12. Computer Aided Collaborative Learning: Challenges and Opportunities

Mazhar Hussain Malik

Senior Lecturer , Department of Computing and IT (CIT)

Global College of Engineering and Technology Muscat, Oman

Amjed Sid Ahmed

Senior Lecturer, Department of Computing and IT (CIT)

Global College of Engineering and Technology Muscat, Oman

Ahmad Hosseini

Senior Lecturer , Department of Foundation Studies (FS)

Global College of Engineering and Technology

Muscat, Oman

12.1Introduction

The collaborative learning is an active approach for the learning process where a group of learners can work together to solve their problems, complete a task or understand new concepts. This approach, making the learner vigorously engaged in the learning phase, adds active interaction to the learning process and concepts instead of passively listening to the lectures or just noting down the facts and figures. Collaborative Learning motivates learners to work on different projects and complete assigned tasks as a group while they are individually responsible for their performance and the outcomes. They defend their positions, redefine their ideas and listen to other points of view to gain complete understanding as a group instead of individuals.

The benefits of collaborative learning, which can be seen as organizational and individual, highlight the wide range of applicability of this approach. Every organization can benefit from having an energized and well-informed workforce whilst the individual workers also profit by being personally involved in the learning and this can be achieved by embedding collaborative learning in the organization. Collaborative learning may occur in a regular classroom vibe or through online delivery; however, online learning has a considerable effect on the learning level when done collaboratively.

Collaborative learning can also create a sense of inclusion, specifically for those who feel being secluded in class activities or for the introverted learners. Group-structured activities are helpful for at-early-stage learners to organize their efforts, to source the needed material and references, to work semi-independently without being monitored by the teacher or instructor, and most importantly rely on their individual potentials in a positively competitive atmosphere of teamwork. It brings a sense of accountability as each learner holds up a role for the teaching-learning duet to be synchronized. Collaborative learning assigns a task to a group and requires

job distribution and cooperation among the team members. In the meantime, it improves the leading traits for the leader-type learners.

Collaborative learning is a comprehensive term for a vast variety of educational approaches which involve students, or students and teachers together, in the learning process. This approach is specifically productive in distance learning as it removes the barrier of non-collaboration and individualized processing of learning by provoking the sense of inclusion through online methods. Federico 2000 cited Keegan 1998 by asserting that distance learning involves providing instructions through non-traditional methods, such as television, correspondence, radio and the use of satellites. This process also consists of the issuance of guidelines using the internet, digital media, hardware and software. Furthermore, the instructor can communicate with many students simultaneously by electronic media. In this regard, distance learning comes in two types, namely, synchronous, and asynchronous instruction.

Digital learning or computer aided learning, as a common form of distance learning, would entail developing off-campus lessons, workshops, and seminars, where the teacher is not present physically. The United States recorded about 3.2 million complete online enrolments during the fall term of 2005 (Allen and Seaman 2007). This number increases with the technological advancement and rapid growth of online courses. Online learning is not only a reasonable solution for learners who would like, or have no other option, to study at distance, but also a main medium which provides resources accessible to a bigger audience worldwide. With the 2020 pandemic, more experts and scholars stepped into researching for the impacts of online learning as well as its scope and benefits.

As experts need to study the impact of online classes on the academic and social well-being of children (Khalifa and Lam2002), the scope of collaborative learning should be also included into the picture. According to (Tinto 1997) , the classroom environment helps to bridge the

academic and social integration of students in higher education. Moreover, the kind of relationship that occurs in online classrooms is of great importance to students. Tinto explained that the activities of teachers within the classroom environment play a significant role in enhancing their notion of scholarly belonging. Furthermore, it enhances the ability of students to persist whilst engaging in their academic pursuits. Existing evidence supports the fact that the development of an online community exerts a positive impact on the overall success of a student in the education sector (Tinto 1997).

However, questions remain about the potentials provided by a fully online class to support and enhance the growth of communities with a high level of learning (Brown 2001; Rovai 2002). From a general perspective, online education, relative to traditional methods, enables students to interact with their teachers actively. It also provides them with more resources and enables them to grow independent in their learning journey; however, it hinders the communal features which can grow through face-to-face interaction in a regular classroom. It appears that introverts can benefit from being in an online session, particularly if they are anonymous. They can actively question their instructors without fear or stress and at the same time they enjoy the participation in group activity whenever there is a break-out session or a group project.

