (Puntambekar & Hubscher, 2005). Thus, the learner is involved in a continuing process of conversational reasoning as a means of

understanding the adult's statements or activities, taking into consideration both statements and activities to fuel progress (Stone, 1998). The learner is able to understand the adult's perception of the task at hand and is, therefore, more competent to perform a new action (Stone, 1998).

The scaffolder conducts ongoing assessments to correct scaffolding strategies based on a learners' current capabilities. Through this ongoing diagnosis, the scaffolder recognizes a learner's limited capabilities or their learning progress. According to Wood et al. (1976), a scaffolder is continuously assessing the child's development to offer assistance that is suitable for the learner. In other words, scaffolders recognize the learners' present knowledge and continually diagnose the current state of learning (Calder, 2015). Diagnosis leads to interactions that differ in style and content from person to person, and for the same person at different times (Hogan & Tudge, 1999; Puntambekar, 2009).

The scaffolder reduces scaffolding when learners accomplish learning tasks. If the learner attains understanding, the instructor is able to fade the assistance over time (Van de Pol et al., 2010). While lessening the assistance, the instructor is able to transfer accountability to the learner so that the learner will have the opportunity to manage his or her own learning (Van de Pol et al., 2010). As the learner takes ownership of the activity, the scaffolder fades the scaffold. At this point, the learner has internalized the relevant problem-solving procedures based on the prior scaffolded experience (Turuk, 2008). Fading of scaffolding ultimately provides learners with a chance to accomplish the work by themselves (Dabbagh, 2003; Jarvela, 1995; Pressley et al., 1996).

Three Dimensions for Operationalizing Scaffolding

To operationalize this practice, three dimensions of scaffolding are presented to explain its different phases. These three dimensions include the level of scaffolding, the type of

scaffolding, and scaffolding methods. In the first dimension, two levels of scaffolding—high and low—are suggested to investigate appropriate scaffolding strategies based on learners' characteristics. The second dimension includes two types of scaffolding: conceptual and strategic. The third dimension incorporates six scaffolding methods to provide specific teaching strategies. Figure 9 visualizes three dimensions for operationalizing scaffolding.

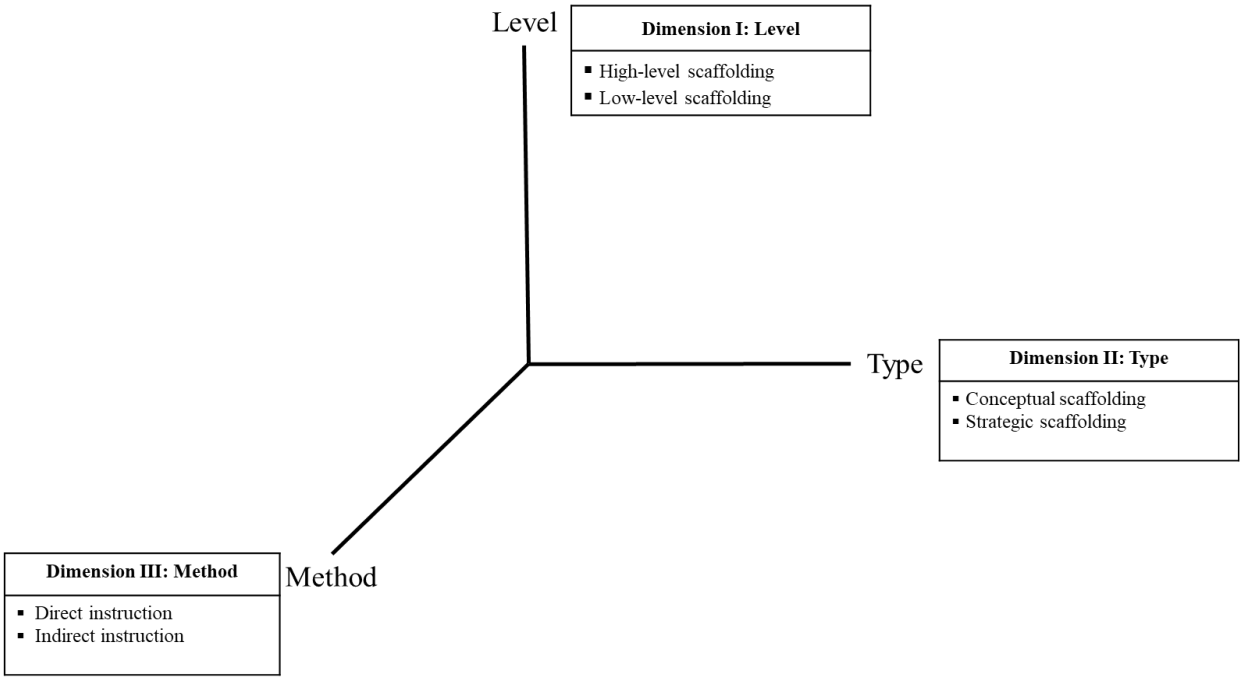

Figure 9. Three dimensions for operationalizing scaffolding.

Dimension I: Level of scaffolding. The first dimension for operationalizing scaffolding is the level of scaffolding. In the presented structure, each level of scaffolding includes different features and scaffolding strategies. The levels of scaffolding are categorized based on learners' characteristics. Dabbagh (2003) argues that a large amount of scaffolding could lessen learners' enthusiasm, causing decreased ambition toward self-directed learning and meaning-making activities. In contrast, she asserts that insufficient scaffolding could negatively affect learners' capability to succeed at specific activities, inducing annoyance, anxiety, and eventually reducing their motivation. Therefore, scaffolders need to figure out learners' characteristics and utilize

suitable strategies based on the appropriate level of scaffolding. Figure 10 represents features of the two levels of scaffolding.

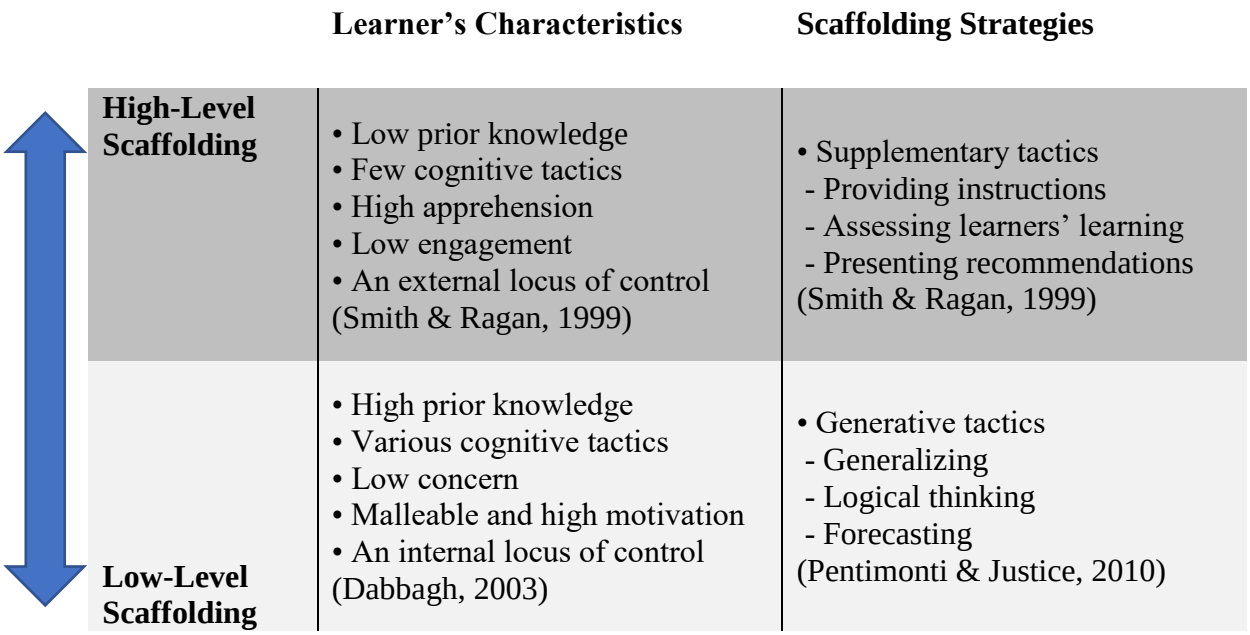

Figure 10. Features of the two levels of scaffolding.

High-level scaffolding. High-level scaffolding is utilized when learners exhibit low prior knowledge, few cognitive tactics, high apprehension, low engagement, and an external locus of control (Smith & Ragan, 1999). High levels of assistance include organized adult support, usually offered when a learner is just beginning to display an ability (Norris & Hoffman, 1990). In a learning setting, where a high level of scaffolding is needed, supplementary tactics are commonly more appropriate (Dabbagh, 2003). To provide supplemental strategies for learners, the instructor guides them to learning activities. For example, the instructor is providing all or a large portion of the learning objectives, explanations, sequencing, structure, and highlighting of the subject, as well as assessing and checking learners' progress and presenting recommendations for transfer of information to other subjects (Smith & Ragan, 1999).

Low-level scaffolding. Low-level scaffoldings are supplied when learners are nearing maturation in a specified field of ability or development (O'Connor et al., 2005). Matured

learners possess high prior knowledge, various cognitive tactics, malleable and high motivation, and low concern (Dabbagh, 2003). They also attribute accomplishment or failure in learning activities to internal reasons. In an educational setting where a low-level scaffolding is required, generative approaches such as generalizing, logical thinking, and forecasting can be encouraged or adopted (Pentimonti & Justice, 2010). These strategies are associated with the constructivist perspective of learning, which facilitates learners to build upon their own comprehension of the subject matter (Dabbagh, 2003). In low-level scaffolding, the instructor and the learners share the responsibility of learning. Dabbagh (2003) argues that in this approach, the learner and the instructor are both assisting in teaching and learning procedures where control is equalized or dispersed amongst learners, instructors, and learning outcomes.

Dimension II: Types of scaffolding. Different types of scaffolding strategies have different functions. Scaffolders need to select scaffolding tactics according to an appropriate function. In dimension II, two types of scaffolding are presented to explain the different purposes of scaffolding. Hannafin et al. (1999)'s types of scaffolding—conceptual and strategic—are adopted to explore the purposes of scaffolding. Table 4 summarizes the functions and mechanisms of these two types of scaffolding.

Table 4

The types of scaffolding

Type of Scaffolding	**Purpose**	**Strategies**
Conceptual scaffolding	How to prioritize what is essential	• The graphical description of relations among notions • Frameworks highlighting ordinate-subordinate relations • Knowledge and cues supplied by specialist
Strategic scaffolding	How to find alternative ways of studying	• Identifying successful tactics • Selecting the required information

Conceptual scaffolding. Conceptual scaffolding provides assistance so the learner can choose to prioritize what is essential or what to contemplate (Hill & Hannafin, 2001). This type of scaffolding assists learners in deciding what they want to study, what they perceive, how current knowledge and the subject are associated, and how new subjects can be arranged with regard to field knowledge (Bulu & Pedersen 2010). Conceptual scaffolding can be made available via various mechanisms, from the graphical description of relations among notions to knowledge and clues suggested by masters to frameworks illustrating ordinate-subordinate relationships (Hannafin et al., 1999). For example, Ding et al.'s (2011) study explained both the instant and continued effectiveness of conceptual scaffolding on learners' problem-solving abilities. To supply college learners with guided conceptual scaffolding, the researcher presented learners with a problem only after presenting them with two conceptually based multiple-choice questions. The findings of this study revealed that this conceptual scaffolding supported learners in looking for and adopting suitable central concepts to resolve the problem, and this repetitive exercise also assisted learners in conducting cross-topic transmissions.

Strategic scaffolding. Strategic scaffolding provides learners with alternate perspectives or skills for studying, or recommendations for original questions (Yu et al., 2013). Strategic scaffolding highlights different methods for examining, scheduling, and performing when learners are presented with an open-ended question, and prompts them to focus on recognizing and choosing required information, as well as assess materials and incorporate new information with prior experience and knowledge (Kim & Hannafin, 2004). Prediger and Krägeloh (2015), for example, implemented a study of strategic scaffolding for identifying successful comprehension tactics and facilitating their usage. They created a multifaceted scaffolding instrument to produce fruitful comprehension procedures for multi-stage algebraic problems. The

findings showed that the instrument scaffolds learners' processes effectively: learners internalized the tactics and procedures, allowing the scaffold to disappear.

Dimension III: Scaffolding methods. The third dimension of scaffolding represents scaffolding methods. Scaffolding methods are utilized to provide learners with specific guidance (Van de Pol et al., 2010). These methods consist of direct and indirect instructions. Indirect instructions include hints, questioning, and prompting, while direct instructions include feedback, explanations, and modeling.

Indirect instructions. Hints are suggested along with each reminder to provide learners with clues about the types of ideas they should examine and express in their reasoning (Owensby & Kolodner, 2004). Hinting stimulates the learner to conduct reasoning in order to respond to a question or resolve a problem, and/or encourages a learner to recall knowledge assumed to be known to learners (Hume et al. 1996). For example, Rus et al. (2017) assessed two hint-level educational tactics, a small amount of scaffolding and a large amount of scaffolding, in the communicational intelligent tutoring systems setting. A large amount of scaffolding strategy continually provided a hint for the next stage. On the other hand, a small amount of scaffolding offered learners the helpful low-level cues. Data from the experimental research showed that pre-post learning outcomes were meaningful in both settings.

Questioning is a traditional scaffolding technique instructors can use to explain organization, as well as to schedule, check, assess, and make rationalizations (Xun & Land, 2004). Questioning could also be used as procedural, metacognitive, or elaborative scaffolding (Xun & Land, 2004). For example, Thompson and Mackiewicz (2014) studied how questions operate in writing center meetings led by knowledgeable peer tutors. The findings revealed that questions enable peer tutors and peer tutees to compensate for their knowledge deficiencies and

monitor each other's comprehension. Questions also enable peer tutors to assist in conversations in writing center meetings and promote learner engagement. Peer tutors use questions to support learners as they explain what they need to express, recognize difficulties with what they have described, and brainstorm.

Prompting is utilized in learning settings to stimulate learning activities and to facilitate reflection regarding learning tasks (Blunk & Prilla, 2015). According to Lee, Chen, & Chang (2014), prompting is useful for scaffolding learners' higher order thinking abilities, self-questioning, self -monitoring/reflection, and self-explaining. They argued that a general prompt provides common guidance, but specific prompts not only include generic prompts, but also detailed tactical instructions for learners. For example, Davis and Linn (2000) examined whether reflection prompts facilitate knowledge integration for learners in science projects. The learning outcomes showed that prompting for learners' reflection considerably enhances knowledge integration.

Direct instructions. Feedback includes providing knowledge related to the learner's capability (Van de Pol et al. 2010). Feedback is a method for offering guidance to help ensure that the leaner continues making progress (Benko, 2012). Finn and Metcalfe (2010), for instance, assessed the effect of three types of scaffolded feedback: "answer-until-correct multiple-choice feedback, standard minimal feedback, and corrective feedback" (Finn & Metcalfe, 2010, p. 951). The results of this research indicated that scaffolded feedback results in the best recall of the right responses in the instance of a delay.

An explanation is the provision of further reasoning or detail (Yantraprakorn, Darasawang, & Wiriyakarun, 2013). An explanation consists of declarations that account for the learner's emerging comprehension of declarative or propositional knowledge, procedural

knowledge, and conditional or situational knowledge (Hogan & Pressley, 1997). This type of assistance is used to improve learners' knowledge and enhance their comprehension (Yantraprakorn et al., 2013). For example, Legare and Lombrozo (2014) investigated the specific effects of explanations on studying by facilitating learners to describe a mechanical toy. The responses of learners who played with the toy were compared with those of learners who only viewed it. The findings demonstrated that across all age ranges, explanation facilitates causal studying and generality.

Modeling expert procedures is demonstrating for learners directly, by stating what a specialist would do when confronted with a comparable problem (Belland, 2014). Successful scaffolding includes modeling as a learning procedure so that learners can see and study process abilities, thinking abilities, and problem-solving abilities, while obtaining subject knowledge (Tran, 2014). As an example, Magno (2010) evaluated the effectiveness of scaffolding as a reading activity. Scaffolding was conducted by an instructor making suggestions while a learner read aloud. Feedback was provided regarding fluency, interpreting, and demonstrating while the learner read about an unfamiliar topic. The results of this research demonstrated a significant enhancement in the learner's reading rate and competence, and a significant lessening of their reading concern pre- and post-test.

A Model of Peer Learning Incorporating Scaffolding Strategies

Based on the results of the literature review presented above, a synthesized model was developed. The proposed model of peer learning is a conceptual model of how to incorporate scaffolding strategies within a peer learning environment. Design strategies and the relevant literature are described to assist peers and learners in using appropriate scaffolding strategies in peer learning environments. This model was developed according to the key elements of

scaffolding for enhancing peers' teaching skills and learners' ability to acquire new skills and information in peer learning settings. Key elements consist of related theories, principles for conceptualization of scaffolding, and the three dimensions for operationalization of scaffolding. The key elements of scaffolding were reorganized and synthesized into four steps for the development of the model. The four steps are comprised of: (1) knowing each other, (2) learning together, (3) checking what you learned, (4) finalizing peer learning. Each step includes sub-steps to provide specific guidelines. Figure 11 presents the steps and guidelines of the model.

