Systematic Mapping Studies on Argumentative Knowledge Construction Process in Social Collaborative Learning Environment towards Students' Higher Order Thinking Skills

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Received: 20 October 2017
Received in revised form: 1 November 2017
Accepted: 15 November 2017
Published: 1 December 2017

ABSTRACT

To face the challenges of 21st century education system, preparing learners towards higher order thinking skills absolutely crucial. To date, most of researchers found that learners still dearth of this thinking skills and demanding for more than examination-based rank and rote memorization solely to achieve this mission. With the rapid expansion of computer technology usage, computer-supported collaborative learning (CSCL) apparently can be a promising platform to bring learners towards more flexible learning environment. Communication between learners in CSCL normally will involve a deep discussion and leads them towards processes of evidence and argumentation. This process is known as argumentative knowledge construction (AKC). When dealing with the argumentation, knowledge is shared or spreaded among the students as they work towards the same learning goals, for example, a common understanding of the subject at hand or solutions to problems. In particular, students are not passive recipients but is an active receiver in the process of their attainment of knowledge when they participate in the discussion, retrieve information and exchange ideas with their peers. In the social collaborative argumentation, knowledge is constructed and shared with friends, not owned by a particular student after earning it from learning activities, course materials, and instructors. However, how to analyze AKC process in social collaborative learning to confirm that it really reflects students' higher order thinking skills is still not clear. Thus, this paper try to answer six (6) objectives which are (1) What types of thinking skills involved along the AKC processes in CSSLE? (2) What is the potential of AKC in CSSCLE? (3) What are the types of process involved in AKC through CSSCLE? (4) How CSSCLE can be so important for AKC process? (5) In what educational contexts and levels have AKC been most investigated and (6) What types of frameworks frequently used in analyzing AKC studies? For this purpose, we conducted a meta-analysis and systematic mapping study on the AKC analytical frameworks to answer all research objectives. Overall results for each research objectives then summarized in this paper.

Keywords
Argumentative Knowledge Construction, Social Collaborative Learning, Higher Order Thinking Skills, Systematic Mapping

Introduction

To face the challenges of 21st century education system, preparing learners towards higher order thinking skills absolutely crucial. Unfortunately, the current learning method is all about examination-oriented education, not dynamic, and was not based on knowledge development to generate the high level of students' thinking skills. Thus, this teaching process and learning method has shown that student will always learn without the needs to understand the concept which resulting students that are incapable of answering the higher level questions and still remain in the low level of thinking skills (KPM, 2012).

From this issue, it is clearly that teaching and learning techniques that promote memorization (i.e. often short-term knowledge) do not support HOTS. Snyder & Snyder (2008) claimed thinking skills is a mental habit that requires students to think about their thinking and about improving the process, and it requires students to use HOTS and not just reciting or accept what they read or are told without critically thinking about it (Schafersman, 1991; Tempelaar, 2006; Scriven & Paul, 2008). So, how to stimulate the HOTS? It was found that, in a collaborative learning environment, students' cognitive engagement can be potentially increased since interaction with peers promotes sharing of ideas resulting in knowledge construction (Veerman & Veldhuis-Diermanse, 2001). Studies also show that collaborative learning provides opportunities for sharing information, which in turn will encourage self-reflection on their own learning and students' critical thinking skills were shown significantly when it is done socially and collaboratively

amongst peers (Mukama, 2010; Gokhale, 1995; Dillenbourg, 1999; Veerman, Andriessen & Kanselaar, 2002; Chou & Chen, 2008; Noroozi, 2012)

Collaborative learning discussion also will engages students in investigations of ideas, constructing knowledge and problem investigation that builds group decision making abilities towards higher order thinking skills (Wilen, 2004). This is called social constructivism (Scardamalia & Bereiter, 2006; Vrasidas, 2000) where students work together to interpret meaning or construct ideas through communication. Normally, social constructivism will prepares students with real-world content such as prompts for open discussion, opportunities for social interaction, and chances for reflection results in productive discussion. An examination of student discussion comments and the resulting meaning making should specify the practical cognitive levels in that discussion.

For collaborative learning, two or more students have to negotiate and reach agreement on different things, for example tasks, goals and concepts and definitions used. An important process in this negotiation is the argumentation (Baker, 2009; Veerman, Andriessen & Kanselaar, 2000; Veerman, 2000). Through negotiation, conflict resolution and other mechanisms for the construction of new knowledge are possible. Thus, in collaborative argumentation, constructing knowledge at a higher level is more important for students' learning, because it ensures students are experiencing meaningful and fruitful learning (Shukor et al., 2014). Moreover, learners will acquire knowledge through the elaboration of learning material by constructing arguments (Stegmann, Weinberger & Fischer, 2007) and argumentative knowledge construction is based on the assumption that learners engage in certain discourse activities and that the frequency of these discourse activities is related to knowledge achievement (Weinberger & Fischer, 2006). Thus, to nurture student-thinking skills to the higher level, a crucial part of critical thinking is to identify, construct, and evaluate arguments. The details on this will be reviewed in the research background.