Computer aided learning is not limited to online learning. Offline devices and software also play a significant role in collaborative learning as they help learners review the lesson and practice multiple times while a regular class session cannot be re-performed once it ends. With the help of computers, teaching, practicing, learning and assessment can be easily conducted, and classrooms can be simulated. Online or offline teaching incorporates the learners into a virtual reality, to say the classroom, where they can reduce the anxiety and stress of the actual classroom. The assessment simulation is also a genuine way of practicing before the actual examination.

12.2Collaborative Learning Theories

Learning theories in pedagogy have different strains depending on the target group being at what range of age. The Collaborative Learning theories are divided into two groups, one related to social development and the other to cognitive development. Social development entails the sense of identity, role and purpose where Cognitive development involves thought, rationale and perception. (Bélanger 2011) Social development and cognitive development of adults and children follow different patterns and differ in collaborative learning. In this section, we discuss the theories of cognitive learning which will be with children learning and later we will consider the cognitive learning process which adults undertake to develop their thoughts and perceptions in their lives.

12.2.1 Vygotsky's theory

This theory focuses on the social understanding and interaction in the learning environment. As per the theory social context plays a vital role in the design and development of understating and knowledge. The theory suggests the impossibility of perception development by an individual without implementation of social context. One of the key aspects of this theory is proximal development which is an ability to visualize what a person can do and what they cannot. (Hadwin, Allyson, Sanna , and Mariel 2018).

12.2.2 Piaget's theory

Jean Piaget is the founder of "Cognitive Theory" development and the way infants and children understand their environment and how they develop their understanding based on hypotheses. During this cognition process, children construct understanding about the environment based on their initial perception and how they perceive the world changes gradually and based on the new experience. He calls this constant trend of

replacing a perception with the newly and differently experienced experience the cognitive development. Hence, they construct their own and individual understanding of the surrounding world, examine discrepancies between the understanding and experience, and then replace them with new perception. The gradual and constant growth of experience, perception, new experience, correction, and new hypothesis is the core idea of Cognitive Theory. They experience in order to get the correct answer and organize their mental process (Jeong, Heisawn, and Cindy 2016). Piaget also introduced the concept of "Schema" which is the unit of knowledge that allows individuals to organize and understand the knowledge in efficient ways. A schema is a cohesive and repeatable sequence of actions which are intrinsically interrelated and spin around a core concept. Based on Piaget's theory there are four different stages of cognitive development which need to happen before the start of the learning. The first stage, "Sensorimotor" or the infancy, starts from the birth to up to two years and in this stage the child develops object permanence. The second stage is "Preoperational", starting from the age of two to seven and is related to symbolic thinking development. The child develops the third stage, called the "concrete operational" stage, from the age of seven to eleven as a period related to logic development. Finally, the fourth stage is the "operational stage" in which the child starts developing from the age of 11 when a child starts to think logically and works out complex hypotheses.

12.2.3 Kegan's Theory

Both Vygotsky and Piaget consider their cognitive theories fit to children, as they believed the cognition process stops around the age of 25. However, Robert Kegan, among some other scholars, believes that cognition and learning are lifelong processes. He praises the genius of Jean Piaget but also adds new ideas to his legacy. (Kegan, 1982) Based on Kegan's theory, individuals move along an attitude shift, from a

subjective framework of defining themselves as “what they are” towards an objective framework of “what they have”. This transform takes place throughout life and never ceases. All the beliefs, assumptions and key behaviors can be labeled under this category in which the individual holds an up-close point of view with less possibility of self-reflection. (Kegan 1994) Kegan highlights the solid attitude one may have for a certain set of ideas without questioning them. Kegan introduces five stages of growth and development which he explains each stage as “loss” of the previous stage. He believes the “Self” develops as the person grows up. Unlike Piaget, he does not start his review of the “Self” by “differentiation” with “Others”. However, he looks upon human beings from a more holistic point of view which implies that human beings are born with the “Self” and develop it throughout life. Therefore, in this lifelong motion, he recognizes five “Selves”, each one replacing the previous one throughout the life, the incorporative self, impulsive self, imperial self, interpersonal self, and institutional self. (Kegan 1982).