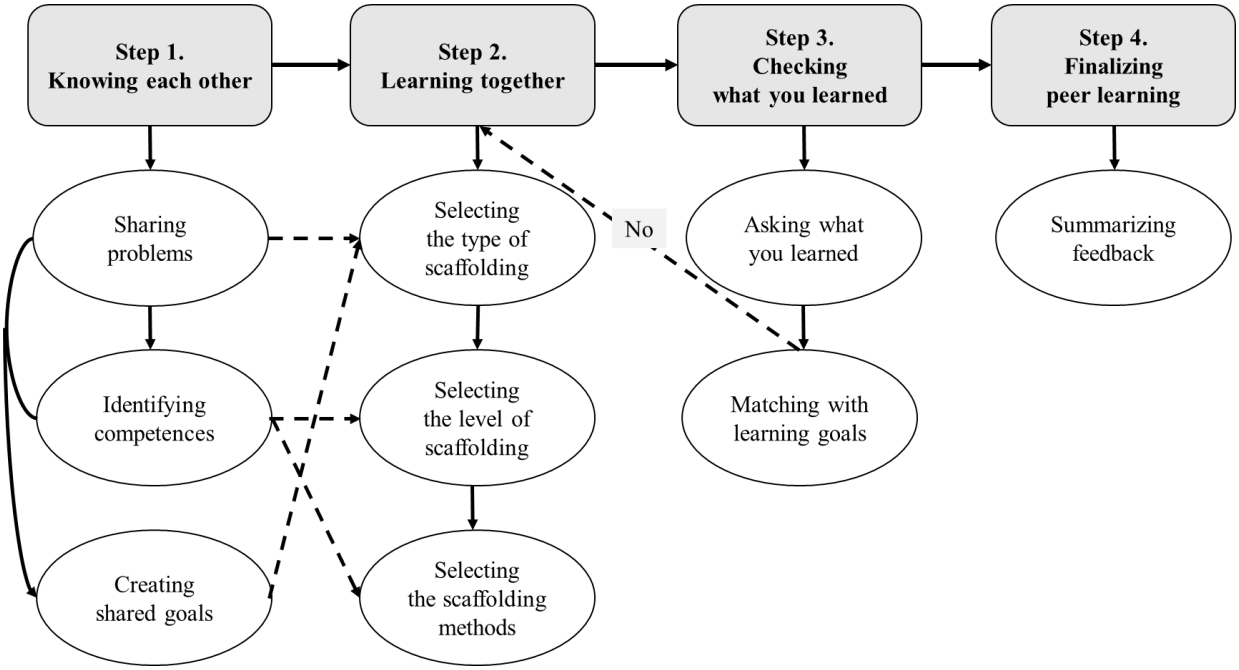

Figure 11. The model of peer learning incorporating scaffolding strategies.

Step 1: Knowing each other. The first step is to help peers recognize learners' problems and their competencies. As mentioned before, the peer can initiate the problem-solving activity through identifying the learners' specific problems, and this must occur before peer learning can begin (Bull et al., 1999). According to Obikwelu, Read, & Sim (2012), learner profiling is also the starting point for the scaffolding cycle. The main task of learner profiling is assessing both a learner's initial competence and the target competence, which are related to the notion of ZPD.

The significance of this process rests in the fact that the level of guidance offered by the instructor depends upon the relationship between the learner's initial competence and the competence level required for a given task (Obikwelu et al., 2012).

When the peer and the learner locate the relevant problems and the target competence, they set up ultimate goals so they may have common purposes. Setting goals is related to intersubjectivity, a characteristic of scaffolding. According to Wood et al. (1976), intersubjectivity is attained when the peer and the learner share an understanding of the goal that they need to accomplish. Through establishing these shared goals, peers facilitate the learner's self-regulated development (Diaz et al., 1990). Figure 12 describes the activities of step one.

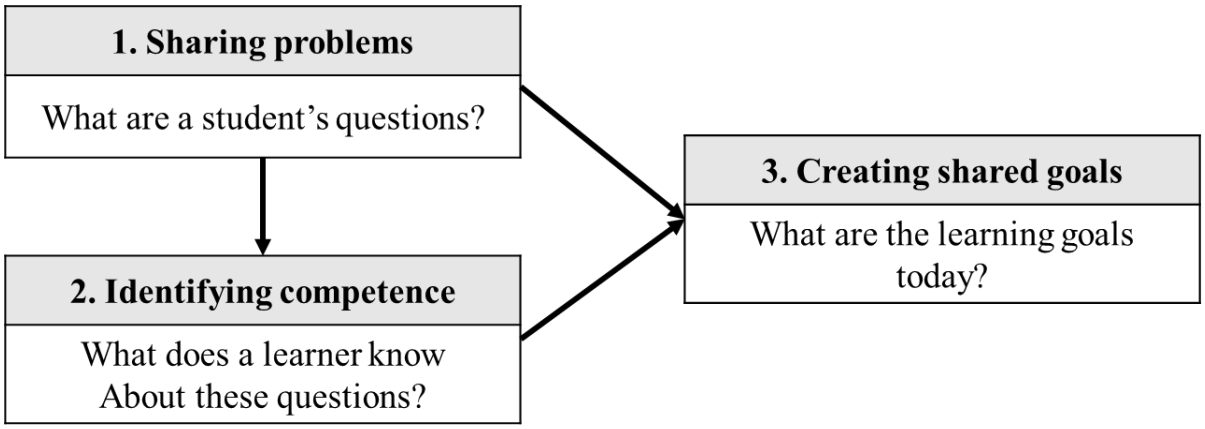

Figure 12. Peer learning activities of step one.

Step 2: Learning together. The second step aims to guide peers to use appropriate scaffolding strategies based on a learner's current abilities and the characteristics of his or her problems. When the peers choose scaffolding strategies, they consider the level of scaffolding, the type of scaffolding, and scaffolding methods. Figure 13 shows a flow chart for selecting scaffolding strategies based on these three considerations.

Peers select the type of scaffolding based on the characteristics of the learner's problems. Conceptual scaffolding is utilized to help learners understand important concepts or notions related to these problems (Hill & Hannafin, 2001). Peers can use strategic scaffolding to find

alternative study methods (Hill, Hannafin, & Domizi, 2005). For example, peers may use a concept map when learners are struggling to understand important notions. Peers may also suggest available resources for learners to find alternative approaches to their problem-solving.

Peers determine the appropriate level of scaffolding based on the learners' current capabilities and their degree of motivation. High-level scaffolding is selected for learners who exhibit low prior knowledge and motivation (Smith & Ragan, 1999). In contrast, when the learner demonstrates high prior knowledge and motivation, low-level scaffolding is offered (Dabbagh, 2003). The level of scaffolding plays a key role in selecting specific scaffolding methods.

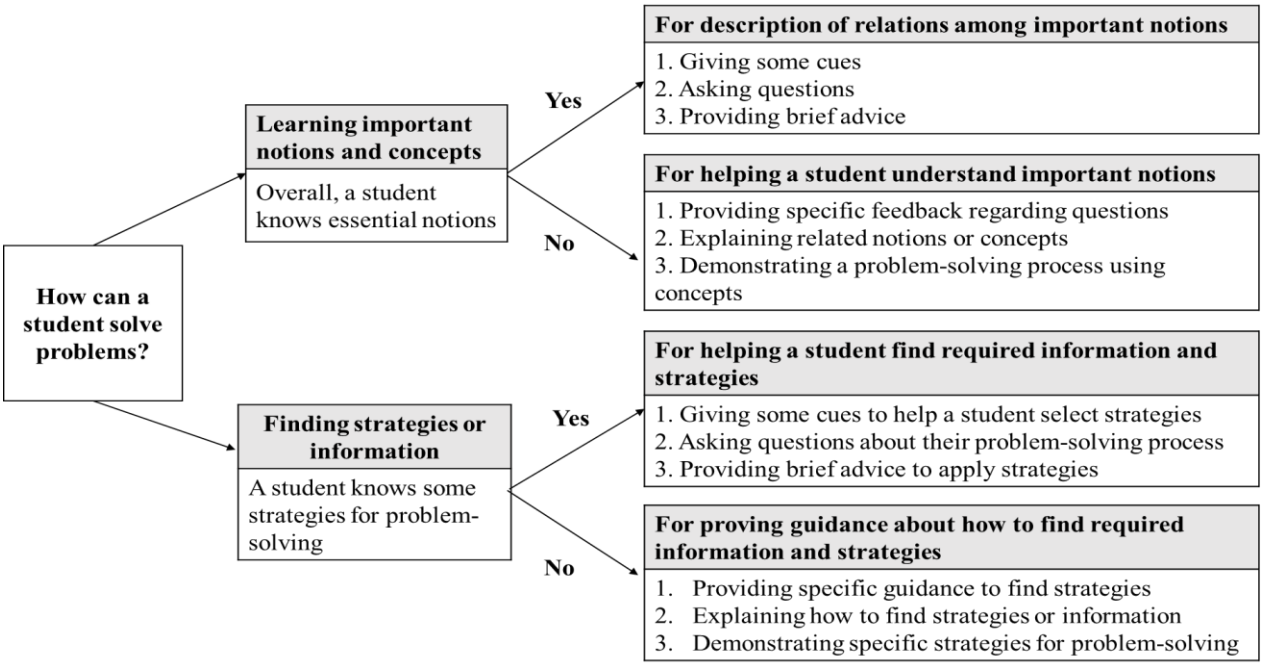

Figure 13. A flow chart to select appropriate scaffolding strategies for peer learning.

Based on the level of scaffolding, scaffolding methods are chosen to provide detailed instructions. Among scaffolding methods, indirect instructions—hints, questioning, and prompting—are utilized to provide low-level scaffolding, since these instructions facilitate the learner's reasoning (Lee et al., 2014). To provide high-level scaffolding, the peer uses direct

instructions such as offering feedback, explanation, and modeling. Direct instructions provide learners with detailed guidance and demonstrations (Yantraprakorn et al., 2013).

Step 3: Checking what you learned. The third step is to help the peer assess the learner's progress towards the stated learning goals. According to Chen et al. (2003), the peer must evaluate the learner's improvement, and modify scaffolding strategies when required. For example, when they are learning together, the peer observes and assesses whether or not the learner understands concepts important to solving the problem. If the learner does not understand these things, the peer uses conceptual scaffolding and direct instructions to assist the learner's comprehension. If the peer understands all the concepts at hand, the learner can use indirect instruction and another type of scaffolding to facilitate the problem-solving process. A rubric has been developed to assess learners' abilities related to understanding important notions or strategies, or their overall understanding. Table 5 presents the rubric to check learners' progress.

Table 5

A rubric to assess a learner's achievement

Questions	**Yes**	**No**
1. A learner knows important notions to solve problems.		
2. A learner understands how related notions are utilized to solve problems.		
3. A learner knows strategies for solving problems.		
4. A learner's responses to my questions are correct.		
5. A learner can use additional resources related to solving problems.		
6. A learner can solve problems without any help.		
7. Overall, a learner achieves learning goals.		

The purpose of scaffolding is to remove the need for support and reduce the level of assistance necessary for learners to enhance their capabilities (Chen et al., 2003). Thus, fading is critical to finalizing scaffolding strategies (Davis, 2015). Before fading scaffolding, the peer

assesses the learner's progress based on the learning goal. When the learner achieves the preset goal, the peer can then remove scaffolding activities.

Step 4: Finalizing peer learning. The fourth step is to assist the peer in summarizing provided feedback at the end of the peer learning session. Summary feedback refers to offering feedback regarding a series of practices after the final practice has been completed (Swinnen, 1996). Summary feedback can be utilized to examine whether the learner's actual ability matches the anticipated ability (Nelson & Schunn, 2009). Through providing summary feedback, the peer finally checks the learner's ability and provides a final opportunity to identify an unnoticed issue before finishing the peer learning activity. If the peer and the learner do not have any issues after sharing summary feedback, they conclude the peer learning activity.

Summary

Literature reviews regarding sociocultural theory, ZPD, and the characteristics, conceptualization, and operationalization of scaffolding are the foundation for the development of the model of peer learning. Sociocultural theory and ZPD, which focus on learning interactions, provide the theoretical foundation to operationalize scaffolding strategies.

According to the results of the literature review, the main characteristics of scaffolding are intersubjectivity, the role of the scaffolder as an assistant, ongoing diagnosis, calibrated support, and fading. Based on the characteristics of scaffolding, the concept of scaffolding is described as setting goals, assisting learners through scaffolder interactions, ongoing diagnosis, and finally fading.

To operationalize scaffolding, three dimensions—the level of scaffolding, the type of scaffolding, and scaffolding methods—are presented. The level of scaffolding (high or low) is determined based on a learner's prior knowledge. The types of scaffolding include conceptual

scaffolding and strategic scaffolding. The type of scaffolding is determined according to a learner's characteristics. Scaffolding methods comprise direct instructions (e.g. hints, questioning, and prompting) and indirect instructions (e.g. feedback, explanations, and modeling). Scaffolding methods can be determined according to the level of scaffolding needed.

Based on the results of the literature review, this model of peer learning has been developed to incorporate different scaffolding strategies. This model consists of four steps: (1) knowing each other, (2) learning together, (3) checking what you learned, and (4) finalizing peer learning. In step one, a peer identifies a learner's problems and related competence and sets up learning goals. To learn together in step two, a peer decides the type, level, and methods of scaffolding to provide learners with appropriate scaffolding strategies. In step three, a peer assesses what a learner's progress and if the shared learning goals have been met. Finally, a peer explains the summarized feedback to conclude the peer learning session. Through this model, peers can select proper scaffolding strategies for their learners and learn how to design their peer learning activities.

Table 6 represents the indications of the peer learning components, both within online education itself and in its suggested application.

Table 6

Indications and essential factors of the model of peer learning

Component of a model of peer learning	**Guide principles for application**	**Indication in the peer learning environment**
1. Knowing each other (Dabbagh, 2003; Hubscher, 2005; Puntambekar & Stone, 1998; Rogoff, 1990; Wertsch, 1985; Wood et al., 1976)	▪ Sharing learners' problems ▪ Identifying learners' competencies to solve problems ▪ Creating shared goals for peer learning	▪ A peer asks about learners' problems or concerns regarding a specific subject using an electronic worksheet. ▪ A peer can ascertain learners' prior knowledge and skills regarding their problems via an electronic worksheet.

		▪ A peer and learners set learning goals based on learners' problems using an electronic worksheet.
2. Learning together (Belland, 2014; Chi et al., 2001; De Grave, Dolmans, & Van Der Vleuten, 1999; Pea, 2004; Stone, 1998; Van de Pol et al., 2010; van Oers, 2014)	▪ Selecting the type of scaffolding - Conceptual scaffolding - Strategic scaffolding ▪ Selecting the level of scaffolding - High-level scaffolding - Low-level scaffolding ▪ Selecting the scaffolding methods - Indirect scaffolding that includes hints, questioning, and prompting - Direct scaffolding that contains feedback, explanations, and modeling	▪ A peer and learners can choose appropriate scaffolding strategies based on the characteristics of learners' problems. - Conceptual scaffolding is utilized when a peer helps learners find important notions related to learning goals. - Strategic scaffolding is decided upon when learners want to find tactics to achieve their learning goals. ▪ A peer and learners can determine the level of scaffolding based on learners' prior knowledge. - High-level scaffolding is selected when learners do not have prior knowledge regarding learning goals. - Low-level scaffolding is selected when learners have prior knowledge related to learning goals. ▪ A peer and learners can determine the scaffolding methods based on the level of scaffolding. - Indirect scaffolding is used when a peer and learners select low-level scaffolding. - Direct scaffolding is utilized when a peer and learners select high-level scaffolding.
3. Checking what you learned (Abdullah et al., 2013; Azevedo & Hadwin, 2005; Lajoie, 2005; Najjar, 2010; Nordlof, 2014; Puntambekar & Hubscher, 2005; Puntambekar & Kolodner, 2005; Reid, 1998; Stone, 1998)	▪ Asking what learners learned in peer learning ▪ Matching with learners' achievement with the learning goals	▪ A peer examines learners' knowledge or skills they learned in the peer learning. ▪ An electronic rubric is provided for a peer to check learners' achievement based on their learning goals. If learners do not accomplish their learning goals, a peer selects another scaffolding strategy based on learners' current abilities.

4. Finalizing peer learning (Dabbagh, 2003; Davis, 2015; Hubscher, 2005; Jarvela, 1995; Pressley et al., 1996; Puntambekar & Hubscher, 2005; Stone, 1998; Van de Pol et al., 2010)	▪ Summarizing feedback learners learned	▪ A peer can provide a summary of all feedback using an electronic form and ask learners about whether or not they have further questions.

The Development of the Online Education Program

The online education program was created after the model of peer learning was developed. This online education program was utilized to teach all the steps of the model to peer tutors who participated in a peer tutoring program, which is one type of peer learning, for external validation. Through the online education program, peer tutors learned all the processes of the model and practiced designing their peer tutoring activities for peer tutees.

Related theory – Gagne's nine events of instruction. Gagne's nine events of instruction were adopted to develop the online education program. Gagne's nine events present the order of stages that should be incorporated in instructional design in combination with the usage of educational technologies (Semple, 2000). These events were developed to stimulate and assist the procedures of information processing (Gagne et al., 2005). The nine events of instruction include the following activities: "(1) gaining attention, (2) informing learners of the objective, (3) stimulating recall of prior learning, (4) presenting the content, (5) providing learning guidance, (6) eliciting performance, (7) providing feedback, (8) assessing performance, and (9) enhancing retention and transfer" (Gagne et al., 2005, p. 195). Based on these nine events of instruction, the online education program included nine steps to facilitate learning while using the model of peer learning.

Outcomes and Analysis. *Content – The model of peer learning.* In this online education program, peer tutors were able to learn how to design their peer tutoring activities using the four steps of the model of peer learning. Through this online education program, peer tutors learned and practiced the model in their peer tutoring activities.

Audience – peer tutors. For this research, peer tutors took part in this online education program for external validation of the model. They were undergraduate students working in the peer tutoring program. Because peer tutors provided peer tutoring activities, one type of peer learning, they could learn and adapt the model for their peer tutoring activities.

Outcome and objective. Through this online education course, peer tutors were able to (1) set learning goals based on learners' competencies and problems, (2) select and provide appropriate scaffolding strategies for peer tutoring which is one type of peer learning, (3) examine learners' achievement, and (4) summarize important feedback.