Conclusively, there are six objectives that will be emphasized in this paper which are:

- What types of thinking skills involved along the AKC processes in CSSLE?
- What is the potential of AKC in CSSCLE?
- What are the types of process involved in AKC through CSSCLE?
- How CSSCLE can be so important for AKC process?
- In what educational contexts and levels has AKC been most investigated?
- What types of frameworks frequently used in analyzing AKC studies?

The main goal of this paper is to summarize the main results obtained from the meta-analysis and systematic mapping on argumentative knowledge construction (AKC) analytical frameworks towards improving students' higher order thinking skills and outline future work.

Research Background

Apparently, teaching should promote experiences that require students to become active and participating in the learning process. Working collaboratively affirms that students' cognitive engagement can be potentially increased since interaction with peers promotes sharing of ideas resulting in knowledge construction (Veerman & Veldhuis-Diermanse, 2001). While learning collaboratively, normally there is a discussion element paired with other teaching methods (e.g. post-lecture demonstrations, role-playing, group work, etc.) in order to allow students to share, connect and develop ideas from what they learned during the previous lesson segment. Discussion is presented as a way to engage students in investigating ideas, exploring problems and their solutions, builds group decision-making abilities and advance HOTS (Wilen, 2004).

However, when conducting the discussion, there are three possible situations according to Baker (2009).

- firstly, people can try to ignore problem: perhaps people do not want to offend others by appearing 'difficult'; there may be a general feeling that the question is not important enough to warrant a more in-depth discussion; maybe they are short and want to move on, and so on;
- secondly, people may restrict themselves to a simple exchange of different opinions, " yes it is correct / no it is not / yes it is / ... there." But such an approach does not generally produce the desired results;

- thirdly, each can express information and ideas related to the problem, the kind that has the potential to change the degree of acceptance of different solutions, and also examine the coherence of the set of information and expressed this line of thinking.

Baker (2009) called this as an "argumentative interaction". Argumentative interaction in a collaborative environment is referred when two or more students have to negotiate and reach agreement about different matters. Through the negotiation, solving conflicts and other mechanisms in the process of construction of new knowledge is possible. Theoretically, collaborative argumentation seems to be constructive when students really negotiate and are willing to compromise. Therefore, in collaborative argumentation, constructing knowledge at a higher cognitive level is important for students' learning because it ensures students are experiencing meaningful learning (Shukor, et al., 2014). Learners then will acquire knowledge through the elaboration of learning material by constructing arguments where AKC is based on the assumption that learners engage in specific discourse activities and that the frequency of these discourse activities is related to knowledge achievement (Stegmann, Weinberger, & Fischer, 2007; Weinberger, & Fischer, 2006).). In short, if teacher teaches the students to construct and analyze arguments, then they teach students to think critically without any central critical thinking skill needs to be left behind an instructional approach that emphasizes argument. These qualities are important in argumentative dialogues and debates in which the goal is to assess the strengths and weaknesses of others' contributions. Several studies such as Littlefield (1995), Marttunen & Laurinen (1999) also suggested that learning environments in which students are actively involved in the interaction and debates with each other are useful when the aim is to promote argumentation skills.

Therefore, to foster student thinking skills to the higher level, a crucial part of critical thinking is to identify, construct, and evaluate arguments. Surveys such as that conducted by Loureiro & Neri de Souza (2009) have shown that argumentation and questioning are two of the most significant skills that students must have in order to become more pro-active as far as reasoning and critical thinking are concerned. An argument can be defined as the reason(s) a person gives in support of a claim. Basically, argument is not just a matter of presenting information but rather is a matter of presenting a conclusion based on information or reasons. The argument consists of evidence presented in support of an assertion or claim that is either expressed or implied (Seyler, 1994). Meanwhile, Chin & Osborne (2010) defines argumentation is considered a verbal, social, and rational activity employed to convince someone about the acceptability of a perspective by proposing statements and evidences that justify or refute a previously expressed idea. This competence is, therefore, central to the process of thinking.

Computer-Supported Social Collaborative Learning Environment (CSSCLE)

Nowadays, ICT has great potential to support learning and knowledge construction in higher education. As shown by Voithofer & Foley (2007), the main feature of ICT with respect to practicing argumentation and HOTS is its potential support to the focused discussion of alternative points of views between participants. Students in social digital environments are not affected by a number of special factors of face-to-face settings that can hinder discussion such as gender, age, ethnicity, performance skills. Besides, studying through ICT consists mainly of text-based contributions to the topics under consideration since written text demands precision, careful consideration, and explicit expression of thoughts (Henri, 1992).

Alike with face-to-face collaborative environment, AKC with computer-supported collaborative learning (CSCL) also requires two or more students negotiating and reaches agreement about different matters. The only different is the interaction among students is mediated by computers technology. Several advantages of applying CSCL in AKC are:

- allowing time for deep reflection;
- students have more time to reflect, research and compose their thoughts before they take part in the discussion;
- facilitates learning by allowing students to see and respond to the work of others and
- develops thinking & writing skills.

All these elements are important in improving the performance of individual and group. Therefore, student learn best when they actively construct their own understanding through social interaction with their peers (Richardson, 2006). The question now is how to analyze argumentative knowledge construction process in the online collaborative learning to confirm that it is really reflects students' HOTS? Thus, there is a need for analysis strategies on how

online collaborative argumentation can be designed to improve the use of collaborative peer feedback in education and how students can learn to use argumentation processes as a tool for learning activity (i.e. to clearly define the extent to which students distinguish, identify and describe the meaning content that appears in collaboration with other students in an online setting as an important aspect which can promote reflective learning and development in students, as well as their critical ability or HOTS).