12.3Bloom’s Taxonomy and Learning Domains

Educational psychologist Benjamin Bloom developed his taxonomy in 1956 intending to promote a higher form of thinking in education. The higher ways of thinking that Bloom's taxonomy introduced in education were analysis and evaluation of concepts, principles, and procedures which deviated from the educational norm of rote learning. Bloom's taxonomy provides a framework that has often been used in designing academic training and learning processes. Besides, it sets three hierarchical models that categorize educational learning goals into different levels of specificity and complexity. The three models of Bloom’s taxonomy are “cognitive” dealing with mental skills, “affective” being emotion-based, and “psychomotor” being action-based (Bloom 1956; Bloom, Engelhart, Furst, Walquer, and David 1956).

The three-model form KSA (Knowledge, Skills and Attitudes) is the model that instructional designers, trainers and educators use for the teaching-learning process. The "knowledge" arises from the cognitive model that denotes the aspect of recalling facts, basic concepts, answers, and terms that have been taught. The "attitude" in the affective model defines how people respond emotionally, and also elaborates the ability they develop for feeling other persons' or living things' joy or pain. Attitude, thereby, arises from an affective domain that targets the growth and awareness of emotion, attitudes and feelings. Lastly, "skills" are associated with the psychomotor model that describes the ability of an individual to manipulate instruments and tools physically. The focus of the psychomotor domain is on development and change in behavior or skills.

The initial perception was that the KSA is utilized in the learning behaviour where learners form the goals of the learning process. That is to mean, after the learning process, the learner should have acquired the right knowledge, attitude and skills that they can use in future. The goal of education, therefore, is to elevate learners to better understanding and mental development of handling problems in life. Gaining knowledge, new attitudes and skills indicates the achievement of this goal. Later, some scholars managed to elaborate concepts on the affective and cognitive domain but failed to do so in the area of psychomotor. Conversely, other researchers have developed more than three models of psychomotor. The researchers have classified the three domains into further subdivision in a hierarchy that starts from simple to the most complex. The divisions are not outlined adequately since other rankings have been formulated, such as SOLB (Structure of Observed Learning Behavior).

12.3.1 Cognitive Domain

This domain entails the development of intellectual skills and knowledge (Bloom et al., 1956). It involves recognizing particular facts, concepts and procedural concepts incorporated in skills and intellectual abilities development. Moreover, the domain

includes six categories ranked ascendingly from the simplest to the most complex as knowledge, comprehension, application, analysis, synthesis and evaluation. Each category marks the level of difficulty where the first one must be mastered before proceeding to the next category. However, some scholars, including a former student of Bloom, modified the taxonomy in the mid-nineties (Anderson , Bloom 2001). The first change made by these scholars was altering the names of the six categories from noun to verb forms. The second change was rearranging the classes, and the third change was developing processes and ranks of the knowledge matrix. The newly formed taxonomy reflected an active form of thinking and was also perhaps more accurate than the previous taxonomy. The new taxonomy can be described as:

- Remembering; involves retrieving or recalling previously learned information, for example, quoting prices for customers out of memory.
- Understanding; comprehending what translations, instructions, and problems mean. For instance, explain in one word, the steps of performing a task.
- Applying; using concepts learned in a novel situation. For example, applying statistical laws to evaluate the reliability of a written test.
- Analyzing; separating concepts or materials various parts to organize it in the structure that can be understood. An example is troubleshooting pieces of equipment through logical deduction.
- Evaluating; judging the values of materials or ideas. Choosing an appropriate solution is a good example.
- Creating; developing patterns or structures from various distinct elements, for instance, writing the company operations manual.

The revised taxonomy was thereby improved in terms of usability through the use of action words and added a knowledge and cognitive matrix. Even though the previous

taxonomy had the three-level of knowledge that could be processed, it failed to discuss them extensively and made the taxonomy remaining one-dimensional. The taxonomy's three dimensions were factual involving the essential elements students must know to be acquainted with discipline and entailing conceptual interrelationship existing within essential elements, and procedural, which is a method of inquiry. In the revised version, the authors integrated these three levels with cognitive processes to form a knowledge matrix. Besides, they included another level of knowledge which is metacognition which is the general knowledge of cognition, awareness and one's cognition.