Introduction of the online education program. *Pre-survey.* Five questions were asked to investigate prior knowledge regarding peer learning and scaffolding. In this research, peer tutors answered these questions before learning the model. Figure 14 shows a screen shot of the pre-survey.

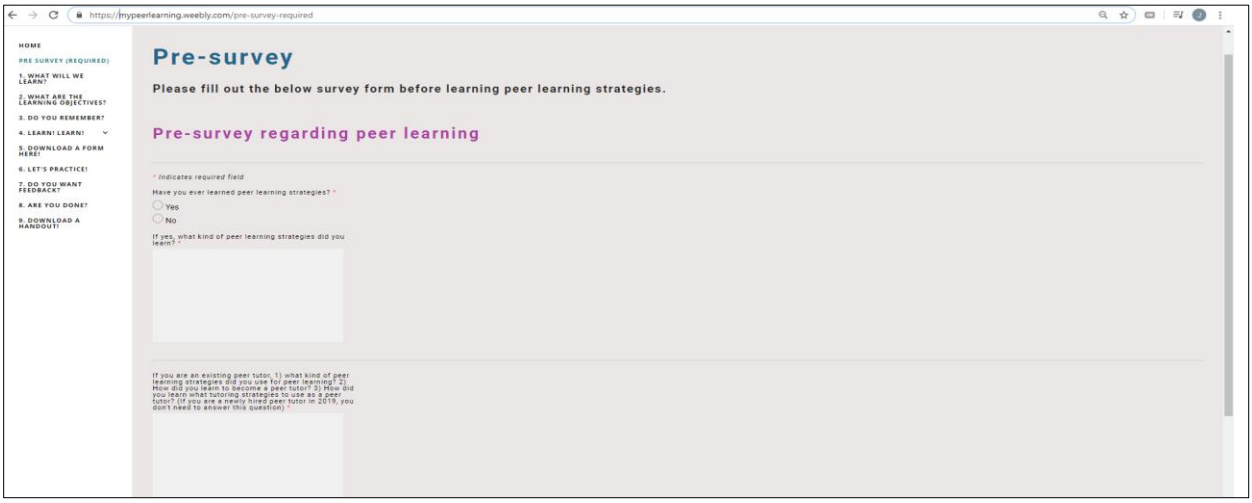

Figure 14. Screen shot of "pre-survey."

1. What will we learn? The necessity of the use of the model was introduced through an instructional video to gain peer tutors' attention. Figure 15 shows a screen shot of this step.

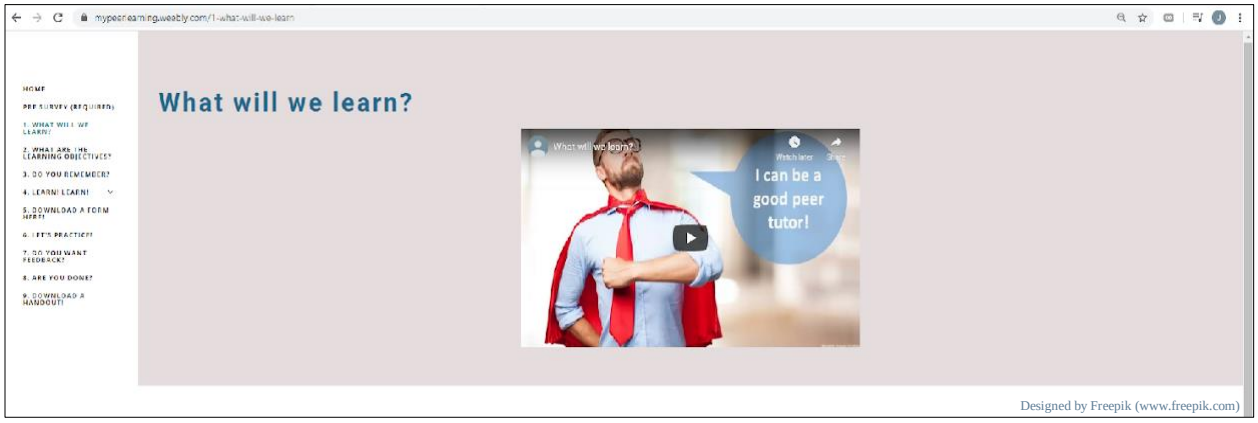

Figure 15. Screen shot of "What will we learn?"

2. What are the learning objectives? Using text descriptions, the four learning objectives were introduced. Figure 16 shows a screen shot of the learning objectives.

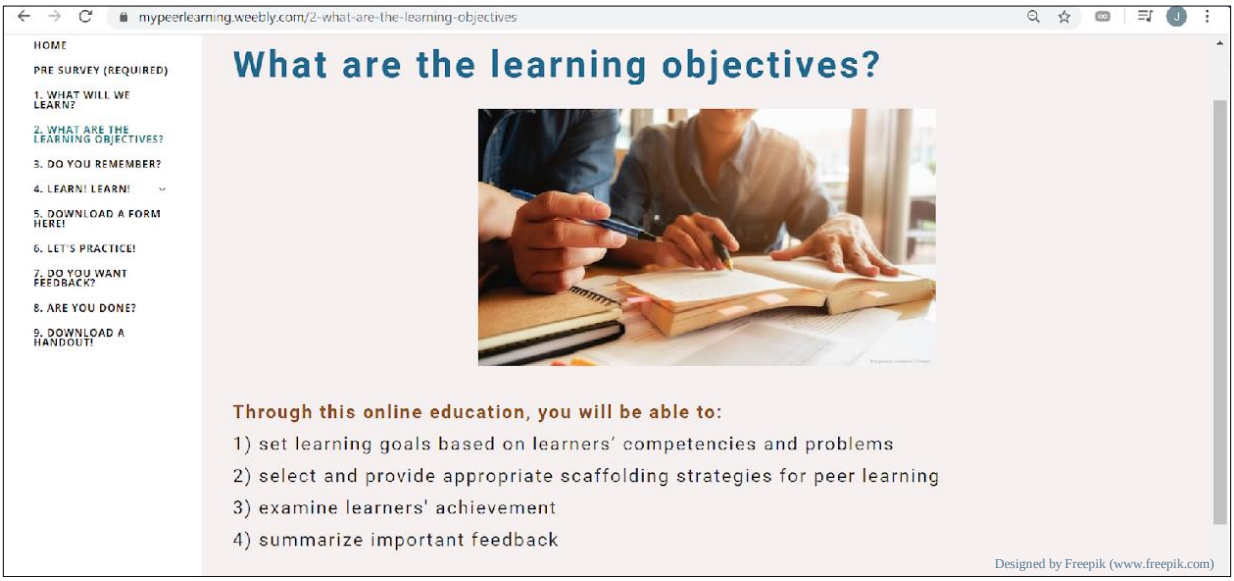

Figure 16. Screen shot of "What are the learning objectives?"

3. Do you remember? To recall prior knowledge regarding peer learning, peer tutors were asked three questions about their peer tutoring experiences which is one type of peer learning. Figure 17 presents a screen shot of related questions.

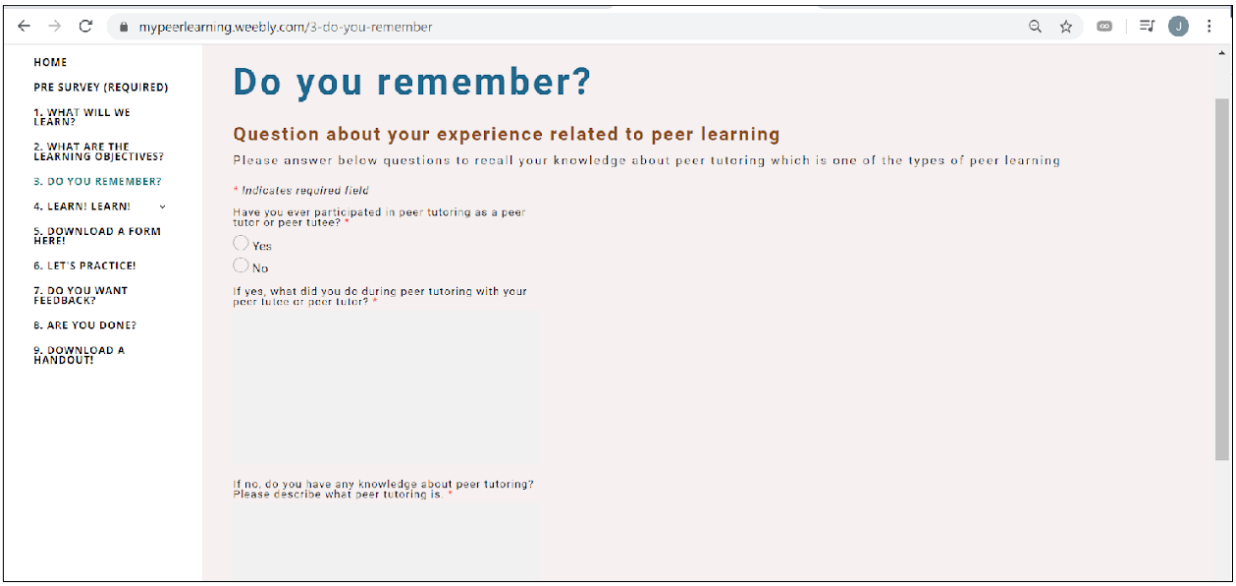

Figure 17. Screen shot of "Do you remember?"

4. Learn! Learn! To learn all the strategies of the model, the four steps of the model were explained. This content was delivered through video instruction, video demonstration, text descriptions, and related images. Figure 18 presents a screen shot of the fourth step.

Figure 18. Screen shot of "Learn! Learn!"

5. Download a form here! Electronic forms were provided to help peer tutors practice the model in their peer tutoring activities which is one type of peer learning. Appendix F presents electronic forms peer tutors could utilize. Electronic forms consisted of tables to set up learning

goals, a flow chart to select appropriate strategies, a rubric to check learners' achievement, and a table to summarize important feedback. Along with these forms, text descriptions were provided to explain how to use them for peer learning, especially for peer tutoring in this research. Figure 19 shows a screen shot of this step.

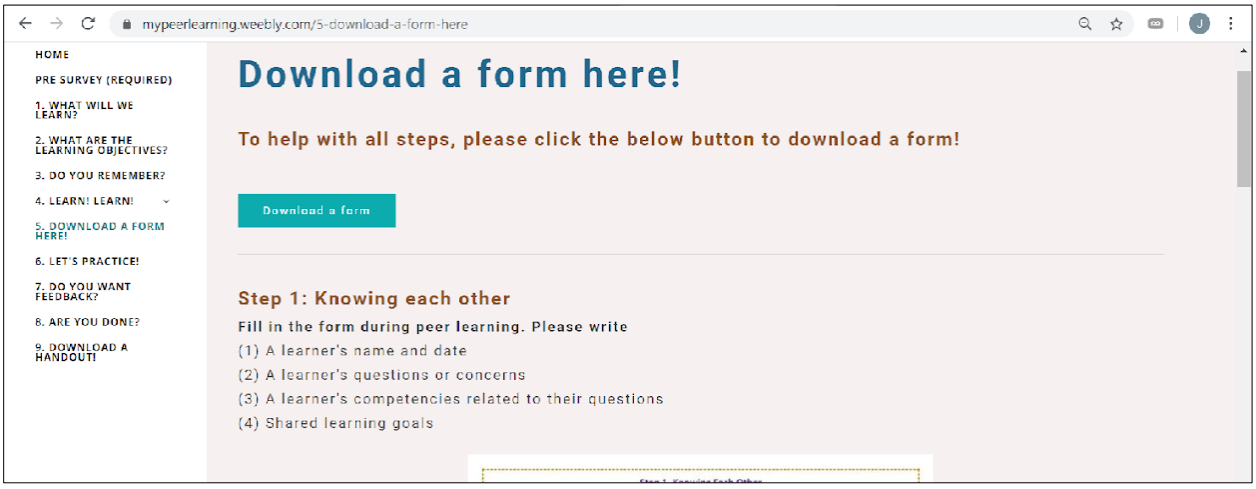

Figure 19. Screen shot of "Download a form here!"

6. Let's practice! Peer tutors applied the model for their peer tutoring activities to elicit performance. In this study, peer tutors learned the model and downloaded electronic forms. In their peer tutoring sessions, peer tutors provided the peer tutoring activities based on the model for peer tutees and completed the electronic forms. After concluding a peer tutoring session, peer tutors sent electronic forms to a peer tutee and a researcher. Figure 20 shows a screen shot of the practice.

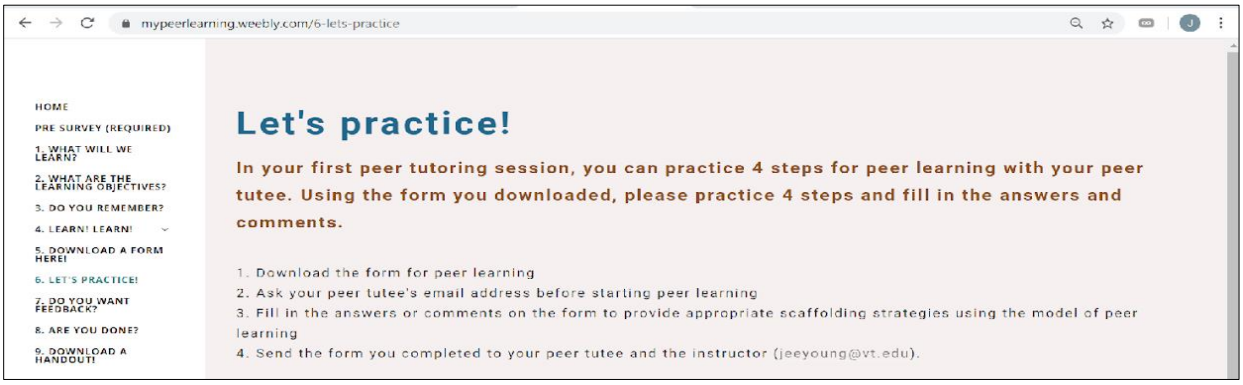

Figure 20. Screen shot of "Let's practice!"

7. Do you want feedback? Feedback was provided whenever peer tutors asked questions while they practiced the model in their peer tutoring sessions. An instructor provided rapid and positive feedback when peer tutors filled in and sent the form. Figure 21 presents a screen shot of the step related to feedback.

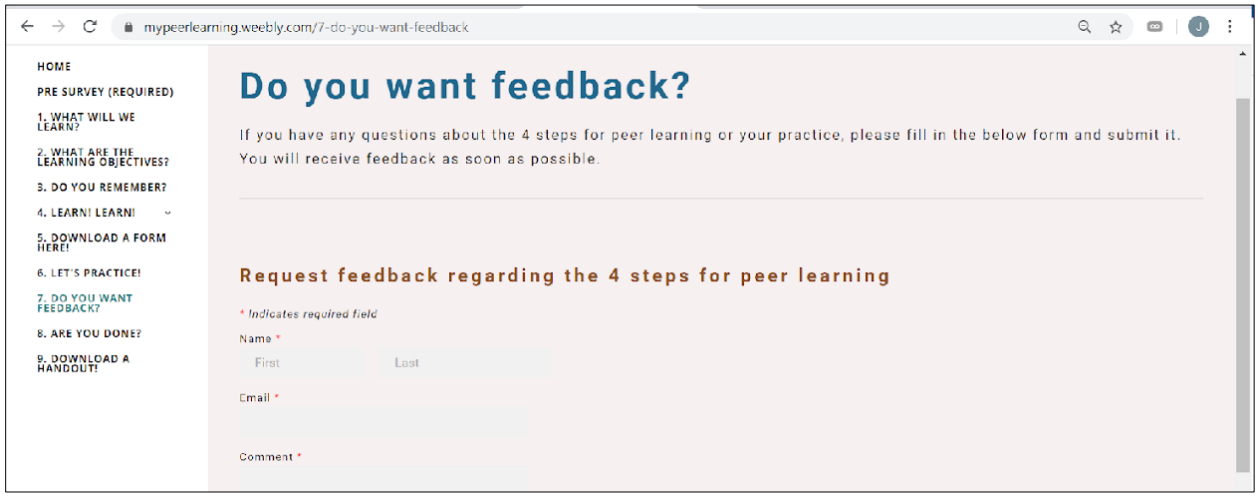

Figure 21. Screen shot of "Do you want feedback?"

8. Are you done? An instructor checked the electronic forms peer tutors submitted to assess their performance. If peer tutors filled in the electronic forms and completed peer tutoring sessions using the model, they passed the online course. Figure 22 shows a screen shot of this step.

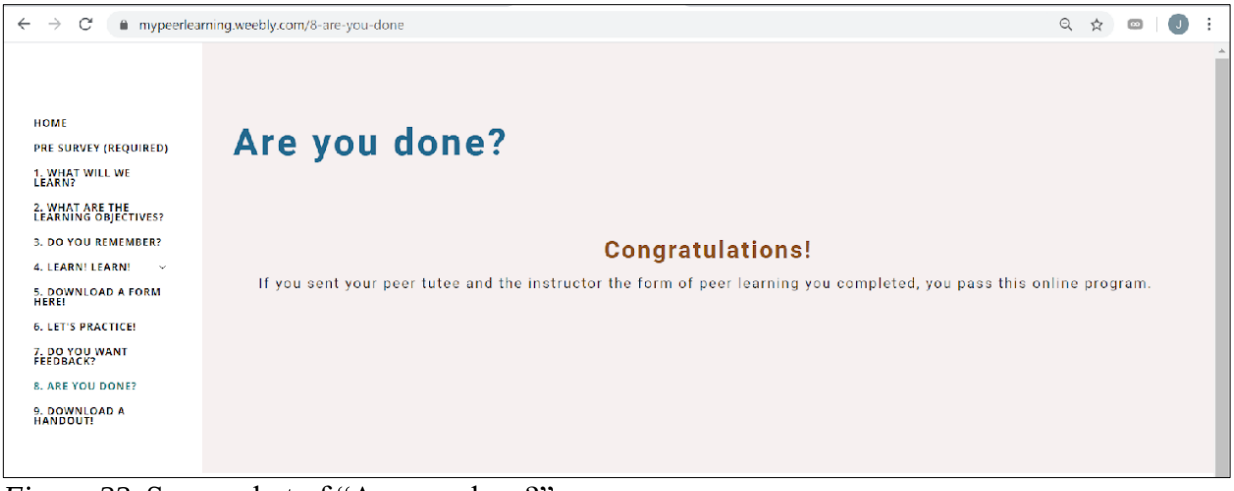

Figure 22. Screen shot of "Are you done?"