Mainly, a written text demands precision, careful consideration, and explicit expression of thoughts (Henri, 1992). Thus, a variety of new tools and technologies cultivating computer-supported collaborative learning (CSCL) and computer-supported cooperative working (CSCW) appeared and established themselves on the Internet (Kim, 2012; Coffin, Hewings & North, 2012). This development is frequently referred to as Web 2.0 (Coffin, Hewings & North, 2012; de Sousa Borges, 2014). On the one hand, the term Web 2.0 describes a set of new interactive technologies and services on the internet (Gokhale, 1995). The term Web 2.0 was created to embrace such collaborative applications and also to show social approach to generating and distributing Web content, features of open communication, decentralization of authority, and freedom to share and re-use. Implicit and explicit in many Web 2.0 applications are social networks, through which users share and filter content, collaborate, seek information, and interact socially on the Web.

Nevertheless, one of the key features of Web 2.0 application is collaboration. These social applications have the capacity to function as 'intellectual partners' to promote critical thinking and facilitate cognitive processing (Voithofer & Foley, 2007). Text, voice, music, graphics, photos, animation and video are combined to encourage thinking and creativity when undertaking high-level tasks. They offer a variety of resources that can be used for problem solving, critical thinking collaboration and so on (Littlefield, 1995) in both physical classrooms and virtual learning environments. In addition, Web 2.0 technologies, with their potential for interactivity will foster active participation and student-centered learning.

Collaboration among students is a defining characteristic of constructivist classrooms (Jonassen, Mayes & McAleese, 1993) and Web 2.0 has enormous potential for social interactivity in promoting collaboration and mutual learning. Virtual communities of students can be organized on the Internet, allowing them to work in small groups to achieve common objectives and to strengthen their commitment to the values inherent to collaborative working. The more or less diverse grouping of students for the purpose of undertaking tasks may favour the creation of 'zones of proximal development' (ZPD) (Vygotsky, 1978) and provide students with opportunities to construct shared meaning of their practices (Dillon , 2004).

A Meta-Analysis of AKC Process in CSSCLE

In order to retrieve the related research paper on AKC in CSCL, The following key words were used to search for related publications: [argumentation AND knowledge construction], [collaborative argumentation] and [argumentative knowledge construction]. The searching also conducted via Springer, IEEE Xplore Digital Library, Science Direct, and Google Scholar. Through a review of more than 50 scholarly papers, only 10 candidate papers were selected after applying the inclusion and exclusion criteria that considered relevant to the study:

i. the studies concern specific thinking skills that lead to need for collaborative AKC (focused in education),
ii. the studies must be published between 2008 onwards, and
iii. the studies must mention the CSSCLE used by the educators to support students in collaborative argumentation.

After being analyzed qualitatively, the meta-analysis on the thinking skills that lead to the need for AKC process in social collaborative learning towards enhancing students' HOTS were summarized and presented in Table I. As shown in Table I, most of the studies involved students in higher education. AKC process implemented in these studies varies across disciplines (e.g. science, history, literacy skills, gaming and programming language). Despite having involved various forms of support (i.e. virtual learning objects, software-based tool and Internet-based tool), these studies have generally identify various thinking skills that lead to the need for AKC process in the social collaborative learning environment or CSSCLE.

Table 1. Related studies on AKC process towards students' thinking skills in CSSLE

Paper	Research Study & Purpose	CSSLE	AKC Process	Focused skills
Tsovaltzi et al., (2013)	To investigate on how AKC in multidisciplinary CSCL groups can be facilitated with a trans active discussion script.	SharePoint (asynchronous text-based discussion board)	Analyze, discuss, and solve problem case related to given domains.	Problem solving skills
Coffin, Hewings and North (2012)	To investigate the potential benefits of argument structure provided through individual computer-supported argument diagramming to foster academically sound opinions in the context of Facebook.	Facebook and LASAD (web based system)	Pretest & posttest (intervention) Facebook discussion Questionnaire	Critical thinking skills Problem solving skills
Yannis (2012)	To consider the extent to which students' current repertoires of meaning making resources might influence the way their argumentation unfolds, and have implications for how teachers and tutors might best intervene in order to guide and develop students' interactions.	SharePoint (asynchronous text-based discussion board)	Claim Thesis Recommendation Counterclaim Informing Recount Description Explanation Counterfactual explanation Procedure Refutation Concession Argument prompt Information prompt	Critical thinking skills Inquiry skills
Castillo (2013)	To investigates the effectiveness of micro-script fading in computer-supported argumentation activity in contrast to the peer-monitoring technique, as a means to enhance students' learning outcomes.	iArgue (web-based argumentation forum tool)	Argument based on collaboration script and peer-monitoring, pre & post-test.	Critical thinking skills Reasoning skills
Loureiro & Neri de Souza (2009)	To develop argumentative abilities for written composing of psychology senior students.	Rational 2.07 software (Computer-Aided Argumentative Mapping)	Questionnaire EVARG-IE, analysis and evaluation of arguments	Critical thinking skills
Sethi, Ricky, and Gil Yolanda (2011)	To propose an innovative approach for the development of social collaboration argumentation systems.	eCollege and Blackboard (asynchronous text-based discussion board).	Question-answer Discussion	Critical thinking skills Reasoning skills
Weinberger, Stegmann, Karsten and Fischer (2010)	To investigate the effects of an argumentative script (with versus without) and the learning arrangement (individual versus	Online Discussion board (asynchronous text-based	Analyze the problem case, Specify claims, Review analyses and	Problem solving skills