12.3.2 Affective Domain

Affective domain includes how people respond to emotional feelings such as values, enthusiasm, affection, motivation and attitude (Krawthwohl 1964). The first main category of this domain is the receiving phenomenon that describes the willingness to hear, selected attention and awareness. The second category responds to phenomena which entail active participation on the part of the learner. The learner has to attend and respond to a specific phenomenon. The third category is valuing, which marks the work a person ascribes to a particular behavior, phenomenon or object. The fourth one is an organization which is prioritizing values by contrasting and resolving conflicts between them. The last category is internalized values which have a value system that controls behavior.

12.3.3 Psychomotor Domain

Psychomotor domain integrates physical movement, coordination and the use of the areas of motor-skills (Simpson 1972). Psychomotor skills are developed through constant training practice, and they are measured in terms of speed, techniques of execution, precision, distance and procedure. Therefore, psychomotor skills vary from conducting simple manual tasks to undertaking difficult, complex tasks like operating

machines. The seven main classes of this domain from simplest to the most complex are perception, set, guided response, mechanism, complex overt response, adaptation and origination. Perception features the ability to use sensory clues and directed motor activity, whereas set marks the readiness of a person to act. Guided response entails imitation used in early stages of learning and trial and error employed in learning complex skills. Mechanism marks the point when the response has become habitual while complex overt response involves the skill ful performance of the motor act. Lastly, adaptation is the stage when skills are well developed, and origination entails creating new movement patterns.

12.4Collaborative Learning individual benefits

12.4.1 Ignite active learning: When employees are involved in collaborative learning, they become actively engaged which means that they can get more skills and knowledge. Collaborative learning allows learners to listen and understand other points of view which help them promote their learning abilities.

12.4.2 Boost critical and quick thinking: Collaborative learning allows participants to boost their thinking power which enables them to synthesize and adjust their responses. This enables them to acquire new information and set their point of view with the stream of new ideas. Collaborative learning environment allows learners to listen to other ideas and thoughts and provide arguments to their peers. Using this dynamic approach allows learners to gain better understanding about the domain as learners can look and consider all the possible angles (Nyembe, Bangisisi and Howard 2019; Mazhar, Amjed 2020).

12.4.3 Enhance speaking and listening skills: This form of learning allows individuals to speak in front of an audience and listen to them actively, and also helps them build a framework of ideas to be executed, increasing their individual confidence and enabling them to actively interact with the society.

12.4.4 Lead to problem solving: Collaborative learning helps to bring different teams or individuals together and present them a problem to solve. It leads to developing new features in the product and allows the team members to understand the future needs about the product. Problem solving exercises while working in a group builds intellectual thinking in the employees which is useful for individuals and organizations (Nyembe, Bangisisi and Howard 2019; Mazhar, Amjed 2020).

12.4.5 Develop new products: Collaborative learning plays a significant role in group work as teams can work together to identify the gaps in the existing product, coming up with different solutions and finally selecting the best possible solution to create or modify the existing product (Nyembe, Bangisisi and Howard 2019; Mazhar, Amjed 2020).

12.4.6 Build a collaborative learning environment: Collaborative learning enables to build a collaborative learning environment where workers can team up to solve problems, giving ample opportunities to learners and trainers to enhance their skills and expertise (Nyembe et al. 2019).

12.5 Collaborative Learning organisational benefits

The collaborative learning initiates many key benefits to organizations, among which we can count the followings:

12.5.1 Enhance Leadership skills: Working in a group allows individuals to achieve the organizational goals which are common and helps individuals use the opportunity to get high-level skills. This also helps individuals to organize, teach, assign tasks, manage themselves and groom their leadership skills. Working in a group increases existing skills as participants are involved in teaching others and enables them to learn new skills from other employees. Collaborative learning reduces the need for the formal training

and encourages employees to maximize their expertise (Nolan, Clare, Kim, Kelley, Gulley, and Elizabeth 2020).

12.5.2 Enhance team and departmental relationships: Contact building is a crucial feature while working in an organization environment and it is seen that when the individuals have limited contacts across other teams, it is very difficult to build the connections and teamwork. Collaborative learning enables individuals to become more productive when they work in a team and they find better ways to work with others, which in long term helps organizations. By building this team spirit and departmental relationship, the individuals imply strong connections with each other and ultimately, they shall become an asset for the organization (Stevanoviü, Jelena, Srdjan, Tatjana, and Monika 2020).