9. Download a handout! An electronic handbook could be downloaded to enhance retention and transfer. Appendix G presents an electronic handout peer tutors could download. This handout included all text explanations regarding scaffolding and the model, as well as electronic forms. Figure 23 shows a screen shot of this last step.

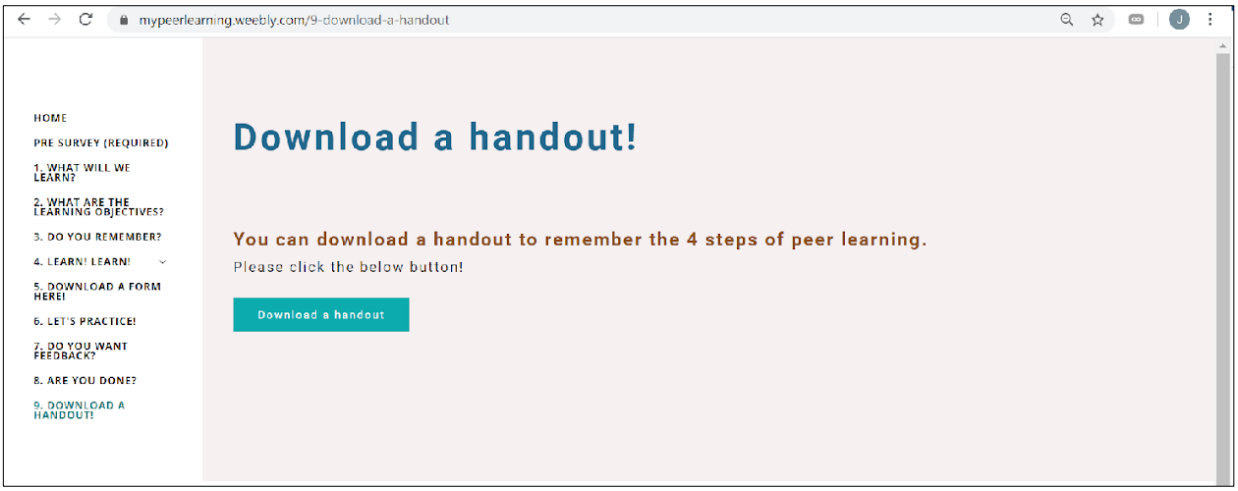

Figure 23. Screen shot of "Download a handout!"

Chapter 5: The Results of Model Validation

The findings of model validation regarding the model of peer learning are stated in this chapter. For model validation, expert reviews with three experts and external validation interviews with eight experienced peer tutors and five newly hired peer tutors were conducted. To analyze the collected data, transcripts related to external validation interviews and written feedback from the experts were prepared. Open-coding was conducted to discover interesting words or sentences from each transcript and the written feedback in order to answer research questions. Based on the findings of open-coding, categories, including the sub-categories of the five cases (e.g. expert 1, expert 2, expert 3, experienced peer tutors, and newly hired peer tutors) and a codebook were created using NVivo. Patterns and themes were located among the categories and sub-categories and summarized to generalize the findings of each case. To show and compare the generalized findings of each case, checklist matrix summary tables were created. According to the results of a matrix analysis, the conclusions were determined to answer the research questions related to model validation.

This chapter presents data summaries of the five cases and the four checklist matrix summary tables to demonstrate the data analysis procedure. Final conclusions are described to answer the following research questions:

1. How does the proposed model of peer learning impact the knowledge, skills, and practices addressed through peer learning?
2. How can this model of peer learning be improved?

Data Analysis Summary

All the collected data from expert reviews and external validation interviews were analyzed individually and then synthesized to find themes or patterns across each case. Five cases (expert 1 in scaffolding, expert 2 in peer learning, expert 3 in instructional design and technology, experienced peer tutors, and newly hired peer tutors) were created to compare results. The identified themes and patterns were related to the research questions, such as the impact of the model and suggestions for its improvement. After finding common patterns or themes across each case, the results of the five cases were summarized and presented with direct quotes from the expert reviewers or peer tutors. Each expert was arbitrarily assigned identifying numbers and each peer tutor was given a pseudonym to protect their identifying information.

Expert 1 in scaffolding. Expert 1 believed that the model was clearly structured, and helped peers provide peer learning activities. According to expert 1, "In terms of its basic structure, I think this model of peer learning makes sense. By outlining the process peers should take, providing forms, and a guide, you've essentially provided a scaffold for them to begin working from." Expert 1 also felt that this model was developed based on a rigorous theoretical foundation to help learners achieve their goals. For example, as expert 1 explained, "It's built upon sociocultural learning theory and utilizes Vygotsky's Zone of Proximal Development. It hits at key elements of a social learning process. This is important from a cognitive perspective."

However, Expert 1 also believed that the model lacked specific strategies and applications. Expert 1 commented: "What is missing in this current iteration is information on specific strategies and the application of those strategies." In particular, this model did not contain a specific explanation of the non-linear process, as expressed by expert 1: "A concern is getting peers to understand that this process may not be linear…In some ways, the model does

not address what should happen when learning does not occur the first time and peers need to reassess the situation." Expert 1 also felt that the benefits of the model were not clearly explained: "In the actual model discussion, the benefits aren't explicitly stated here. They are implied from the preceding literature review."

To improve the model, specific strategies could be explained in more detail, as expert 1 suggested: "Strategies are mentioned at a surface level, but deeper insight into those practices would be needed before peer tutors could actually begin to use those scaffolding strategies and sustain them." The model also needs to explain the non-linear process needed if learners do not achieve their learning goals. According to expert 1, "The key missing element is what happens after step three if learning goals are not met. This needs to be addressed in some way so it helps peers see that it's not always a completely linear process."

Expert 2 in peer learning. Expert 2 believed that the model was beneficial in its "clarification of each item in each box." This model's strength lies in its "manageable number of steps with [a] feedback loop" and "practical and relevant steps."

However, this model lacked clarity, as expert 2 explained: "I did not understand what each item truly meant until I worked through the educational unit and, in particular, the examples provided."

Expert 2 recommended adding illustrations and tables to make the model more rigorous: "You have some supporting illustrations and tables in your text that are very helpful in conveying components of the model." In addition, more clarity and content could be added to the model. Expert 2 commented, "The model would benefit from a bit more content to be functional alone; e.g., in step two, under type, level, and methods, there is room to add some bullets indicating the types, level, and method. So, I think the model needs more clarity and content if it

is to help peers incorporate scaffolding strategies." In step one, a title could be changed for clarity. Expert 2 noted that "'identifying competencies' under step one is very vague. But, from the educational unit, competencies seem to refer to 'what the peer tutee already knows/is able to do'. That is, change 'Identifying competencies' to 'identify what the peer tutee already knows and is able to do in relation to the problem'."

Expert 3 in instructional design and technology. Expert 3 thought that the model of peer learning aligned well with the results of the literature review. According to expert 3, "The design is based on empirical research and synthesized down to an understandable and useful model. The steps seem to align well with the current research and understanding of best practices based on the research findings cited in the literature review section." This model was also "clean and easy to understand."

Expert 3 thought that the weakness of this model was that it did not present various examples. Expert 3 stated, "Without many examples, it may not provide enough information for peer scaffolding to be used expertly in the peer learning process."

To improve the model of peer learning, the titles of the steps could be changed. For example, expert 3 recommended new titles: "(1) Getting to know the learner, (2) Guided instruction using scaffolding, (3) Assessing learning goals, and (4) Summary of learning." For peer learning, peers and learners could set a specific timeline. Expert 3 commented, "When goals are set, are they set for a specific timeline? This could be discussed a bit more." Moreover, peers could provide "a summary for partially completed goals" and learners could "participate in the summary process."

Newly hired peer tutors. Newly hired peer tutors had not learned and practiced scaffolding before learning the model of peer learning. They learned "how to deal with different

situations," "how to encourage learners to answer questions," "how to handle tough learning situation," and "the Socratic method" in the orientation.

Through the online education program based on the model, they learned "the notion of scaffolding" and "how to decide different scaffolding strategies based on learners' knowledge." They reportedly thought this model to be straightforward, clear, and concise. Olivia stated, "It is very straightforward. It was very clear and concise, so I liked that, easy to follow for me." The main feature of this model was that it is structured—it is easy to understand and follow. James commented, "I think I like the scaffolding structure, for sure. I think the scaffolding structure made it more clear to me . . . [the] process to follow, which made it a little easier." Newly hired peer tutors thought that this model was applicable to different subjects and learners. Jane stated, "I think it's very useful because people have different background knowledge before coming into tutoring. We can use the model for every tutoring session." They thought that this model was helpful in ascertaining learners' knowledge and problems and deciding upon appropriate strategies. Emma explained that "It helps you figure out where you are now, and then what steps you need to take to get better or to improve. And it helped me identify her needs, and then I knew exactly what strategies were going to be the most helpful to addressing those, and which ones would not be as helpful." In particular, they thought that step one was useful in finding a direction for peer learning. Emma stated, "I think step one helps start the session off really strongly, and from there it's a lot easier to find a direction to go in. I think it's the most important because without this step, I don't think I would get to the other steps."

However, in step two, newly hired peer tutors thought that the diagram was broad and the scaffolding methods were the same. Jane stated, "I see that diagram..I guess it's a bit broad, but then…like for these two scaffolding methods in step two are very similar." If peer tutees had

complicated problems, it was difficult to find their main problems and apply the model. Emma commented, “I think if you don’t know what you’re doing, it could be hard to apply the model. If I teach chemistry, it was a little harder to adapt to like math-related things versus the conceptual ideas in it.” Moreover, peer tutees were not familiar with this process when they used the model. Olivia stated, “I selected scaffolding technique I needed, but peer tutees were not aware of it because I was only the one who knew the model”

Based on the results of interviews with newly hired peer tutors, to improve the model of peer learning, step two should be less vague, and more specific questions related to step two are also needed in step three. Jane commented, “I think making step two more specific [would improve the model]. You could have explained more about why you’re taking this approach.” Mary mentioned, “If there was a way to incorporate the question, almost into step two, it might be that I need to use it.” They thought that the Likert scale could be utilized for question six in step three. Emma stated, “Question six was the only one where there was any sort of hesitation from peer tutees answering a firm yes or no. I think the Likert scale [makes it] easier to answer yes or no.” For effective peer learning, peer tutees need to learn the model as well, as Olivia confirmed: “Teaching the peer tutees about this model would be nice because they didn’t really know a whole lot about it.”

Experienced peer tutors. Most of the group under study (7 of the 8 peer tutors) had learned and used similar strategies before their introduction to the present model. They learned “how to deal with tough situations,” “how to act toward a learner,” “relevant policies,” and “the Socratic method” in their orientations.

Through the online education program, they learned about “the notion of scaffolding,” “asking about what they know or do not know,” “setting goals,” “how to select the best type of

scaffolding," and "the third step to assessing learners' understanding." They thought that the benefit of this model as operationalized in the online education program was that it was applicable to different learning situations. Helen said, "It helps so that the peer tutor cannot treat every peer tutee the same. It helps them treat them differently, like cater to what they need." They stated that this model was straightforward and easy to understand. Nora commented, "The steps were straightforward, it wasn't too many steps it was just four main steps that you need to follow which I like." This model as operationalized in the education program was also well structured so as to check their process. Rory stated, "It's structured so it's always easier for people to understand written down steps than understand abstract [ones]." The experienced peer tutors thought that step one was important and helpful to beginning peer tutoring. Jack explained, "I think taking those down at the beginning of the session was really helpful, because those kind of instructions created a more defined idea of what we were going to do with the session." They thought that the diagram for step two was likewise an effective method of representing the process. Helen stated, "I think a diagram definitely improved my peer learning ability, and ability to help others because it kind of guides what kind of questions I will be asking them and how to effectively help them learn better." The experienced peer tutors insisted that this model as operationalized in the online education program would be especially beneficial for newly hired peer tutors, as Tom commented, "I believe the model would have more impact for a newly hired peer tutor because experienced peer tutors are usually more comfortable guiding a tutoring session without a preset plan. New peer tutors have less experience, and so having the scaffolding model to use as a guide for the session would be helpful for them."

As experienced peer tutors, they did not exhibit significant changes after learning the model. However, after learning the model, they had the capacity to ask about what they do and

do not know. Helen stated, “If I understand what their goals are and specifically what they want and I can now definitely try and understand their needs and prior knowledge so that I can pick what type of guidance they need and I'll definitely keep doing that moving forward.” Two types of scaffolding could assist them to improve peer tutoring skills. Jennifer commented, “I learned from the model that in step two it is important to determine first if there is a learning gap due to specific strategies or overall broad concepts before asking questions. This helps me as a tutor ask the learner questions that will maximize our session.” They also were able to check peer tutees’ understanding and provide summaries to confirm their activities. Amy stated, “I think step three helped me be more sensitive as a peer tutor, and assess learners better. I really like that chart in step four, to make sure that I was doing stuff, to make sure I know where the learner was at.”

However, because step two lacked sufficient explanation in the online education program, the experienced peer tutors thought that more detail was needed to select scaffolding strategies. According to Brandon, “In step two maybe it's too direct, like too quick into saying that they need to learn the notion or find the strategies and maybe be more detailed about how you get to that point or how they do it.” Because peer tutees were unfamiliar with the model, peer tutors had difficulties using the model. Jack commented, “It could be hard to make peer tutees follow a certain path sometimes. This could make it difficult to make them follow a certain learning model sometimes, because they would just like the peer tutor to give them the course content.” Some experienced peer tutors said that this model was not effective for “memorization-based subjects” or “proofreading.” Asking about peer tutees’ problems or prior knowledge was not effective when there was no strong relationship between peer tutors and peer tutees. Jennifer explained this dynamic: “Step one could either go really well or really poorly and I think it depended on the relationship that a peer tutor and a peer tutee had.”

To improve the model of peer learning, as operationalized in the online education program for peer tutors, the experienced peer tutors thought that additional intermediary steps between two and three are needed to reassess peer tutees' understanding. Tom suggested, "I think a good idea would be in the second step, to have maybe another step. Once the peer tutor makes a determination and has a couple of minutes to talk to the learner, then determine again, if they're still on that path or if they need to change paths." In step one, "identifying problems" was better than "knowing each other." The Likert scale could be used in step three "to see if a peer tutee [has] improve[d] from the beginning."

Checklist Matrix Summary Table

Two checklist matrix summary tables were created to compare the results of expert review and external validation interviews regarding the strengths of the model of peer learning so as to ascertain the impact of the model on peer learning. The first table includes three cases of expert review (e.g. expert 1, expert 2, and expert 3) in a column and related categories in a row. The second table represents two cases of external validation interviews (e.g. newly hired peer tutors and experienced peer tutors) in a column and related categories in a row. Through these tables, differences and similarities among the five cases were identified to derive the results. Table 7 shows a summary table to compare the three cases of expert review related to the strengths of the model.

Table 7

A checklist matrix summary table related to expert review of the strengths of the model

	Case		
Strength	Expert1	Expert2	Expert3
Align the steps with the literature	✓		✓
Well structured	✓	✓	
Clear and easy to understand			✓

Table 8 represents a checklist summary table to compare the two cases of external validation interviews regarding the strengths of the model.

Table 8

A checklist matrix summary table related to external validation interviews of the strengths of the model

Strength	**Case**	
	Newly hired peer tutors	Experienced peer tutors
Learn the notion of scaffolding	✓	✓
Learn how to determine scaffolding	✓	✓
Well structured	✓	✓
Clear and easy to understand	✓	✓
Applicable to different learners or learning situations	✓	✓
Useful step one	✓	✓
Learn step three for the assessment		✓
Useful for newly hired peer tutors	✓	✓

Another two checklist matrix summary tables were created to compare the findings of expert review and external validation interviews related to suggestions for the improvement. The third table consists of three cases of expert review (e.g. expert 1, expert 2, and expert 3) in a column and associated categories in a row. The fourth table shows two cases of external validation interviews (e.g. newly hired peer tutors and experienced peer tutors) in a column and interrelated categories in a row. Through these two tables, common suggestions were identified among five cases. Table 9 represents a matrix analysis regarding suggestions to improve the model of peer learning. This table compares three cases of expert review.

Table 9

A checklist matrix summary table related to expert review of suggestions for improvement of the model

Suggestion	**Case**		
	Expert1	Expert2	Expert3
Additional steps between step two and three	✓		
State the benefits of the model	✓		
Additional specific strategies	✓	✓	
Additional illustrations and tables		✓	
Change titles		✓	✓
Set a specific timeline			✓
Provide summaries for partially competed goals			✓
Learners can participate in step four			✓

Table 10 show a matrix summary table to compare two cases of the external validation interview for the improvement of the model.

Table 10

A checklist matrix summary table related to external validation interviews of suggestions for improvement of the model

Suggestion	**Case**	
	Newly hired peer tutors	Experienced peer tutors
Additional steps between step two and three		✓
Additional specific strategies	✓	
Change titles		✓
Additional specific questions related to step two in step three	✓	
Use Likert scale in step three	✓	✓
Teach the model for peer tutees	✓	✓
Fill in the form before and after peer learning		✓
Provide learners' preliminary work before peer learning		✓

Results

Based on the matrix analysis, the results were established to generalize the findings from the five cases. These results were decided when more than two cases represented similar themes or categories. The results include the strengths of the model of peer learning, and serve to examine their impact on peer learning, as well as offer suggestions for their improvement.