	collaborative) on learning processes and outcomes of AKC in the context of a computer-supported learning environment in higher education.	discussion board)	Discuss the problem cases together.	
Jingyan Lu, Ming Ming Chiu, and Nancy WaiYing Law (2011)	To promote high level reflexions and subsequently enrich students' knowledge construction conceptualization.	ArguQuest (eLearning)	1st module: Make questions 2nd module: Interaction with peers 3rd module: Questioning & answering 4th module: Offer reasons & arguments	Reasoning skills Questioning skills Critical thinking skills
Jamaludin, Chee and Ho (2009)	To examine how the discourse moves of students engaged in collaborative learning are related to their justifications during computer mediated communication (CMC).	Knowledge Forum (asynchronous text-based discussion board)	Claim, explanations and evidence.	Inquiry skills
Lucas & Moreira (2010)	To discuss the implications on teaching and learning of argumentation and critical thinking skills.	SecondLife (VLE-Internet based). Online Discussion board (asynchronous text-based discussion board).	Pre-test essay Enactive role play in Second Life (SL) Argument & discussion Reflection tasks Post-test essay Questionnaire & interview	Critical thinking skills

What Types of Thinking Skills Involved along the AKC Processes in CSSLE?

Based on the meta-analysis, several thinking skills were identified such as problem-solving, reasoning, questioning, inquiry, decision making and critical thinking skills. However, critical thinking skills are seen as the most focused thinking skills in AKC (see Table 2). As found by Schellens et al., (2009), giving specific roles to students participating in asynchronous discussions leads to complex thinking. Giving students ownership of the responsibility to create complex thinking as responsibility is transferred to the learning process for students and learning combined with autonomy, within the context of problem based learning and intra and inter-group collaborative work (Lucas & Moreira, 2010). Once again, in constructing knowledge, critical thinking and logical reasoning is an important goal. Students must learn to explain their informed opinions and give reasons for the way in which they carry out tasks and solve problems. Meaning that, learning requires a deep both compromise and engagement with ideas and knowledge. This deep involvement is grounded in this sub-critical thinking ability known as argumentation. To authors, learned the argument represents a very important way to think which eases other convenient base, complex and also desired educational goals as are conceptual change and problem-solving abilities. The ability to argue is one of the highest forms of expression of the highest order thinking and reasoning

Table 2. Thinking skills and CSSCLE

Types of Computer-supported Social Collaborative Learning Environment (CSSCLE)		Focused Skills				
		Problem solving skills	Critical thinking skills	Inquiry skills	Questioning skills	Reasoning skills
Software	Rational 2.07		●			
E-learning	ArguQuest		●		●	●
Web-based	iArgue		●			●

	LASAD	●	●			
	Facebook	●	●			
	Second-Life		●			
Asynchronous Discussion Board	eCollege		●			●
	Blackboard		●			●
	Knowledge Forum			●		
	SharePoint	●	●	●		
	Not mention	●				
Total		4	9	2	1	4

What is the potential of AKC in CSSCLE?

In Table 2, we can clearly see that there are several types of CSSLE involved such as: e-Learning (i.e. ArguQuest), Web-based (i.e. iArgue, LASAD, Facebook, Second-Life), and Asynchronous Discussion Board (i.e. eCollege, Blackboard, Knowledge Forum, SharePoint). The meta-analysis has revealed the importance of CSSCLE or social collaborative learning environment to AKC. The meta-analysis also shows that the thinking skills can occur through argumentative structures and CSSCLE has being an important role in the AKC process. Therefore, online learning environments can provide a variety of specific instructional functions to promote dialogic argumentation and to facilitate active learning beyond what can be achieved in traditional learning environments (Fabos & Young, 1999; Fischer, 1998; Marttunen & Laurinen; 2001; Schellens & Valcke, 2006).

What are the Types of Process Involved in AKC through CSSCLE?