12.5.3 Enhance employee engagement, acquisition, and retention rate: Collaborative learning leads to increased employee engagement and involvement in the organization which improves organizational performance with high retention rate. Collaborative learning also allows employees to achieve better thoughts and useful information compared to what they might get in non-collaborative settings. It is also worth mentioning that collaborative learning enhances employee's skills by providing a better working environment where they can groom themselves and ultimately increase the organizational performance. The performance of organization directly and ultimately depends on employees and when the satisfaction level of employees is higher the organizational efficiency will be esteemed as well (Stevanoviü, Jelena, Srdjan, Tatjana, and Monika 2020).

12.6Computer aided collaborative learning.

Computer aided collaborative learning can be performed online or offline. Both methods can engage learners and are helpful throughout the learning process. (Sharples. 2019) The learning process which takes place in the regular classroom is always constructive, interactive and helps the learners to incorporate their individual traits in their social relation with other learners (Ottery. 2005) However, the capacity of computer-based learning should not be underestimated. The Computer aided collaborative learning environment can be divided into calendar, forums, Viki, Office, blogs and Notes. (Alur, Rajeev, Richard, Rastislav, Ann, Sumit, Bjoern, Yasmin 2020. Chen, Juanjuan, Minhong, Kirschner, and Tsai. 2018).

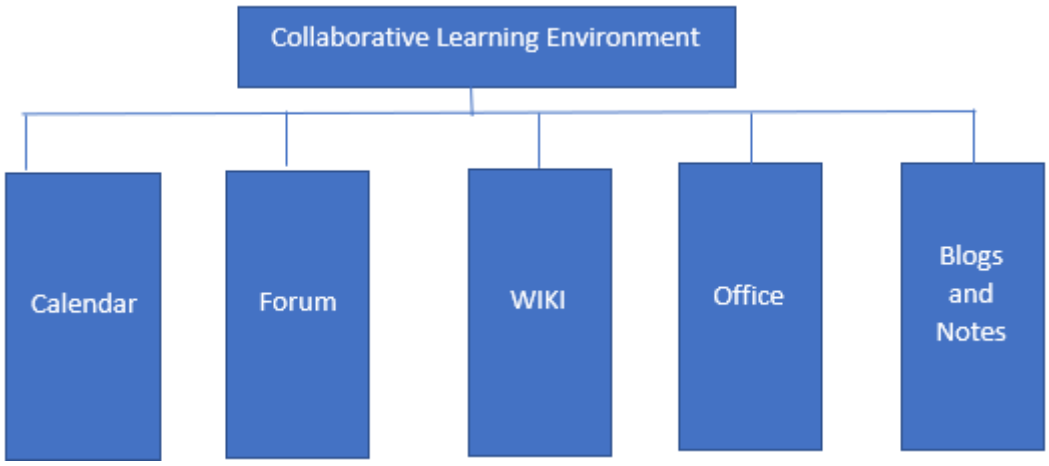

Figure.12.1 Collaborative Learning Environment

Short ALT Text for Figure 12.1, p. XXX [18 words]:

Collaborative learning environment can be categories into five different sections which are calendar, forum, wiki, office and blogs and notes.

The mentioned tools are mostly interactive platforms which can be utilized online or offline. The type of environment leaves a great impact on the learner, which emphasizes the importance of collaborative learning here. The following platforms are all produced based on collaborative learning approaches.

12.6.1 BlackBoard Collaborate Ultra

Blackboard Collaborate is a real-time video conferencing tool that allows learners to use virtual whiteboard, add files, and share applications and screen. The strength of this application is that there is no need to install any software to join a session and it easily opens in the browser.

12.6.2 WIZIQ

WIZIQ is a cloud-based education platform which is used to access training and teaching modules using desktops, laptops and smartphones. The platform allows the user to conduct the classes online with different packages being available as per the need of the customers (Alrahmani. 2017).

12.6.3 Google Apps for education

Google for education is a service that provides the customizable versions of different google products using domain names provided by the customers. It features different web applications with similar functionalities aligned with traditional office suits including Gmail, Google Meet, Google Calendar, Google Drive, Google Docs, Google Sheets, Google Slides, Hangouts, Group, News, Play, Vault and Sites. Google for education and Google Apps are Non-profits and free and offer the same amount of storage as Google Apps for Work accounts.