Strengths of the model of peer learning. This model was developed based on a rigorous literature review. It was based on theoretical foundations such as sociocultural theory, ZPD, and the essential factors of scaffolding. This model was well aligned with the results of the literature review. Because the model draws upon the theoretical framework related to scaffolding, newly hired peer tutors and experienced peer tutors were able to learn the principles and important concepts of scaffolding through the online education program for peer tutors that was developed based on the model. They also learned various scaffolding strategies to help them determine appropriate peer learning activities.

The model was well structured with practicable and manageable steps. Because scaffolding strategies broke down into four steps, the model was clear, and made it easy to understand peer learning skills and to practice them in the real peer learning environment. This model was applicable to different learners and subjects. Based on the characteristics of a given learner or the specific problems of a subject, peers applied different scaffolding strategies using the model of peer learning. Step one was especially beneficial for peer learning activities. Through implementing step one, peers could understand the learners' problems and prior knowledge and set appropriate learning goals. The peer learning activities in step one comprised the important foundation to determine entire peer learning strategies. The model was more useful for newly hired peer tutors than for experienced peer tutors. Most experienced peer tutors had

prior peer learning experiences using scaffolding strategies, while newly hired peer tutors had not previously used scaffolding strategies in their peer learning activities. The model of peer learning, as operationalized in the online education program for peer tutors, therefore, was most useful for newly hired peer tutors to learn peer learning strategies and enhance their peer learning skills.

A list of suggestions. Based on an analysis of expert reviews and external validation interviews with peer tutors, to improve the model as operationalized in the online education program, more steps and explanation between steps two and three are needed. According to the model, if a learner does not achieve his or her learning goal, a peer figures out the learner's difficulties in step three and selects another appropriate scaffolding strategy in step two. This process should be explained further so that peers may understand that it is non-linear and practice it easily in their peer learning. More specific strategies are also required to provide detailed guidance for peers' practice. The titles of the four steps could be changed to represent these steps precisely. In step three, the Likert scale can be used in a rubric to examine a learner's achievement with precision. Because learners are unfamiliar with the model and do not yet know its importance, they need to familiarize themselves with the model briefly in advance of their peer learning so they may understand why this model is useful for their learning. Table 11 presents the list of revisions suggested for the model.

Table 11

A list of suggested revisions to the model as operationalized in an online education program

	Revision list
The model of peer learning	▪ Add more steps or explanations between steps two and three ▪ Add more specific strategies - State the benefits of the model - Add more detailed explanations and bullets in step two ▪ Change titles - Step 1: Getting to know a learner - Step 2: Guided instruction using scaffolding

	- Step 3: Assessing learning goals - Step 4: Summary of learning ▪ Use the Likert scale in step three ▪ Teach the model for learners

Chapter 6: Discussion and Conclusions

Peer learning supports learners in acquiring new knowledge, understanding different notions or concepts, taking responsibility for their learning, attaining positive relationships with other learners, and enhancing their social skills, by interacting with peers and other learners in group activities (Keppell, Au, Ma, & Chan, 2006; Majid & Tina, 2009). However, peers are sometimes unprepared to support others' learning in peer learning environments. This can make it difficult for learners to partake in an effective peer learning process with their peers. One strategy to enhance peers' teaching skills and learners' ability to acquire new skills and knowledge in peer learning is scaffolding. Though some previous models of peer learning have focused on questioning skills (e.g. King, 1997; Sevenhuysen et al., 2013; Webb, 1989), these models did not include the entire scaffolding process, from diagnosis to fading. To overcome this limitation, the current study developed a conceptual model of peer learning incorporating scaffolding strategies, to help peers design activities for other learners.

Design and development research, including model development and model validation (Richey & Klein, 2007), was implemented to develop and validate the model. This study consisted of four phases: a literature review to determine model elements, model development, internal and external model validation, and revision. In phase one, an intensive literature review was conducted to build the foundation for the development of the model. Through literature review, previous research regarding related theories, the conceptualization of scaffolding, and the operationalization of scaffolding was examined and analyzed to identify common findings. These findings were then synthesized to determine the main elements of the model. Development of the conceptual model was informed by the results of the intensive literature review. The resulting model contains four steps: knowing each other, learning together, checking what you

learned, and finalizing peer learning. This model was developed using theoretical foundations such as sociocultural theory and ZPD, the conceptualization of scaffolding (e.g. intersubjectivity, ongoing diagnosis, and fading), the three dimensions for operationalizing scaffolding (the level of scaffolding, the type of scaffolding, and scaffolding methods). This model was then operationalized into an online education program for peer tutors who participated in peer tutoring, which is one of the three types of peer learning, for the purpose of model validation. In phase three, in order to verify the elements and processes of the model, expert review was conducted with three experts in the areas of scaffolding, peer learning, and instructional design and technology. Newly hired peer tutors and experienced peer tutors in the peer tutoring program completed the online education program then participated in external validation interviews for external validation to examine the model's impact on the actual peer learning environment. In the final phase, a list of suggested revisions was synthesized based on the findings of the expert review and external validation interviews with the peer tutors.

In this chapter, the main results of this study and their possible interpretations are discussed, along with the related literature, to answer the questions posed by this research. Implications for higher education and instructional design and technology are also presented for future usage. Lastly, the limitations of study and its implications for future research are discussed to enhance future research in this field.

Contributions of the Study

This conceptual model of peer learning was developed by means of synthesizing the theories and main principles of scaffolding to provide scaffolding strategies for peer learning activities. Scaffolding is an effective teaching and learning strategy for designing peer learning environments, from the initial diagnosis to the final assessment. Through incorporating

scaffolding strategies, this model of peer learning has significant potential to provide guidance for designing peer learning activities and enhancing peers' teaching skills. Instructors and instructional designers also can apply this model when training peers or designing peer learning activities in both online or face-to-face learning contexts. This study was implemented to answer the following research questions:

1. What elements should be included in a model of peer learning that incorporates scaffolding strategies?
2. How can the model be developed to operationalize all elements of scaffolding?
3. How does the proposed model of peer learning impact the knowledge, skills, and practices addressed through peer learning?
4. How can this model of peer learning be improved?

Elements of the model. For the development of the model of peer learning to incorporate scaffolding strategies, sociocultural theory and ZPD were applied as theoretical foundations. Sociocultural theory insists that learning is entrenched within social procedures, and that social interaction is important for the improvement of learning (Vygotsky, 1978). Sociocultural theory is commonly related to scaffolding because its main characteristics are associated with scaffolding (Van de Pol et al., 2010; Walqui, 2006). According to sociocultural theory, (1) scaffolding includes a social procedure with interpersonal activities; (2) scaffolding is intermediated by symbols and tools; (3) scaffolding is removed ultimately from the learning procedure when the learner appropriates and internalizes the new concepts or knowledge (Turner & Berkowitz, 2005). From the perspective of sociocultural theory, scaffolding occurs through ZPD, which is "the distance between the actual level as determined by independent problem-solving and the level of potential development as determined through problem-solving in

collaboration with more capable peers" (Vygotsky, 1978, p. 86).

The concept of scaffolding includes characteristics such as intersubjectivity, a scaffolder as an assistant, ongoing diagnosis, calibrated support, and fading (Davis, 2015; Van de Pol et al., 2010). Scaffolding begins when a scaffolder and a learner discuss the learner's problems and prior knowledge, and then set shared learning goals. The scaffolder offers calibrated support to learners based on their current understanding (Van de Pol et al., 2010). During scaffolding, ongoing diagnosis is essential to provide appropriate assistance, through continuously adjusting the offered guidance based on the learner's changing abilities and knowledge (Puntambekar & Hubscher, 2005). Eventually, if the learners accomplish their learning objectives, the scaffolder fades assistance and transfers the responsibility for learning to the learners so that they can control their own learning (Van de Pol et al., 2010).

Three dimensions of scaffolding were presented to operationalize scaffolding. They consist of the level of scaffolding, the type of scaffolding, and scaffolding methods. The level of scaffolding includes high-level and low-level of scaffolding. High-level scaffolding is applicable to provide supplementary teaching tactics for learners who have few cognitive tactics and exhibit low current understanding (Smith & Ragan, 1999). In contrast, if learners can employ multiple cognitive tactics and display sufficient prior knowledge, low-level scaffolding can be employed (Dabbagh, 2003; Pentimonti & Justice, 2010). The type of scaffolding includes conceptual scaffolding and strategic scaffolding. Conceptual scaffolding focuses on aiding learners in comprehending the problem at hand, and allows them to gain a more accurate understanding of it. Strategic scaffolding, on the other hand, prompts learners to offer their own inquiries about the current subject and guides them to different ways of tackling it successfully. (Yu et al., 2013). Scaffolding methods include direct instructions (e.g. hints, questioning, and prompting) and

indirect instructions (e.g. feedback, explanations, and modeling).

The development of the model of peer learning. The present model of peer learning was developed based on the elements of scaffolding discussed above (sociocultural theory, ZPD, the concept of scaffolding, and the three dimensions of scaffolding). This model includes four steps and sub-steps to operationalize all elements of scaffolding.

In the first step, knowing each other, peers execute a first diagnosis with learners to understand their problems or concerns and discern their prior knowledge related to these problems. Based on the results of this first diagnosis, peers can determine learners' ZPD, the distance between their current and expected capabilities (Vygotsky, 1978). Learners' target abilities for problem-solving can be set as learning goals for peer learning. Through setting learning goals, intersubjectivity is implemented to share the goals of learning between learners and peers (Yelland & Masters, 2007).

In the second step, a peer and a learner work together using appropriate scaffolding strategies. A peer determines specific scaffolding strategies based on a learner's current abilities and the characteristics of his or her problems. The three dimensions, (the type of scaffolding, the level of scaffolding, and scaffolding methods), are utilized to help a peer select and provide suitable scaffolding strategies. A peer determines the type of scaffolding based on the characteristics of the learner. Conceptual scaffolding can be selected when a learner does not know the essential concepts to solve problems, while strategic scaffolding can be utilized if a learner is not familiar with problem-solving tactics (Hill & Hannafin, 2001; Hsiao, 2017). The level of scaffolding and scaffolding methods are determined by a learner's prior knowledge and current skills related to problem-solving. A peer offers direct instructions with high-level scaffolding when a learner does not have high prior knowledge and various tactics to solve

problems, whereas a peer provides indirect instructions with low-level scaffolding when a learner has high prior knowledge and can employ numerous tactics (Dabbagh, 2003; Pentimonti & Justice, 2010; Smith & Ragan, 1999). As a scaffolder, a peer facilitates learning activities using selected scaffolding strategies (Granott, 2005).

In the third step, a peer assesses a learner's achievement. A peer's ongoing assessment leads to the provision of an exact calibration of assistance, so that a peer can offer the appropriate level and type of assistance (Puntambekar & Hubscher, 2005). Through an assessment in step three, a peer recognizes a learner's progress toward achieving learning goals. If a learner does not achieve their learning goals, a peer returns to step two and selects different scaffolding strategies based on the results of the assessment in the third step. When a learner accomplishes the learning goals, the peer reduces scaffolding and transfers responsibility to the learner, who should ultimately be able to achieve the anticipated learning goals in the absence of scaffolding strategies (Kim, Belland, & Axelrod, 2019).

In the final step, a peer provides and summarizes important comments or feedback to enable a learner to remember important concepts and strategies for future problem-solving. Summarized feedback is also useful to confirm a learner's current learning abilities and recognize overlooked questions or problems before completing peer learning (Nelson & Schunn, 2009). Peer learning can be concluded when a peer and a learner have no shared issues during the feedback stage.

For external validation, an online education program was developed to teach all steps of the model of peer learning to peer tutors who provided peer tutoring activities which is one type of peer learning. Based on Gagne's nine events of instruction (Gagne et al., 2005), an online education program including nine steps was provided to stimulate and assist peer tutors to learn

all the steps in the model. An electronic form and handout were included to enhance peer tutors' practice and retention. Through this online education program, peer tutors learned and practiced how to apply the model of peer learning to their peer tutoring activities with peer tutees.

Impacts of the model of peer learning. According to the results of model validation using expert reviews and external validation interviews with peer tutors, this model of peer learning, as operationalized in the online education program, does impact peers' knowledge, skills, and practices related to scaffolding in their peer learning activities.

Peers gained essential knowledge related to scaffolding, such as the concept of scaffolding, its main underlying assumptions, and various relevant strategies, via the online education program based on the model. Prior research has shown that peers who are familiar with scaffolding strategies facilitate learners' effective learning, prompt critical questions and reflections, and cultivate teamwork in their peer learning (Boud, 2001). They also supervise learners in the learning progress, assist each other, and confirm that learners achieve their learning goals (Liaw, Chen, & Huang, 2008; Razak & See, 2010).

Peers also can enhance their teaching skills for peer learning using the structured steps and various scaffolding strategies of this model. According to the findings of model validation, this model is well organized and structured, with manageable steps that are easy to follow. Through the structured steps of the model, peers encourage learners to interact with them and participate in their own learning procedures (Davidson & Major, 2014). Using this model, peers also acquired various scaffolding strategies to utilize these skills across different subjects and with different learners. Depending on the specific characteristics of an individual learner, and the overall context of his or her learning, scaffolding is applicable to providing feedback for appropriate learning tasks and personalized cues at the right time (Gómez, Zervas, Sampson, &

Fabregat, 2014). By learning the diverse scaffolding strategies of the model, peers are able to offer suitable teaching and learning strategies for each learner in a personalized way. In particular, the scaffolding tactics in the model are helpful for peers who lack peer learning experience. The peer tutors in this study argued that the current model was useful for newly hired tutors unfamiliar with teaching strategies and procedures for peer learning, a common difficulty faced by novice peer tutors. Therefore, a more structured strategy is required so that they can gain peer learning skills (Chan & Leijten, 2012). The model provides novices with opportunities to learn scaffolding strategies for effective peer learning.

Suggestions for the improvement of the model. Based on the results of model validation, several suggestions were proposed to improve the model to help peers understand and practice scaffolding strategies for their peer learning.

More steps or explanations could be added to explain how non-linear processes work in the model. The present model of peer learning proposed non-linear processes because it involves a problem-solving process. A widespread non-linear model of problem-solving asks learners to pinpoint the problem and formulate novel solutions. To do this, they must locate the relevant information and establish the best method to achieve their goal through experimentation (Crawford, 2014). Through the current model, peers and learners recognize learners' problems and find and test solutions in peer learning environments. Therefore, the main characteristic of this model is a non-linear scaffolding process for problem-solving. For example, the non-linear scaffolding process between steps one and two should be further delineated so that peers can understand specific strategies to employ when learners do not achieve their learning goals after providing the initial scaffolding strategies.

According to Richey (2005), a model helps establish guidelines for design and assists

practitioners in integrating theory into their practice. In this study, the model was developed to provide standards and strategies for peers to design and practice scaffolding in peer learning environments. To help peers use the model for their learning activities, it should include more specific strategies and descriptions to enhance their understanding. For example, the model could include scaffolding's specific benefits and more detailed explanations of how to implement the model easily. Titles in all steps could also be changed specifically to enhance peers' understanding of the model.

To assist with the evaluation of learners' achievement in peer learning, a Likert scale can be utilized in a rubric. Likert scales, which present the array of replies to a research question, are typically utilized to measure perspectives on a given subject or problem (Jamieson, 2004). In this model, an evaluation using a rubric is conducted to examine whether or not learners achieve learning goals using related concepts and strategies. In other words, the purpose of the evaluation in the model is to measure their progress through a method other than grading. Likert scales can be used effectively in the model to examine the extent to which learners understand strategies and concepts, and how they achieve their learning goals.

The main purpose of the model is to enhance peers' teaching skills and learners' ability to acquire new skills and knowledge. Although peers who are in the teaching role can provide skillful scaffolding strategies using the model, if peer learners do not recognize the importance of the model and its specific strategies, they will find difficulties to participate in their peer learning actively. Peers can be introduced to the model before beginning peer learning to better facilitate their participation.

Limitations of the Study

This research investigates a model of peer learning, which incorporates scaffolding

strategies to design a peer learning environment. Despite the potential value of this study, this research has three limitations related to external validation. First, this study examined the implementation of a peer tutoring program in a public university. This means that the results of external validation are not applicable to peer tutoring programs in all the universities. Second, the results of external validation derived from a peer tutoring program, which is only one form of peer learning. This study did not conduct external validation in cooperative learning and collaborative learning environments, which are other types of peer learning. Therefore, the findings of external validation are not applicable to cooperative learning and collaborative learning settings. Third, although this model was developed to apply to all subjects or areas, external validation was only conducted in certain areas such as mathematics, science, and language. Therefore, the results of external validation are not generalized in all subjects or areas. In addition, in this study, model development and model validation were conducted by the same researcher.

Implications for Future Research

In design and development research, model research consists of model development, model validation, and model use research (Richey & Klein, 2007). In this study, model development research and model validation research were conducted to develop and validate a model of peer learning. Therefore, in future research, model use research should be employed to demonstrate the effectiveness of the use of the model in a variety of peer learning settings. For example, future research might examine the effectiveness of the model in various types of peer learning environments (e.g. collaborative learning and cooperative learning), across various subjects (e.g. mathematics, linguistics, and education), and various types of learning form (e.g. online learning, face-to-face learning, or blended learning).

Although the purpose of the model is to enhance peers' teaching skills and learners' capacity to acquire new knowledge, this research only examined the perspectives of peers who were in the teaching role. So, future research should focus on learners' experiences of using the model in their peer learning activities. Using an experimental study, learners' specific learning outcomes in peer learning that applied the model might be identified and compared to learners in peer learning scenarios lacking the model. Learners' perspectives could also be examined through qualitative research to describe their peer learning experiences using the model and the specific effects of the model.