Most of the study will do a step-by-step process in order to foster and evaluate the AKC process among students. Based on Table 1, the types of process involved in the studies is about to similar between each study. The types of AKC process in CSSCLE can be identified as below (see also Figure 1):

Level 1: Problem analysis, Pre-test performance, Questionnaire
Level 2: Given task or activities (e.g. games - Lucas & Moreira, 2010)
Level 3: Discussion, Argumentation (e.g. claim, thesis, recommendation, counterclaim, informing, recount, description, explanation, counterfactual explanation, procedure, refutation, concession, argument prompt, information prompts), and Questioning-Answering
Level 4: Post-test performance
Level 5: Interview

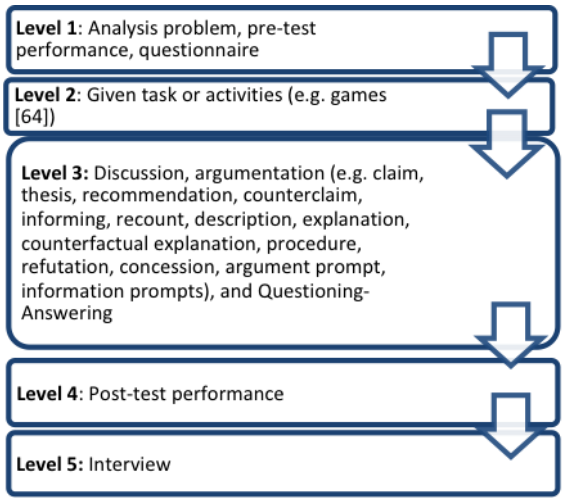

Figure 1. Types of AKC process in CSSCLE

How CSSCLE can be so Important for AKC process?

Discussions of the aims of education inevitably include fostering the development of critical thinking skills, arguing and reasoning abilities in students as a major goal of education. So, developing argumentative skills is increasingly becoming important for online collaborative learning as they improve the ability to persuade and convince to reach consensus. From the meta-analysis, processes in AKC determine the effectiveness of the studies and leads towards the thinking skills. Analysis, claim and discussion features are the most widely used throughout the process. The inclusion of HOTS (such as analysis, evaluation, & synthesis) in AKC activities shows that knowledge is constructed during argumentation process in a CSSCLE. Noroozi (2012) indicated that computer-supported collaboration scripts are amongst the most prominent instructional approaches that can be used to facilitate coordination of the distributed knowledge and trans active discussion and argumentation in CSCL settings. Thus, in the meta-analysis, we found that an instrument such as discussion script, questionnaires and pre-posttest along the AKC process has supported the AKC discussion and collaborative argumentation. In addition, computer-supported 'learning script' can improve the quality of argumentation in discussion and individual knowledge on argumentation, then lead to deeper processing of learning material and finally to better learning (Fischer & Mandl, 2005). On the other hand, collaborative scripts can extend the zones of proximal development (ZPD) (e.g. enable student to formulate a right question which otherwise he could not have). Scripts should both change observable behavior and cognitive behavior (i.e. from do not know to know). Collaboration scripts may lead to an alternative orchestration of argument in discourse, and so on of cognitive processes. Therefore central to this kind of CSCL research is collaboration scripts – a program of action that activates or assign roles and activities associated with these roles that help individuals to understand and to act in certain collaborative situations.

In brief, there is a growing interest in using social collaborative learning environment for AKC towards students' HOTS where the empirical and theoretical research on argumentation has grown significantly considerably over the past few decades. Jonassen & Kim (2010) reviewed the literature on the ways and modes how argument capacity impacts to other cognitive abilities and ways of obtaining knowledge. They found that argumentation is somehow related to higher order thinking. In developing and testing cognitive tools, it appears argumentation is almost separately chosen as the genre framework to work with, as it allows for activities that involve challenging cognitions and their foundations

In Bloom's taxonomy, for example, involving the skills of applying, analysis, evaluation, and synthesis (creation of new knowledge) are considered to be of a higher order, which requires different learning and teaching methods, than the learning of facts and concepts. Higher order thinking involves the learning of complex judgmental skills such as critical thinking and problem-solving. Higher order thinking skills are more difficult to learn or teach but also more valuable because such skills are more likely to be usable in novel situations. Since thinking and learning are interrelated as one has to independently think and seek solutions to a problem or situation in order to gain knowledge, thus in the future, we suggest focusing more on critical thinking skills which has

become the most thinking skills focused along the AKC process and the collaborative scripts in argumentation that support the AKC process. In addition, HOTS is believed as one of the most essential soft skills for future employability of the new generations.

The Systematic Mapping Process for AKC Analytical Frameworks

From the meta-analysis, we further investigate the analytical frameworks used in the AKC process. Even though research has been conducted on several topics related to AKC, more extensive research is needed for AKC analytical frameworks studies. AKC is critically important at present, as they can be a mean to achieve relevant goals, from both a personal and an institutional point of view as abovementioned (i.e. HOTS).

Unlike meta-analysis process, from the beginning, we have decided to use only the word [argumentative knowledge construction] as our main keyword. de Sousa Borges et al., (2014) emphasized that this action will let a greater number of papers can be analysed and dropping the odds of leaving relevant studies out of the final set. Also, with this keyword, we performed searches on well-known electronic databases to cover relevant scientific journals and articles from a wide variety of domains such as Computer Science, Education and Educational Research, Science, Engineering and Psychology as shown in Figure 3. At first, we retrieved 281 primary papers. However, after applying the inclusion and exclusion criteria (i.e. title, abstract and keywords), only 51 candidate papers were found relevant. After completely studying the whole papers, the final set of 17 primary papers is recorded as shown in Figure 3. As a result, we provide an overview of the AKC analytical frameworks literature from 2010 until present. These peer-reviewed papers are identified through journals, database searches, and linking from known sources to form the base for this review (see Figure 3 and Table 4). The whole systematic process was based on Petersen et al., (2008) as shows in Figure 2.