12.6.4 Kahoot

Kahoot is a game-based learning platform which is used for educational technology in the educational institutions. The Kahoot provides the user the option of generating multiple choice questions which are accessed via Kahoot app or through browser. Kahoot can be used to review students' knowledge for assessments, and it helps to create classroom activities.

12.6.5 FlipGrid

FlipGrid is a website which allows the teachers to create the grids which ae used for video discussions and each grid acts like a message board where teachers can paste their questions, called topics, and students are able to paste their video responses.

12.6.6 Skype in Education

Skype is also a free web-based communication tool which allows users to make calls, do video conferences and send instant messages. There are about 300 million active Skype users around the world. Skype provides students and teachers with the opportunity to participate in the virtual tours of the different places, communicate with the authors and researchers, and also engage in the conversations with classrooms around the world. Addition to that, Mystery Skype enables the two classrooms to connect from different locations in a fun way and both classrooms can call each other on skype and can ask questions.

12.7 CHALLENGES AND OPPORTUNITIES FOR DESIGNING COMPUTER AIDED COLLABORATIVE LEARNING

Computer aided collaborative learning is coming up with a lot of challenges and opportunities in the 21st century. The importance of computer-added collaborative learning is significantly increased in the first quarter of 2020 due to pandemic. The need of collaborative learning tools is increased significantly in the different sectors of education whether those are universities, Colleges or schools. Since March 2020, the whole world is under a pandemic situation and learning has shifted to a new paradigm which is focusing on distance and eLearning. There are certain challenges and opportunities which are associated with computer aided collaborative learning, mentioned as follows:

The first and foremost challenge of collaborative learning is the availability of infrastructure, considering the fact that learning and educational tools are normally used in universities and in some cases in the colleges, but these are less used in the case of schools. However, during the

2020 pandemic situation the need for online collaborative tools increased as students were not able to attend their regular classes and they needed to study from home. Hence, there is a need to have collaborative learning tools which enable students to work in groups or pair to perform their group tasks .There is a great need to enhance the existing infrastructure with respect to hardware requirements. The infrastructure requires high specification hardware with respect to processing power, RAM and storage capacity. There is also a great need for upgrading the Internet infrastructure, as there is certain increase in multimedia traffic and to boost the learning management platforms.

Secondly, software and platforms which are running in the collaborative learning system should have the capacity to meet the requirements of desired specification so these tools and platforms can work properly.

The third and the most important challenge which is associated with computer aided collaborative learning is education for children who are in the age group of 3-11, specifically as due to the pandemic situation the current available platforms are not suitable to help this age group of students in their learning. Educational institutions need to have a major shift in computer added collaborative learning tools which can address the issues faced by different levels of students, so that their learning will not be interrupted nor stopped in any circumstances.

To conclude, computer aided collaborative learning tools are the ultimate solution which can help students to gain knowledge from their homes in the pandemic situation without affecting their group studies by using these types of tools. It is suggested to apply the 21st century requirements and engineering tools such as Agile approach to gather the requirements and design the computer aided collaborative learning tools which allow us to gain the maximum benefit by getting high satisfaction.

References

Allen, I. Elaine, and Jeff Seaman. 2007. "*Online nation: Five years of growth in online learning*. "Sloan Consortium. PO Box 1238, Newburyport, MA 01950.

Al-Rahmi, Waleed Mugahed, and Akram M. Zeki. 2017. "A model of using social media for collaborative learning to enhance learners' performance on learning." *Journal of King Saud University-Computer and Information Sciences* 29, no. 4: 526-535.

Alur, Rajeev, Richard Baraniuk, Rastislav Bodik, Ann Drobnis, Sumit Gulwani, Bjoern Hartmann, Yasmin Kafai et al. 2020. "Computer-Aided Personalized Education." *arXiv preprint arXiv:2007.03704*.

Cruikshank, Richard E. Mayer, Paul R. Pintrich, James Raths, and Merlin C. Wittrock. 2000. "Taxonomy for Learning, Teaching, and Assessing." *A: A Revision of Bloom's Taxonomy of Educational Objectives, Allyn & Bacon*.