This research presented a list of suggested revisions for the improvement of the model. Based on this list, the model could be revised and reimplemented in another peer learning environment. Future research can investigate how the revised model impacts peers' teaching skills and learners' ability to acquire new skills and knowledge, and explore other suggestions for further improvement of the model.

Conclusion

This study was conducted to develop and validate a model for a peer learning environment based on scaffolding strategies. To validate the developed model, external and internal validation were implemented to gain feedback from expert reviewers and peer tutors regarding the effectiveness of the model in authentic peer learning environments.

For the development of the model, various elements of scaffolding, such as Vygotsky's (1978) sociocultural theory, ZPD, and the main concepts of scaffolding were incorporated. The results of this study indicated that the scaffolding strategies of the model can benefit peers, especially peer tutors in this research, in designing their peer learning activities and improving their teaching skills. In addition, the structured model was useful for peers who were functioning

in a teaching role when implementing scaffolding strategies, allowing them to avoid difficulties in their peer learning activities.

This study represented the potential of the model to provide effective peer learning environments. The model might be an effective instructional strategy for peers to provide appropriate scaffolding strategies for their learners. The model also may be beneficial for instructors, instructional designers, and administrators designing peer learning environments, whether in online or face-to-face environments, and could also be used for effective peer training.

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Appendix A. IRB Approval

VIRGINIA TECH

Division of Scholarly Integrity and Research Compliance
Institutional Review Board
North End Center, Suite 4120 (MC 0497)
300 Turner Street NW
Blacksburg, Virginia 24061
540/231-3732
irb@vt.edu
http://www.research.vt.edu/sirc/hrpp

MEMORANDUM

DATE: October 18, 2019

TO: Katherine S Cennamo, Jeeyoung Chun

FROM: Virginia Tech Institutional Review Board (FWA00000572, expires January 29, 2021)

PROTOCOL TITLE: A Model of Peer Learning Incorporating Scaffolding Strategies

IRB NUMBER: 19-351

Effective October 18, 2019, the Virginia Tech Human Research Protection Program (HRPP) and Institutional Review Board (IRB) determined that this protocol meets the criteria for exemption from IRB review under 45 CFR 46.104(d) category(ies) 2(ii).

Ongoing IRB review and approval by this organization is not required. This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these activities impact the exempt determination, please submit a new request to the IRB for a determination.

This exempt determination does not apply to any collaborating institution(s). The Virginia Tech HRPP and IRB cannot provide an exemption that overrides the jurisdiction of a local IRB or other institutional mechanism for determining exemptions.

All investigators (listed above) are required to comply with the researcher requirements outlined at:

https://secure.research.vt.edu/external/irb/responsibilities.htm

(Please review responsibilities before beginning your research.)

PROTOCOL INFORMATION:

Determined As: **Exempt, under 45 CFR 46.104(d) category(ies) 2(ii)**
Protocol Determination Date: **May 21, 2019**

ASSOCIATED FUNDING:

The table on the following page indicates whether grant proposals are related to this protocol, and which of the listed proposals, if any, have been compared to this protocol, if required.

Appendix B. Expert Reviewer Consent Form

Title of Research:

A Model of Peer Learning Incorporating Scaffolding Strategies

Principal Investigator

Dr. Katherine S. Cennamo, Virginia Tech

Jeeyoung Chun, Doctoral learner at Virginia Tech

I. Purpose

The purpose of this study is to develop and validate a model of peer learning incorporating scaffolding strategies to enhance peers' teaching skills and learners' ability to acquire new skills and knowledge. This study a) conducts a comprehensive literature review to develop a model of peer learning to support scaffolding in a peer learning environment, b) develops the model of peer learning based on the results of the literature review and a related online education program to provide peers with guidelines to design peer learning incorporating scaffolding strategies, c) validates the model of peer learning through expert review and external validation interview, and d) revises the model of peer learning using the data from model validation.

II. Procedure

If you agree to participate in this study, you will be an expert reviewer for this study. The expert review consists of questions regarding the model of peer learning. The expert reviewer will examine the validity and feasibility of the model of peer learning. The expert reviewer will provide written feedback regarding the model of peer learning via email.

III. Risks

There are minimal risks associated with participation in this study. Risks to participants are no greater than the risks associated with normal conversation. In addition, you have the right to withdraw from participation at any time by notifying the researcher in writing or in-person of your desire to withdraw.

IV. Benefits

There are no direct benefits to you for participation in this study. No promise or guarantee of benefits has been made to encourage you to participate.

V. Extent of Anonymity and Confidentiality

The researcher will keep all collected data confidential. While information gathered from the study may be used in a dissertation, presentations, and articles in professional journals, the participant's name or any other private information will not be used in any dissertation, presentation, or article, and identifying information will be changed so that data cannot be connected to individuals. Pseudonyms will be used. Every effort will be made to ensure no identifying characteristics of the participant will be revealed in any reporting of the data.
The researcher will analyze the written feedback. Only the researcher, peer reviewers, and committee members will have access to data. All the data will be destroyed after completing the study.

The Institutional Review Board (IRB) may view this study's collected data for auditing purposes. The IRB is responsible for the oversight of the protection of human subjects involved in research.

VI. Compensation

Participation in this study is voluntary. You will not be compensated for participating in this study.

VII. Freedom to Withdraw

You are free to withdraw from this study at any time without penalty. You are free to not respond to any research questions that you choose. You are free to request that any response of yours be removed from the data set without penalty. There may be circumstances under which the investigators may determine that you should not continue to be involved in the study.

VIII. Subjects' Responsibilities and Permission

I voluntarily agree to participate in the research. I have the following responsibilities: to review the scaffolding, peer learning, and model usability as an expert reviewer; and to respond to a set of questions to provide feedback through email including follow-up reviews if needed.

I have read the Consent Form and condition of this project. I have had all my questions answered. By signing this form and scheduling a time for the review, I hereby acknowledge the above and give my voluntary consent.

_____ _____

Participant's Signature Date

Should I have any questions about this research or its conduct, I may contact:

Dr. Katherine S. Cennamo 540-231-9122 cennamo@vt.edu

Jeeyoung Chun 706-461-9454 jeeyoung@vt.edu

Appendix C. Research Participant Consent Form for the External validation interview

Title of Research:

A Model of Peer Learning Incorporating Scaffolding Strategies

Principal Investigator

Dr. Katherine S. Cennamo, Virginia Tech

Jeeyoung Chun, Doctoral learner at Virginia Tech

I. Purpose

The purpose of this study is to develop and validate a model of peer learning incorporating scaffolding strategies to enhance peers' teaching skills and learners' ability to acquire new skills and knowledge. This study a) conducts a comprehensive literature review to develop the model of peer learning to support scaffolding in a peer learning environment, b) develops the model of peer learning based on the results of the literature review and a related online education program to provide peers with guidelines to design peer learning incorporating scaffolding strategies, c) validates the model of peer learning through expert review and external validation interview, and d) revises the model of peer learning using the data of model validation.

II. Procedure

If you agree to participate in this study, you will have a face-to-face interview with the researcher. The interview will be conducted to ask questions regarding the model of peer learning and the related online education program. The interview will take approximately 60 minutes and will be recorded via a voice recorder. This recording will be transcribed. You will review your responses after the transcription has been written. You will be able to ask any questions regarding this study and revise or delete the response.

III. Risks

There are minimal risks associated with participation in this study. Risks to participants are no greater than the risks associated with normal conversation. In addition, you have the right to withdraw from participation at any time by notifying the researcher in writing or in-person of your desire to withdraw.

IV. Benefits

There are no direct benefits to you for participation in this study. No promise or guarantee of benefits has been made to encourage you to participate.

V. Extent of Anonymity and Confidentiality

The researcher will keep all data collected confidential. While information gathered from the study may be used in dissertation, presentations, and articles in professional journals, the participant's name or any other private information will not be used in any dissertation, presentation, or article and identifying information will be changed so that data cannot be connected to individual. Pseudonyms will be used. Every effort will be made to ensure no identifying characteristics of the participant will be revealed in any reporting of the data.
The researcher will transcribe the audio recording for the analysis. Only the researcher, peer reviewers, and committee members will have access to the transcriptions and recording files. The audio recording files will be destroyed after reporting of results is completed. All other study resources will be saved for more than three years in secure locations. When all the research project reporting are finished, the data will be destroyed.

The Institutional Review Board (IRB) may view this study's collected data for auditing purposes. The IRB is responsible for the oversight of the protection of human subjects involved in research.

VI. Compensation

Participation in this study is voluntary. You will not be compensated for participating in this study.

VII. Freedom to Withdraw

You are free to withdraw from this study at any time without penalty. You are free to not respond to any research questions that you choose. You are free to request that any response of yours be removed from the data set without penalty. There may be circumstances under which the investigators may determine that you should not continue to be involved in the study.

VIII. Subjects' Responsibilities and Permission

I voluntarily agree to participate in the research. I have the following responsibilities: to review the online educational materials and to participate in the research for the information base and a face-to-face interview including follow-up interview if needed.

I have read the Consent Form and condition of this project. I have had all my questions answered. By signing this form and scheduling a time for the review, I hereby acknowledge the above and give my voluntary consent.

_____ _____

Participant's Signature Date

Should I have any questions about this research or its conduct, I may contact:

Dr. Katherine S. Cennamo 540-231-9122 cennamo@vt.edu

Jeeyoung Chun 706-461-9454 jeeyoung@vt.edu

Appendix D. Questions for Expert Review

Demographic Information

1. What is the highest level of education you have completed? / What is your major? (e.g. Ph.D./Education)

2. What is your gender? (e.g. Female)

3. What is your age? (e.g. 40)

4. What is your job or position? (e.g. Instructor at a university)

5. What is your relevant expertise for the expert review? (e.g. Scaffolding)

Review Questions

1. Do you think the model of peer learning will help peers incorporate scaffolding strategies to enhance their teaching skills and learners' skills in peer learning? Please explain.

2. What are the strengths and weaknesses of the model of peer learning?

3. Could you provide any additional comments or suggestions that you think would help make improvements to this model?

4. Could you tell me if you had any ideas for enhancing or modifying the online educational program when you reviewed it?

5. If you are an expert regarding scaffolding, to what degree does the model of peer learning demonstrate the advantages of incorporating scaffolding to enhance peers' teaching skills in a peer learning environment?

6. If you are an expert regarding peer learning, do you think the model of peer learning will facilitate learners' learning in a peer learning environment? Please explain.

7. If you are an expert regarding instructional design, are there any particular elements of the model that need adjustment, in your view?

Appendix E. Interview Protocol for the External validation interview

Interviewer: _____

Participant pseudonym: _____

Date & Time: _____

Introduction

The purpose of this study is to develop and validate a model of peer learning incorporating scaffolding strategies to enhance peers' teaching skills and learners' ability to acquire new skills and knowledge. This interview will ask about your experience using of the model of peer learning in your peer learning setting.

Consent form

The interviewee will receive the consent form and sign it before participating in the interview.

Audio recording

The researcher will inform the participant that recording will be started when the interview begins.

Interview questions

Demographic Information

1**.** What year are you in?

2. What is your major and minor?

3. What is your gender?

4. What is your age?

5. When did you start peer tutoring? Did you work here last year? If not, are you a newly hired

peer tutor?

6. What kind of subjects or courses are you teaching in the peer tutoring program?

Prior experience regarding peer learning strategies

1. Prior to your participation in this study, have you ever learned scaffolding strategies to use for peer learning? If yes, what did you learn?

2. Prior to your participation in this study, have you ever used scaffolding strategies in peer learning? If yes, what kind of learning strategies did you use?

Perceptions of the model of peer learning

3. What did you learn through the online education program about the model of peer learning?

4. What did you think about the model of peer learning when you took the online education program?

5. What were some strengths of the model of peer learning?

6. What were some weakness of the model of peer learning?

7. How did you use the model of peer learning in your peer tutoring?

8. (If you worked last academic year as a peer tutor) Did your peer tutoring activities change after learning the model of peer learning? Please explain whether or not your peer tutoring activities changed significantly after you learned the model of peer learning.

9. How did the model of peer learning impact your peer tutoring activities?

10. When you used electronic materials such as a worksheet and a rubric, did you think they were helpful for peer tutoring activities? Could you explain?

11. Did you think of any suggestions for improving or correcting the model of peer learning when you used it in your peer tutoring? If so, would you explain your suggestions?

Perceptions of the online education program regarding the model of peer learning

12. When you took the online education program, did you find any functional problems? If yes, what kind of functional problem did you encounter?

13. The online education program regarding the model of peer learning was delivered through videos, text explanations, and additional electronic materials. Did you think these multimedia components were helpful to learn the model of peer learning? Could you tell me details regarding your opinion?

14. Could you tell me if you had any ideas for enhancing or modifying the online educational program when you took it?

Stop recording and thank the participant for their responses. The researcher will give a $15 gift card in appreciation for participation in the interview.

The participant's responses will be saved and kept confidential, and they will review their responses after transcriptions are created. The participant will be able to ask any questions regarding this study and revise or delete their responses.

Appendix F. An Electronic Form in an Online Education Program

Step 1. Knowing Each Other

Learner's name: _____

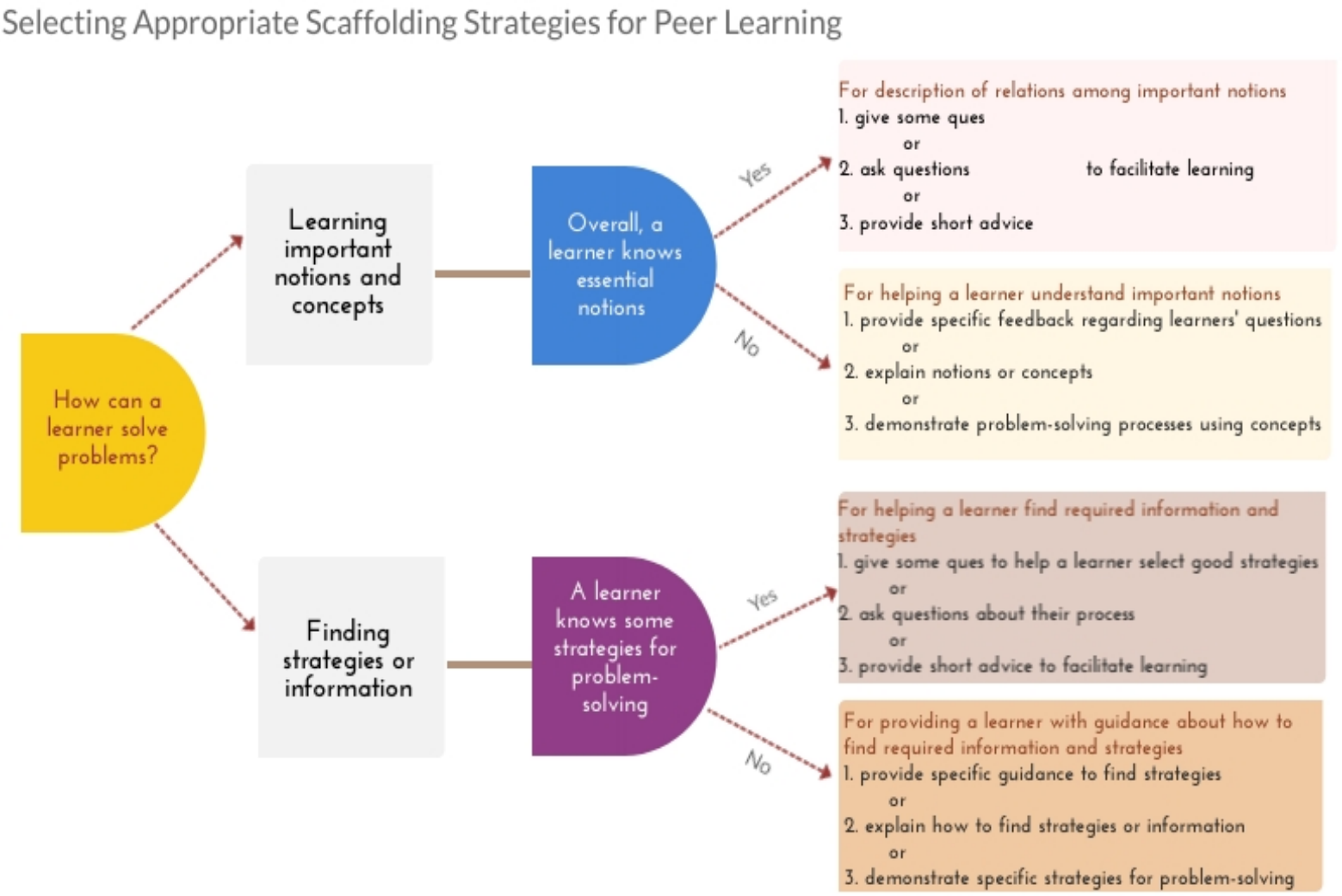
Date & Time: _____

What are the learner's questions?	What does the learner know about questions?

What are the learning goals today?

Step 2. Learning Together

To select scaffolding strategies, please answer each question using the flowchart below.



Step 3. Checking what you learned

Please place a check mark to examine a learner's achievement.

Questions	Yes	No
1. The learner knows important notions to solve problems.		
2. The learner understands how related notions are utilized to solve problems.		
3. The learner knows strategies for solving problems.		
4. The learner's responses to my questions are correct.		
5. The learner can use additional resources related to solving problems.		
6. The learner can solve problems without any help.		
7. Overall, the learner achieves learning goals.		