Figure 2. The systematic process (Petersen et al., 2008)

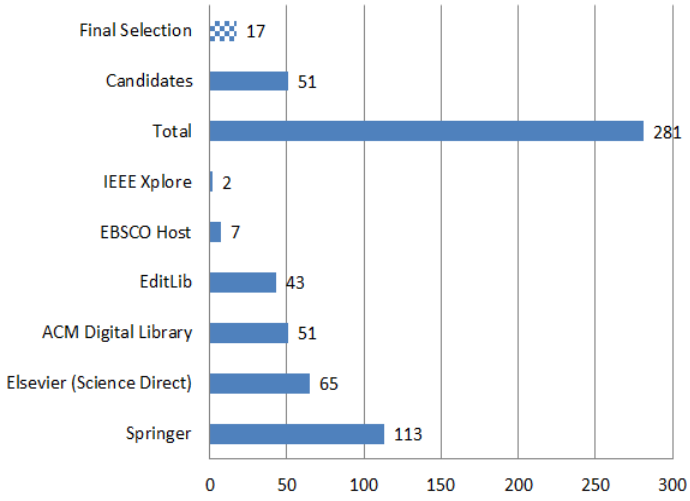

Figure 3. The distribution of primary studies by online databases

In this section, we analyses the results of our mapping study. The main purpose of this section is to give an overview of several types of well-known and rarely use AKC analytical frameworks which have been designed to support education particularly in collaborative argumentation and improving students' HOTS. The information drawn from the selected primary studies is also used to answer our mapping study's objectives as below.

In What Educational Contexts and Levels has AKC Been Most Investigated?

From Table 3, it is clearly found that the research on AKC studies is increasing (from 2010 - 2013). It shows that there is importance action needs to be taken in order to analyze AKC in education especially to foster students' thinking skills to the higher level. Also, most of the AKC studies focusing on the higher education learning (see Table 4) since most researchers focusing on how to improve student teacher or pre-service teacher course which will reflect on how teachers will be able to teach students using HOTS in the future (Scheuer et al., 2011; Scheuer et al., 2013; Weinberger et al., 2010; Tsovaltzi, 2014; Tawfik & Jonassen, 2013; Noroozi et al., 2013).

Table 3. Distribution of primary studies by years

Year	Number of Papers	Paper
2010	3	Weinberger et al., (2010); Asterhan & Schwarz (2010); McLaren, Scheuer & Miksatko (2010)
2011	3	Scheuer et al., (2011); Falcão & Price (2011); Jeong et al., (2011)
2012	4	Osborne (2012); Stegmann et al., (2012); Kim (2012); Coffin, Hewings & North (2012)
2013	5	Scheuer et al., (2013); Scheuer & McLaren (2013); Alagoz (2013); Tawfik & Jonassen (2013); Noroozi et al., (2013)
2014	2	Tsovaltzi et al., (2014); Tsai & Tsai (2014)
Total		**17**

Table 4. Primary studies categorized based on educational level or target audiences

Educational Level or Target Audience	Number of Papers	Paper
Higher Education (HE)	8	Scheuer et al., (2011); Scheuer et al., (2013); Weinberger et al., (2010); Tsovaltzi et al., (2014); Tawfik & Jonassen (2013); Noroozi et al., (2013); Stegmann et al., (2012); Kim (2012);
After School	1	Alagoz (2013)
College	1	Tsai & Tsai (2014)
School/ High School	2	Falcão & Price (2011); Jeong et al., (2011)
Mixed (HE and Schools)	3	McLaren, Scheuer & Miksatko (2010); Asterhan & Schwarz (2010); Coffin, Hewings & North (2012)
Nil	2	Scheuer & McLaren (2013); Osborne (2012)
Total		**17**

What Types of Frameworks Frequently Used in Analyzing AKC Studies?

From the analysis, the results in Table 5 shown that the most frequently used or well-known AKC analytical frameworks in education is Toulmin's Model (4 papers) and Simplified Toulmin (2 papers) which is also originated from Toulmin's model. The next frequently used frameworks in AKC analysis process is CASE framework (3 papers). Next, Rainbow framework with 2 papers followed by Weinberger and Fisher analytical framework with 1 paper. While others (5 papers), showing of some AKC analytical frameworks that rarely or previously used (e.g. before 2010) such as Leitão model, sequential analysis approach developed by Jeong (2005) that incorporates a coding scheme developed by Clark and Sampson (2007, 2008), analysis scheme adapted from Jonassen and Cho (2011), Questioning & Argumentation (QA) model and adaptation from Felton and Kuhn's Counterargument Analysis rooted from Walton's Theory. In short, from the mapping study, we can clearly see that the Toulmin's model is still dominating the strategies on analyzing the AKC process.