Bélanger, Paul. 2011 *Theories in adult learning and education*. Verlag Barbara Budrich.

Bloom, Benjamin S. 1956. "Taxonomy of educational objectives. Vol. 1: Cognitive domain." *New York: McKay*.

Chen, Juanjuan, Minhong Wang, Paul A. Kirschner, and Chin-Chung Tsai. 2018. "The role of collaboration, computer use, learning environments, and supporting strategies in CSCL: A meta-analysis." *Review of Educational Research* 88, no. 6: 799-843.

Federico, Pat-Anthony. 2000. "Learning styles and student attitudes toward various aspects of network-based instruction." *Computers in Human Behavior* 16, no. 4: 359-379.

Hadwin, Allyson, Sanna Järvelä, and Mariel Miller. 2018. "Self-regulation, co-regulation, and shared regulation in collaborative learning environments."

Ahmed, Amjed Sid Ahmed Mohamed Sid, and Mazhar Hussain Malik. 2020. "Machine Learning for Strategic Decision Making during COVID-19 at Higher Education Institutes." In *2020 International Conference on Decision Aid Sciences and Application (DASA)*, pp. 663-668. IEEE.

Jeong, Heisawn, and Cindy E. Hmelo-Silver. 2016 "Seven affordances of computer-supported collaborative learning: How to support collaborative learning? How can technologies help?." *Educational Psychologist* 51, no. 2: 247-265.

Keegan, Desmond. 1998."The two modes of distance education." *Open Learning: The Journal of Open, Distance and e-Learning* 13, no. 3 : 43-47.

Kegan, Robert. 1982 *The evolving self*. Harvard University Press.

Khalifa, Mohamed, and Rinky Lam. 2002. "Web-based learning: Effects on learning process and outcome." *IEEE Transactions on education* 45, no. 4: 350-356.

Bloom, Benjamin S., Max D. Engelhart, Edward J. Furst, Walquer H. Hill, and David R. Krathwohl. 1956. *Taxonomy of educational objetives: the classification of educational goals: handbook I: cognitive domain*. No. 373.19 C734t. New York, US: D. Mckay.

Nolan, Clare, Kim Ammann Howard, Kelley D. Gulley, and Elizabeth Gonzalez. 2019. "More Than Listening: Harnessing the Power of Feedback to Drive Collaborative Learning." *The Foundation Review* 11, no. 2: 11.

Nyembe, Bangisisi Zamuxolo Mathews, and Grant Royd Howard. 2019 "The utilities of prominent learning theories for mobile collaborative learning (MCL) with reference to WhatsApp and m-learning." In *2019 International Conference on Advances in Big Data, Computing and Data Communication Systems (icABCD)*, pp. 1-6. IEEE.

Spigelman, Candace, and Laurie Grobman, eds. 2005. *On location: Theory and practice in classroom-based writing tutoring*. University Press of Colorado.

Quitadamo, Ian J., and Abbie Brown. 2001 "Effective Teaching Styles and Instructional Design for Online Learning Environments."

Rovai, A.P., 2002. Building Sense of Community at a Distance. The International Review of Research in Open and Distributed Learning, [Sl], v. 3, n. 1. *Distances et médiations des savoirs. Distance and Mediation of Knowledge*.

Sharples, Mike. 2019 "Visions for the future of educational technology." *EDUCATIONAL VISIONS* : 151.

Simpson, E. 1972. "The classification of learning objectives in the psychomotor domain." *Gryphon House, Washington, DC*.

Stevanoviü, Jelena, Srdjan Atanasijeviü, Tatjana Atanasijeviü, and Monika Zahar. 2020 "Expanding the level of engineer knowledge for software modeling within corporate education by active and collaborative learning." In *2020 IEEE Global Engineering Education Conference (EDUCON)*, pp. 1807-1814. IEEE.

Sun, Zhong, Chin-Hsi Lin, Minhua Wu, Jianshe Zhou, and Liming Luo. 2018. "A tale of two communication tools: Discussion-forum and mobile instant-messaging apps in collaborative learning." *British Journal of Educational Technology* 49, no. 2: 248-261.

Tinto, Vincent. 1997. "Classrooms as communities: Exploring the educational character of student persistence." *The Journal of higher education* 68, no. 6 : 599-623.