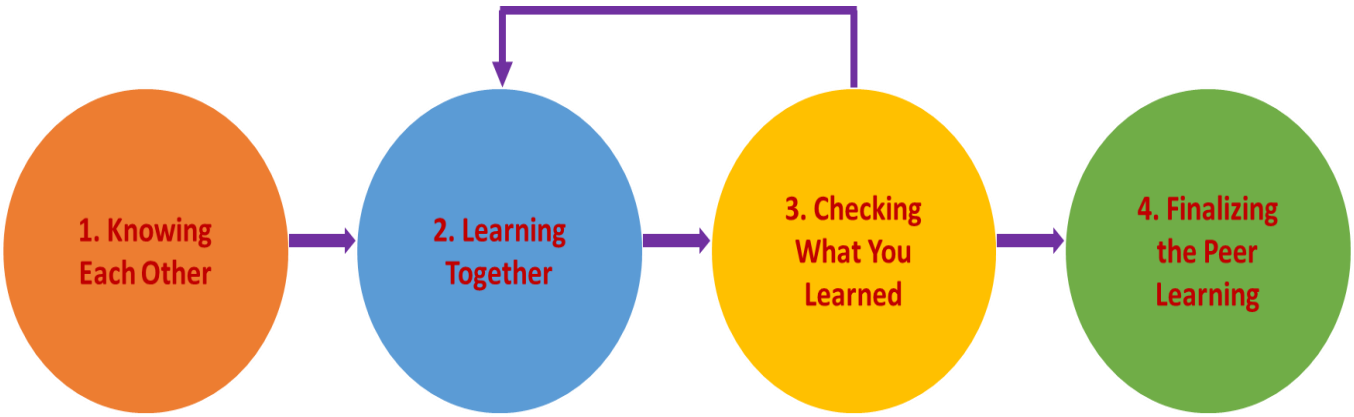
Step 4. Finalizing the peer learning

Explain and write summaries using the form below

Summary of important feedback in this peer learning session
■ ■ ■ ■

Appendix G. A Handout in an Online Education Program

A MODEL OF PEER LEARNING



A HANDBOOK FOR DESIGNING PEER LEARNING ENVIRONMENTS

TABLE OF CONTENTS

WHAT IS SCAFFOLDING?

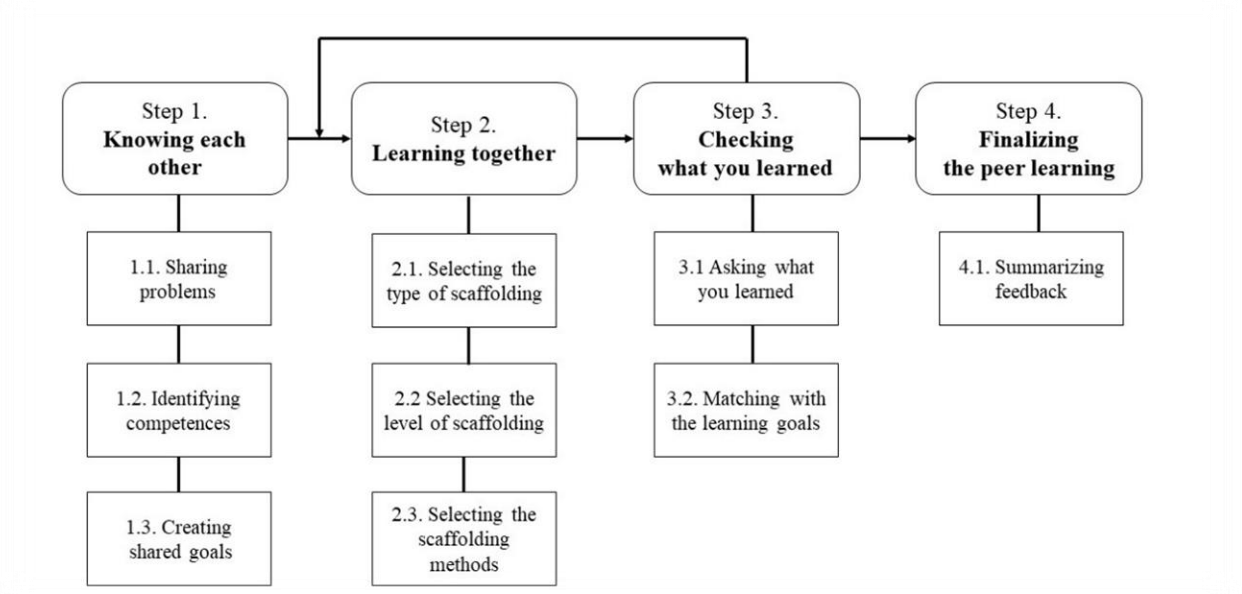
The notion of scaffolding in an educational setting is derived from the metaphor of scaffolding in architecture. In construction, scaffolding is a temporary form to assist and shield the building and is disassembled once construction is complete. Though impermanent, scaffolding is vital for successful construction of a building.

Scaffolding is defined as efforts to provide support to a learner who could not otherwise solve a problem or understand the content presented. The goal of scaffolding is that learners will ultimately perform similar learning activities on their own.

There are three main features of scaffolding: (1) understanding shared goals for learning activities, (2) suitable guidance based on continuing diagnosis of the students' current comprehension, and (3) fading. The scaffolder is in charge of using the characteristics of scaffolding to offer assistance sufficient for the student to be able to accomplish a learning task.

A MODEL OF PEER LEARNING

There are 4 steps for peer learning. Peer tutors can use this model to design their peer learning activities. Each step includes different scaffolding activities.



Step 1: knowing each other.

For the first step, peer tutors recognize learners' problems or concerns regarding their problem-solving activities in peer learning. Peer tutors also ask learners about their prior knowledge and their skills related to these problems. Based on their problems and competences, peer tutors and learners set learning goals to start peer learning activities.

Step 2: learning together.

The second step aims to guide peer tutors to use appropriate scaffolding strategies based on a learner's current ability and the characteristics of problems. When the peer tutors choose scaffolding strategies, they consider the level of scaffolding, the type of scaffolding, and scaffolding methods.

Step 3: checking what you learned.

The third step is to help peer tutors assess learners' learning progress during peer learning activities. Through ongoing assessments, peer tutors identify learners' current learning progress and revise their instructions. When learners achieve their learning goals, peer tutors finish peer learning activities.

Step 4: finalizing peer learning.

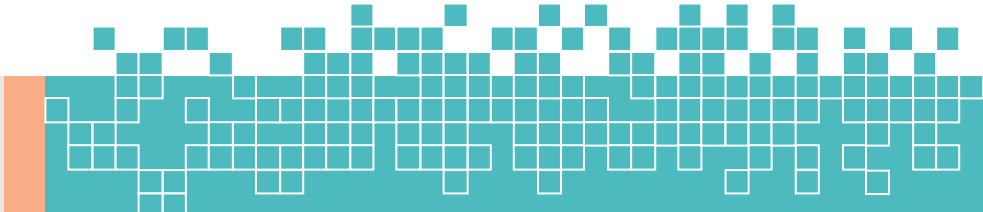
The fourth step is to finalize the peer learning by summarizing the provided feedback at the end of the peer learning activity. Peer tutors and learners confirm important concepts or strategies during their peer learning activities and find disregarded problems before concluding the peer learning activities.

STEP 1: KNOWING EACH OTHER

When a peer tutor meets with learners for peer learning activities, the peer tutor asks them about their problems or concerns, and their current abilities related to the problem. Based on learners' answers, the peer tutor and learners set shared learning goals.

1. Asking learners' problems or concerns

When the peer tutor meets a learner, the peer tutor asks him/her about these topics.



- Name and major
- Major concerns or problems
- Course name related to problems

2. Asking learners' current abilities

The peer tutor needs to figure out the principles or skills necessary to solve a learner's problems after the learner answers the peer tutor's questions. To understand the learner's current capabilities, the peer tutor asks the learners about whether or not they know the main principles or skills of problem-solving.

3. Setting learning goals

If the peer tutor understands a learner's problems and current abilities, the peer tutor suggests learning goals for peer learning activities. Learning goals are related to acquiring the essential skills and knowledge to solve the learner's specific problems. When the learner agrees to study based on the learning objectives the peer tutor suggests, the peer tutor and the learner can start peer learning. However, if the learner proposes other learning goals, the learner and the peer tutor revise learning objectives with their agreement.

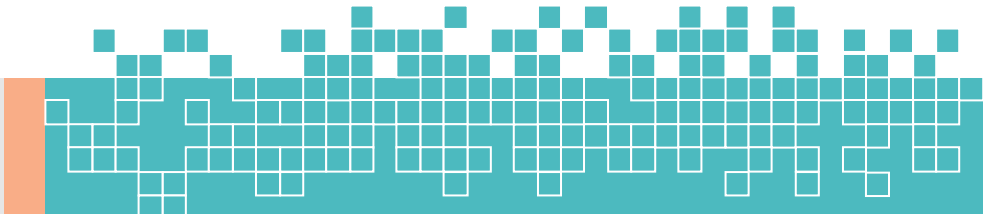
√ The peer tutor can download the form for step 1 activities in Appedix A. The peer can write: 1) learner's name and data, 2) learner's questions or concerns, 3) learner's current abilities, and 4) shared learning goals.

STEP 2: LEARNING TOGETHER

To solve a learner's problems, a peer tutor needs to provide appropriate peer learning strategies. The peer tutor selects peer learning strategies based on the type of learner's problems and current capabilities.

1. Select the level of scaffolding

After the peer tutor ascertains to the learner's current abilities, the peer tutor needs to figure out the level of scaffolding. There are two levels of scaffolding:



High-level scaffolding	• Low prior knowledge • Few cognitive tactics • High apprehension • Low engagement • An external locus of control
Low-level scaffolding	• High prior knowledge • Various cognitive tactics • Low concern • Malleable and high motivation • An internal locus of control

The peer tutor selects the level of scaffolding and confirms it with the learner.

2. Select the type of scaffolding

Based on the type of learner's questions, the peer tutor can select the type of scaffolding. The peer tutor can choose one of two types of scaffolding.

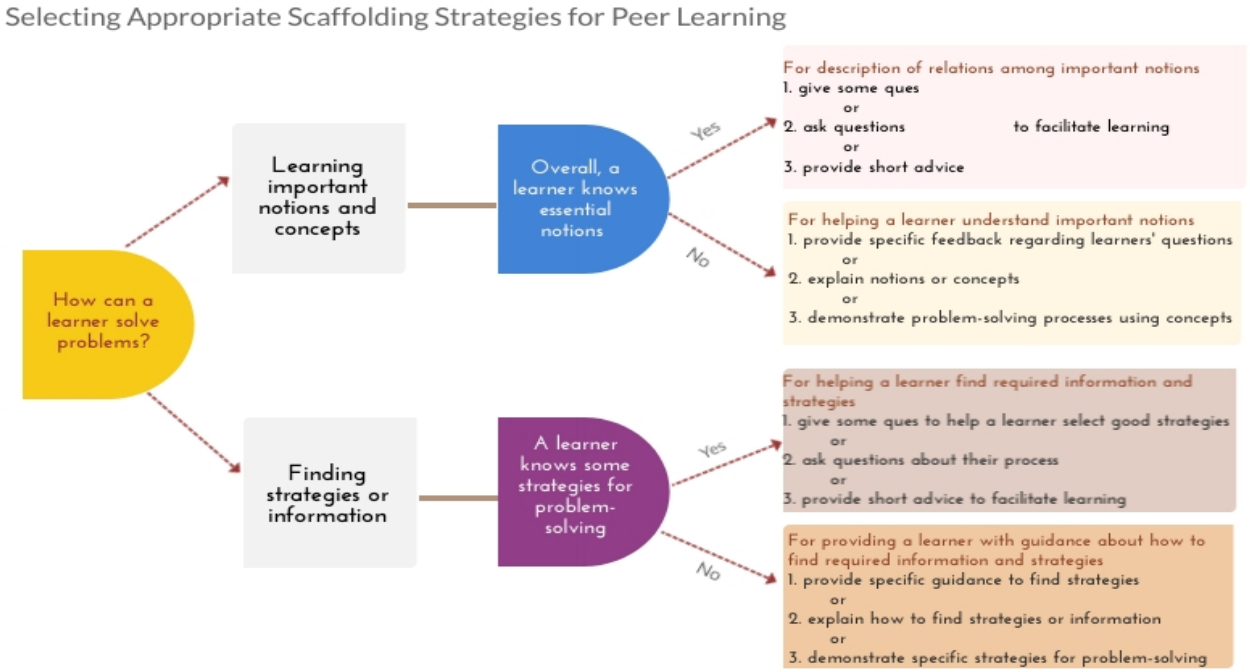
Conceptual scaffolding	Assists learners in deciding what they want to study, what they perceive, how current knowledge and the subject are associated, and how new subjects can be arranged with regard to field knowledge
Strategic scaffolding	Help learners identify and assess information, as well as receive guidance to find an appropriate tactic for problem-solving

3. Select scaffolding methods

Based on the level of scaffolding and the type of scaffolding the peer tutor selects, the peer tutor can choose scaffolding methods. When the peer tutor uses direct guidance to help the learner study important notions or learning strategies, the peer tutor provides specific feedback, explanations, and modeling. In contrast, if the peer tutor selects indirect strategies, the peer tutor can provide hints, questions, and prompts to facilitate a learner's advanced learning.

Direct instruction	• Feedback: provide knowledge related to a learner's capability • Explanation: offer more reasoning or more detail • Modeling: demonstrate for learners directly by stating what a specialist would do when confronted with a comparable problem
Indirect instruction	• Hint: give clues on the types of ideas a learner should examine and express in their reasoning • Question: ask questions for scheduling, checking, and assessing, and making rationalizations • Prompt: stimulate learning activities and facilitate reflection regarding learning tasks

The peer can use the flowchart to select appropriate scaffolding strategies. (see Appendix A)



√ The peer can use the flowchart when the peer designs peer learning environments or select appropriate scaffolding strategies for peer learning. (see Appendix A)

STEP 3: CHECKING WHAT YOU LEARNED

After finishing peer learning activities, a peer tutor examines a learner's achievements based on the learning goals they set. Through this examination, the peer tutor decides whether or not the learner can solve problems without any assistance.

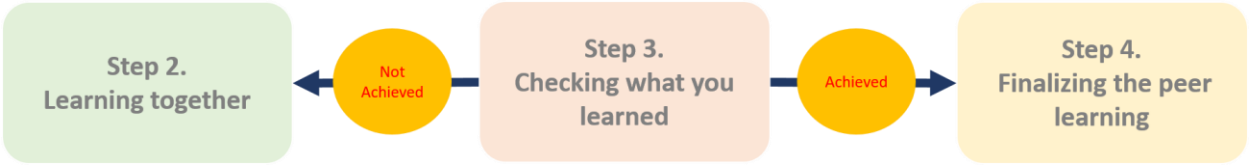
1. Assess a learner's achievement

Based on the below questions, the peer tutor can evaluate a learner's abilities.

- A learner knows important notions to solve problems.
- A learner understands how related notions are utilized to solve problems.
- A learner knows strategies for solving problems.
- A learner's response to my questions are generally correct.
- A learner can use additional resources for problem-solving.
- A learner can solve problems without any help.
- Overall, a learner achieves learning goals.

2. Determine the next step

When the peer tutor decides that a learner achieves learning goals and can study without any guidance, peer learning activities will be finalized. However, if the peer tutor thinks that the learner needs to study more, the peer tutor goes to step 2 to provide additional assistance.



√ The peer tutor can use the evaluation form (see Appendix A). The evaluation form includes seven questions to examine a learner's achievement. The peer can answer "Yes" or "No".

STEP 4: FINALIZING PEER LEARNING

A peer tutor finalizes peer learning activities when a learner achieves learning goals. The peer tutor summarizes important notions and strategies they learned for future use. If the learner has any questions, the peer tutor answers their questions.

1. Summarize important feedback

To solve the learner's problem, the peer tutor and the learner use important notions or principles and learning strategies. The peer tutor provides the learner summaries of important notions or skills for the learner's future problem-solving activities. The peer tutor finally can check the learner's abilities and find unnoticed issues.

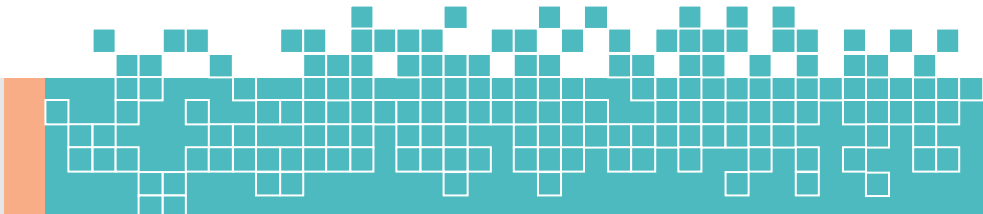
2. Answer a student' questions

Before finishing peer learning activities, the peer tutor needs to give a learner a chance to ask questions. The peer tutor answers a learner's questions before completing peer learning activities.

3. Finishing peer learning activities

If the peer tutor completes a summary of valuable feedback and answers the learner's questions, the peer tutor can finish peer learning activities.

√ The peer tutor can use the summary form for step 4 activities (see Appendix A). Using this form, the peer tutor can write important feedback and send the learner it for future use.