Table 5 Primary studies categorized based on frameworks

Frameworks	Number	Paper
RAINBOW (R)	2	Scheuer et al., (2011); Scheuer et al., (2013)
Toulmin (T)	4	Weinberger et al., (2010); Tsovaltzi et al., (2014); Tsai & Tsai (2014); Coffin, Hewings & North (2012)
Simplified Toulmin (ST)	2	Noroozi et al., (2013); Stegmann et al., (2012);
CASE	3	McLaren, Scheuer & Miksatko (2010); Scheuer & McLaren (2013); Asterhan & Schwarz (2010);
Weinberger and Fisher (WF)	1	Falcão & Price (2011);
Others (O)	5	Alagoz (2013); Osborne (2012); Tawfik & Jonassen (2013); Jeong et al., (2011); Kim (2012);
Total	17	

Besides identifying the objectives of the primary studies, it is also necessary to characterize the type of research that was carried out and reported in these studies. Towards this end, we applied the classification proposed by Petersen et al., (2008). Such a classification comprises the following research types.

- **Validation Research**: studies that fall into this category describe a novel technique, approach, or strategy that has not been implemented in practice, but whose effectiveness has been evaluated to some degree through laboratory studies.
- **Evaluation Research**: this category contains studies that empirically evaluate a technique, approach, or strategy in practice or real settings.
- **Position Papers**: these studies report the authors' point of view. Research in this category does not contain evidence that backs up the authors' opinion.
- **Philosophical Papers**: studies in this category are similar to position papers; however, they shed light on new ways through which educational approaches can benefit from AKC.
- **Solution Proposals**: studies that describe a solution technique, approach, or strategy and argue for its usefulness, such a solution is either novel or extends an existing approach; studies in this category usually present examples and a good line of argumentation (but not strong empirical data).
- **Experience papers**: these studies are concerned with reporting the author's experience during the implantation of a new approach.

To show the distribution of the studies according to AKC analytical frameworks and research types, the bubble plot is generated as in Figure 4 and the primary studies summarization are shown in Table 6. The resulting bubble plot is intended to be seen as a map of research types on AKC analytical frameworks studies used in relating with education. Adapted from de Sousa Borges et al., (2014), a bubble plot consists of two x-y scatter plots that containing bubbles in category intersections. The size of these bubbles shows the number of primary studies that have been classified in the pair of categories in question. This type of visual summary gives an overview that enables researchers to identify categories that have been drawing the most attention and the ones that have not been much investigated. Therefore, by analyzing such a map, it is then possible to identify gaps and opportunities for future research (de Sousa Borges et al., 2014)

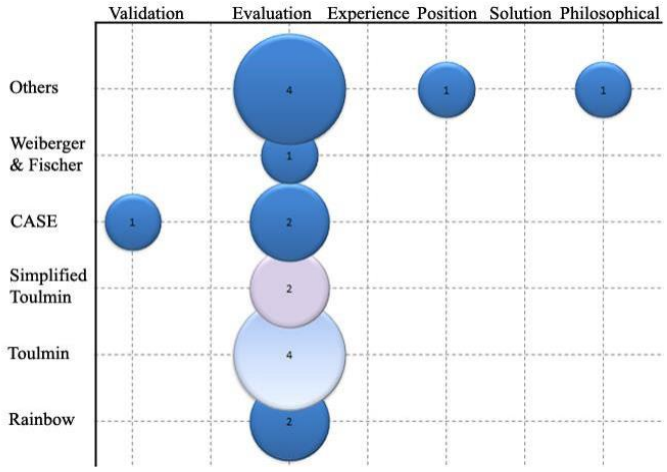

Figure 4 Map of frequently used frameworks for AKC studies

Table 6 also synthesizes the frequency of primary studies according to research classification or research objective. The numbers in parenthesis represent the number of papers in the category, while the numbers in square brackets are the papers' references. Apart from this, we can clearly identify that the research objective of most studies is to evaluate (Evaluation) the AKC process (see also Figure 4). It is possible to identify that there are no studies related to Experience or Solution as most of the works only focusing to report the outcome from AKC process and how AKC works well in social collaborative learning. Nevertheless, it is necessary for more research to be done with the help of end users, i.e. educators or teachers, to report their personal experiences regarding the application and implications of using AKC analytical frameworks in social learning environments as well as testing the effectiveness of using AKC in the social collaborative learning.

Table 6. Distribution of AKC Research Frameworks and Research Objectives

Research Classification	**Types of AKC Frameworks**					
	R(2)	**T(4)**	**ST (2)**	**CASE (3)**	**WF (1)**	**O(5)**
Validation (1)				Scheuer & McLaren (2013)		
Evaluation (15)	Scheuer et al., (2011); Scheuer et al., (2013);	Weinberger et al., (2010); Tsovaltzi et al., (2014); Tsai & Tsai (2014); Coffin, Hewings &	Noroozi et al., (2013); Stegmann et al., (2012);	McLaren, Scheuer & Miksatko (2010); Asterhan & Schwarz (2010)	Falcão & Price (2011)	Alagoz (2013); Tawfik & Jonassen (2013); Jeong et al., (2011); Kim (2012)

	North (2012)	
Position (1)		Osborne (2012)
Philosophical (0)		
Solution (0)		
Experience (0)		

Conclusion

In conclusion, in the future education, it is a basic requirement to prepare learners to engage in a networked, information society where knowledge will be the most critical resource for social and economic development. Lately, the education system has come under increased public inquiry and debate, as parents' expectations rise and employers expressed their concern regarding the system's ability to adequately prepare the students for the challenges of the 21st century. Presently, in a knowledge-based economy, it is important to create new knowledge in order to be able to connect to different pieces of knowledge and learn how to continue obtaining knowledge throughout their lives which encouraging an interest for inquiry and lifelong learning. Each student will learn a range of important cognitive skills, including problem-solving, reasoning, critical and creative thinking, and innovation. In this research, from the meta-analysis, several thinking skills were identified: problem-solving, reasoning, questioning, inquiry, decision making and critical thinking skills, with the last being the most mentioned in previous studies. This result shows that learning to synthesize, evaluate, and process information in new ways is the key to preparing students for the world outside of school.