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APPENDIX A: FORM FOR PEER LEARNING

Step 1. Knowing Each Other

Learner's name:

_____

Date & Time:

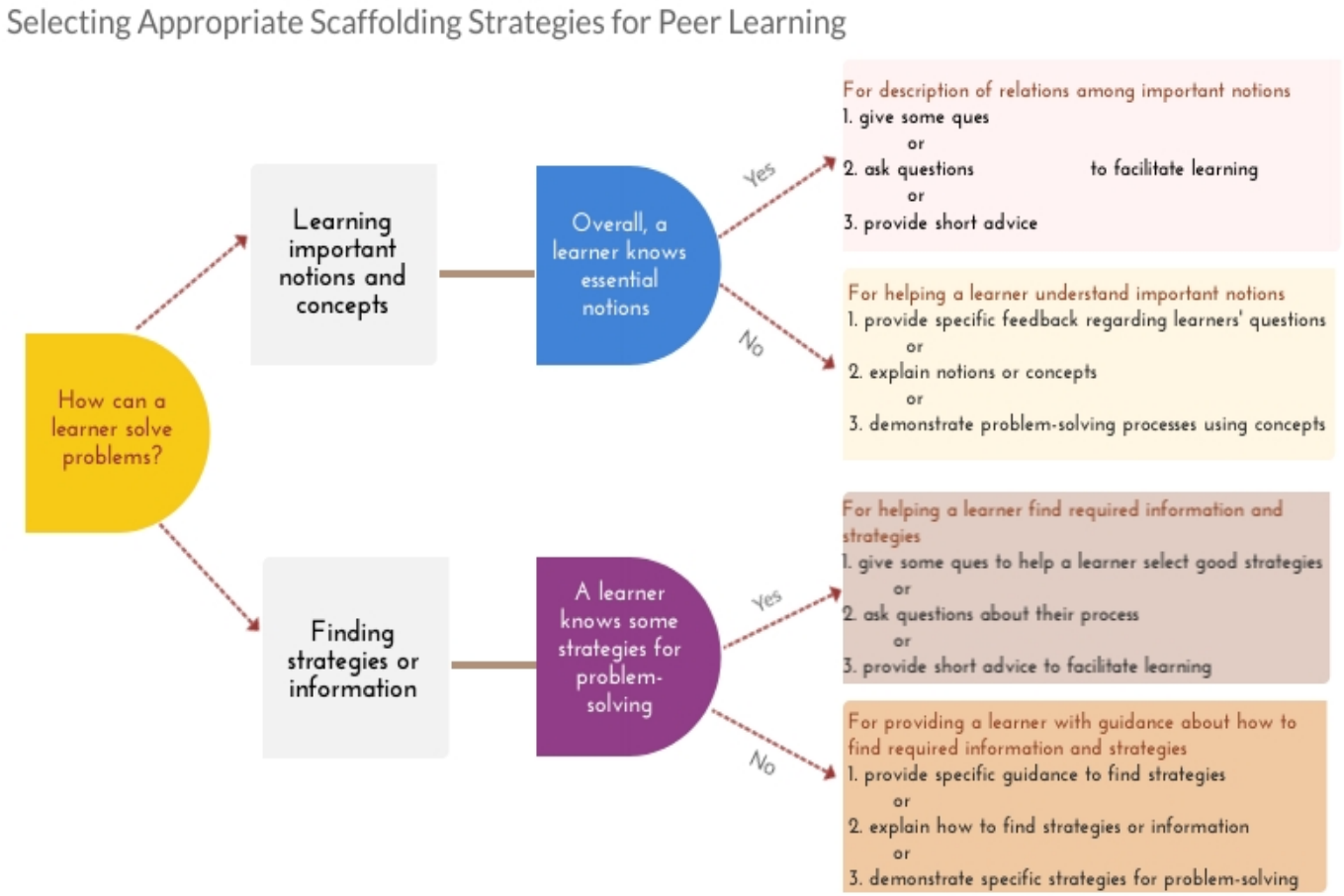
_____

What are the learner's questions?	What does the learner know about these questions?

What are the learning goals today?

Step 2. Learning Together

To select scaffolding strategies, please answer each question using the flowchart below.



Step 3. Checking what you learned

Please place a check mark to examine a learner's achievement.

Questions	Yes	No
1. The learner knows important notions to solve problems.		
2. The learner understands how related notions are utilized to solve problems.		
3. The learner knows strategies for solving problems.		
4. The learner's responses to my questions are correct.		
5. The learner can use additional resources related to solving problems.		
6. The learner can solve problems without any help.		
7. Overall, the learner achieves learning goals.		

Step 4. Finalizing the peer learning

Explain and write summaries using the below form

Summary of important feedback in this peer learning session
■ ■ ■ ■

If you have any questions about this guideline,
please send an email to jeeyoung@vt.edu.

Appendix H. A Codebook for Data Analysis

Expert 1 in scaffolding			
Category	**Sub-category**	**Definition**	**Example quote**
Impact of the model	Clear and helpful	The model was concise to help peers.	I think the overall model is mostly solid.
Strengths of the model	Well organized foundation	There was well organized theoretical foundation.	The strengths of this model of peer learning are that, first, at its foundation, it's built upon sociocultural learning theory.
Weakness of the model	Lack specific strategies and application	The model is vague.	What is missing in this current iteration, in my opinion, is information on specific strategies and the application of those strategies.
	No specific explanation of the non-linear process	There were no specific explanations between step 2 and 3.	Another area of concern is getting tutors to understand that this process may not be linear.
Suggestions for the model	Address what happens after step 3	Non-linear process should be explained.	The key missing element in my mind is what happens after step 3
	Add specific strategies	Specific strategies regarding four steps can be added.	Strategies are mentioned at a surface level, but deeper insight into those practices would be needed.
	State the benefits	The benefit of the model can be suggested.	The benefits aren't explicitly stated here.
Suggestions for the online education program	Change the Math examples	Math examples can be replaced for peers.	An example from linear algebra or calc may be better.
	Create a next page for videos in step 1	Videos can be divided to enhance peers' understanding.	Can these be put on a next page on the module to ensure folks see them?
	Create review questions	Review questions provide peers opportunities to check their understanding.	It may help to build in review questions into the model and check the understanding.

	Use human narrators	Human narrators are better in video instructions.	It would help to have human narrators for the modules.
	Need to practice with a model tutee	Peers can practice the model with a model tutee.	It may be nice to do a training session with a "pretend" tutee.
	Provide follow up trainings	Peers can take follow-up trainings to enhance their understanding.	What would also help would be follow up training at certain intervals.
	Rearrange the pre-survey	The pre-survey can be rearranged for the convenience.	In the second pre-survey, for question two, it would help to first ask if students are existing peer tutors or not.
Expert 2 in peer learning			
Category	**Sub-category**	**Definition**	**Example quote**
Impact of the model	Benefit from the clarification	If the model is clear, it will be beneficial.	The model alone could benefit from clarification of each item in each box.
Strengths of the model	Manageable number of steps	Four steps were appropriate numbers to practice peer learning.	Manageable number of steps with feedback loop
	Relevant and practical steps		Steps seem practical and relevant.
Weakness of the model	Lack clarity and detail	The model was not specific.	Lack of clarity Need a bit more detail (content)
Suggestions for the model	Add illustrations and tables	Illustrations and tables can be added to specify the model.	You have some supporting illustrations and tables in your text.
	Change term in step 1	A title of step 1 can be changed for its clarification.	That is, change "Identifying competences" to "Identify what the tutee already knows and is able to do in relation to the problem."
	Need more clarity and content	The model can include more contents for its clarification.	The model would benefit from a bit more content to be functional alone.
Suggestions for the online education program	Add a progress bar	Peers can check their progress using a progress bar.	Include a progress bar so that a user can track how much time is required of them.
	Use human voices	Human voices are less distracting.	Replace computerized voices with real human voices

	Add more examples	Examples can be provided to enhance peers' understanding.	Provide more examples rather than just content delivery
	Require various interventions in step 1	Various demonstrations can be helpful for various subjects.	Step 1 may require a different type of intervention.
	Show the forms early	The electronic forms are helpful to understand the model.	The forms are helpful support. To be more useful, I recommend incorporating them earlier and throughout the program.
	Add transcripts	Transcripts in videos can be added for universal design.	Add transcripts for universal design to support differently-abled learners.
	Use a handout for the development of the online education	A handout includes specific strategies.	I'd suggest using the Handbook as a guide to going back through the educational program and refining it.
Expert 3 in instructional design			
Category	**Sub-category**	**Definition**	**Example quote**
Impact of the model	Has the potential	The model has the potential for peer learning.	The model of peer learning has the potential to help peers incorporate scaffolding strategies.
Strengths of the model	Align the steps with literature	The model was aligned with theoretical foundations.	The steps seem to align well with the current research and understanding of best practices.
	Clean and easy to understand	The model was straightforward.	The design of the model is clean and easy to understand.
Weakness of the model	Lack of numerous examples	The model was not specific.	Without many examples, it may not provide enough information.
Suggestions for the model	Change the titles	The title can be specified.	Is "Knowing Each Other" or is it "Getting to Know the Learner"?
	Provide summary for partially completed goals	Peers can provide summaries during peer learning.	Is there a summary for partially completed goals or no "Summary" until the student learns everything?

	Set a specific timeline	Peers and learners can set a timeline for their peer learning.	When goals are set, are they set for a specific timeline – like what can be learned in an hour?
	Learners can participate in the summary process	Peers and learners can summarize important notions and concepts together.	It seems the learner would have a better measure of what important feedback they received.
Suggestions for the online education program	Add more examples	More examples are needed for enhancing peers' comprehension.	Accompanying the model with strategy use examples (scaffolding) would improve the chances of a successful peer learning experience.
	Use Human voices	Human voices are effective in videos.	If there is a chance a learner will comprehend better with a human voice, it might be worth it to use a. human voice in the videos.
	Need more scaffolding for the learning modules	Scaffolding strategies can be applied in the online education program.	Peers learning how to use the model will require more scaffolding than is provided in the learning module to include examples.
	Need samples to explain step 2	Samples can be provided to explain complicated processes in step 2	I would want samples "give some cues" - "Ask Questions" - "Provide Short advice"
	Provide a practical scenario with formative evaluations	Peers can practice the model using a scenario.	A practice scenario with some formative assessment questions (with immediate feedback) could enhance learning.
	Provide a scenario to show the whole model	Peers can understand the model using a scenario.	I feel like more time needs to be spent on "Let's Practice" – maybe a scenario showing the whole process.
	Revise and restate the pre-survey	The presurvey can be revised for the convenience.	You may want to say "If the answer is 'No' put 'No' in the box."
	Add transcripts	Transcripts are helpful for various peers.	I might provide a transcript of the videos with links in it to define words they may not be familiar with.

New peer tutors			
Category	**Sub-category**	**Definition**	**Example quote**
Prior knowledge	Did not learn scaffolding	They were not familiar with scaffolding.	No, I have not learned of it.
	How to deal with different situation	They learned these peer learning skills in the orientation.	How to react to different students
	How to encourage learners to answer questions		When you're asking questions, make sure you're not just telling them things and you're engaging them.
	How to handle tough learning situation		How to handle tough situations
	Socratic method		We learned like Socratic strategy, and more questioning things.
Impact of the model	Learn how to decide different scaffolding strategies	They learned this skill and knowledge through the model.	I learned kind of a more structured way of going about the tutoring session and how to decide how to approach.
	Learn the notion of scaffolding		I learned that what I was doing was kind of scaffolding.
Strengths of the model	Applicable to different subjects and learners	The model was applicable for various peer learning situations.	That it can also be applied to any situation.
	Helpful to know learners' problems and decide strategies	Step 1 was useful to figure out learners' problems and current abilities.	It helps you figure out where you are now, and then what steps you need to take to get better or to improve.
	Straightforward, clear and concise	The model was easy to understand.	It's pretty straightforward and easy to follow and easy to learn about.
	Structured	The model was well structured.	I think the strengths are that structured aspect of it.
	Useful step 1	Step 1 was effective for peer learning.	I think step one would have helped me the most.

Weakness of the model	Hard to find strategies for peer tutees' complicated problems	If peer tutees' problems were complex, it was hard to find appropriate scaffolding strategies.	It was a little harder to adapt to like math related things versus the conceptual ideas in it.
	Peer tutees were not familiar with the model	Peer tutees did not understand the model.	The peer tutee was kind of confused about it.
	Scaffolding methods were same in step 2	Scaffolding methods lacked varietys.	Like for these two septs and then these two steps here, very similar.
	The diagram was broad in step 2	The diagram was simple.	I see that diagram..I guess it's a bit broad.
Suggestions for the model	Add more specific questions related to step 2 in step 3	Assessments needs to link with scaffolding activities in step 2.	If there was a way to incorporate the question, almost into the step two somehow.
	Add more specific instructions in step 2	The diagram can be specific.	I think making the step two more specific.
	Teach the model to learners	Peer tutees need to know the process of the model.	I guess teaching the learners about this model would be nice.
	Use Likert scale in step 3	Likert scale can be utilized to examine learners' exact achievement.	I think a lot of the other questions are easier to answer a firm yes or no.
Strengths of the online education program	A handout was a good reference	A handout was helpful to remember the model.	I like it because it will be good to reference later on.
	Forms were helpful for reflection	Peers utilized the electronic forms to reflect on their peer learning activities.	I really like that because it's easy to reflect on it after the process.
	Multimedia content was good for learning the model	Videos, pictures, and text descriptions were helpful to learn the model.	Multimedia makes you focus on it a little more.
	No functional problems	There were no functional problems.	I didn't have any problems.
Suggestions for the online education program	Add a progress bar	A progress bar is helpful to check on learning progress.	If there was a progress bar or something to kind of indication where you were in the module.
	Add questions for the assessment	Peers can check their understanding using questions.	I mean including the video is good, and then ask them training questions after the video ended.

	Use human voices	Human voices are helpful for peers' understanding.	You could have someone record their voice.
	Add more text explanations and demonstrations	More explanations are needed to provide a specific guideline.	I think possibly a little bit more explanation.
	Add a next and previous button	A navigation bar can be added to move to another learning activities easily.	If you put the button that was next and previous, so you could do that.
Experienced peer tutors			
Category	**Sub-category**	**Definition**	**Example quote**
Prior knowledge	How to act toward a learner	They learned these peer learning skills in the orientation.	It was more on how to act toward a learner.
	How to deal with tough situation		The longest one was talking about handling a difficult tutoring session.
	Scaffolding		I didn't realize it, but I have used before.
	Relevant policies		Most of the time the training sessions focus on policies.
	Socratic method		I just learned the Socratic method.
Impact of the model	Learn asking about what learners know or do not know	They learned this skill and knowledge through the model.	The biggest thing that I learned is kind of what I said, kind of the importance of figuring out what is known.
	Learn how to select scaffolding		There's a lot of different branching paths you can take you're trying to determine what's the best types of scaffolding.
	Learn setting goals		You can make really specific goals.
	learn step 3 to assess learners' understanding		I think, the third step is a good thing.
	Learn the notion of scaffolding		I learned what scaffolding is.

Strengths of the model	Applicable for different learning situations	The model was utilized for various learners and subjects.	It helps learners treat them differently.
	Good for new peer tutees	The model might be helpful for new peer tutors.	It's especially beneficial for new tutors.
	Step 2 was a good way to see how to do it	Peers attained peer learning skills through step 2.	It kind of guides what kind of questions I will be asking them.
	Straightforward and easy to understand	The model was clear and concise.	The steps were straightforward.
	Structured	The model was well structured and easy to follow.	It just made it more structured.
	Useful step 1	Step 1 was foundation for entire peer learning process.	I'd say the biggest thing was at the beginning with step one.
Impact of the model for experienced peer tutors	Ask what learners know and do not know	Step 1 was important to figure out learners' current abilities.	I think definitely in the future I will always ask for the goals.
	Check peer tutees' understanding	They learned how to assess learners' achievement.	It's good to know where they were.
	Did not exhibit significant changes	They were familiar with scaffolding strategies.	I wouldn't really say it changed too much.
	Provide summaries	Summarized feedback was helpful.	Sometimes when things get busy it can be easy to forget that, so I think a reminder is very useful.
	Use types of scaffolding to improve peer learning skills	Types of scaffolding introduced various scaffolding strategies.	This helps me as a tutor ask the learner questions that will maximize our session.
Weakness of the model	Not effective for memorization-based subjects or proofreading	The model was not applicable for memorization.	I don't know how well it would work for a memorization-heavy course, like biology.
	Peer tutees were not familiar with the model	Peer tutees didn't know the effect of the model.	The student might not understand the importance of it.
	Step 1 was not helpful without rapport	Step 1 was not effective without a strong relationship between peers and learners.	Asking people what do you know can either go really well or really poorly and

			I think it also depends on the tutor and that relationship you have.
	Step 2 was too direct	More detailed explanations are needed.	Step two maybe it's too direct.
Suggestions for the model	Change the title in step 1	The title 1 was not specific.	I told you for knowing each other, just make it identify the problem.
	Fill in the form before or after peer learning	Writing the form during peer learning was distracting.	It's just maybe better to review it before the session.
	Add more steps between step 2 and 3	More steps can explain the non-linear process.	More steps to recheck that the learners still understand.
	Provide learners with preliminary work	Learners think about their problems and prior knowledge before peer learning.	It would be useful for the learners to go over this to physically fill this out prior to the session.
	Use Likert scale in step 3	Likert scale can be utilized to assess learners' achievement specifically.	They would also fill out the Likert scale again.
Strengths of the online education program	Good multimedia contents	Videos, graphics, and text descriptions were concise.	Having different ways to convey the information was a good thing.
	Helpful electronic forms	The electronic forms were helpful for peer learning.	They were helpful just to remember.
	No functional problems	There were no technical issues.	It worked well for me.
Suggestions for the online education program	Add text explanations and pictures	More explanations are necessary to enhance peers' understanding.	It will make it more visually appealing.
	Use human voices	Human voices are more effective.	If you got real people that actually read out the scenarios, I think that could make them a lot more engaging.
	Add a next button	This button is useful to navigate learning.	It's just only easier for people when they have 'next' buttons.
	Provide an electronic form and a printed form	Both forms can be provided for peers who have different preferences.	I personally prefer paper, but then I noticed some people lose paper.
	Share the form regarding steps 1 and 4	Steps 1 and 4 help peers remember their learning activities.	I think should go in step 4 so that they can see the facts without any yes or no.

	Add a visual timeline	A visual timeline can be represented to help peers understand learning procedures.	Just being able to see steps or just visualize it, that helps me.