Then, the main purpose of mapping study is to provide an overview of what types of analytical frameworks that have been used in the context of analyzing AKC process applied to education. To achieve our goal, we followed a systematic methodology (i.e. systematic mapping) guided by de Sousa Borges (2014). Two objectives are defined to be answered by the mapping process: In what educational contexts and levels has AKC been most investigated? and What types of frameworks frequently used in AKC studies? According to the results, the studies mostly focused on Higher Education (see Table 4) and in Table 3 shown that the research relating to AKC study is increasing from the year 2010. We also found that the frequently used framework for analyzing AKC process in the social learning environment is Toulmin's model (see Table 5). Apart from the results, we also identified that there are few theorists that related to AKC analysis process such as Toulmin, Walton and Leitão and their frameworks had been used previously (before 2010) with Toulmin's model still dominating the AKC analysis strategies. Also, during the screening process, we found that there are few coding schemes that used together with AKC analytical frameworks based on CSCL learning environments in analyzing the argumentation activity (e.g. Weinberger and Fischer (Tsovaltzi et al., 2014; Falcão & Price, 2011). Thus, our next plan is to focus more details on the coding schemes for AKC analysis process.

Conclusively, this paper has listed several thinking skills that lead to need for AKC especially in CSSLE and shown the current systematic mapping that covering research into AKC analytical frameworks applied to education. Together with this contribution is the map (Figure 4). By analyzing such a map it is possible to identify in which way AKC has been explored in educational contexts and thus determining research gaps and future research opportunities (de Sousa Borges, 2014).

Future Suggestions

From the research, we know that there is a growing interest using social collaborative learning environment for AKC towards students' HOTS. Empirical research and theory in argumentation has grown significantly over the past few decades. Despite this diversity of approaches to the study, is almost a consensus among scientists the view that the argumentation is useful to the construction of new knowledge and changes in people's view. Thus, our future works will be focusing on the AKC coding schemes for AKC analysis process. Even the mapping has shown some great results, but still the weaknesses exist due to limited years and maybe we have missed the studies which are relevant to the previous research. Hence, in future, we intend to update this study by taking into account more frameworks and details on AKC coding schemes that support the AKC analysis process in order to improve students' HOTS.

Acknowledgement

The authors would like to thank the Universiti Teknologi Malaysia (UTM) and Ministry of Education (MoE) Malaysia for their support in making this project possible. This work was supported by the Fundamental Research Grant Scheme [R.J130000.7831.4F368] initiated by MoE.

References

Alagoz, E. (2013). Social argumentation in online synchronous communication. International Journal of Computer-Supported Collaborative Learning, 8(4), 399-426.

Allen, S. H. L., & Wern, L. E. (2011). Involvement of Higher Order Thinking Skills Within A Preparatory Course for The Malaysian University English Test. English Teacher, 40.

Asterhan, C. S., & Schwarz, B. B. (2010). Online moderation of synchronous e-argumentation. International Journal of Computer-Supported Collaborative Learning, 5(3), 259-282.

Baker, M.J. (2009). Argumentative interactions and the social construction of knowledge. In N.M. Mirza & A.-N. Perret-Clermont (Eds.) Argumentation and Education: Theoretical Foundations and Practices, pp. 127-144. Berlin: Springer Verlag.

Castillo, A.C. (2013). Promoting Argumentative Abilities in Written Composition of Psychology Senior Students: CAAM Method. International Conference on Education & Educational Psychology (ICEEPSY 2012). Volume 69, 24 December 2012, Pages 1664–1675.

Chin, C., & Osborne, J. (2010). Students' questions and discursive interaction: their impact on argumentation during collaborative group discussions in science. Journal of Research in Science Teaching, 47(7), 883-908.

Chou, P. N., & Chen, H. H. (2008). Engagement in online collaborative learning: A case study using a Web 2.0 tool. Journal of Online Learning and Teaching,4(4), 574-582.

Coffin, C., Hewings, A., & North, S. (2012). Arguing as an academic purpose: The role of asynchronous conferencing in supporting argumentative dialogue in school and university. Journal of English for Academic Purposes, 11(1), 38-51.

de Sousa Borges, S., Durelli, V. H., Reis, H. M., & Isotani, S. (2014), March. A systematic mapping on gamification applied to education. In Proceedings of the 29th Annual ACM Symposium on Applied Computing (pp. 216-222). ACM.

Dillenbourg, P. (1999). Collaborative Learning: Cognitive and Computational Approaches. Advances in Learning and Instruction Series. P. Dillenbourg, ed., Elsevier Science, Inc.,. Available at: http://eric.ed.gov/ERICWebPortal/recordDetail?accno=ED437928.

Dillon , P. (2004). Trajectories and tensions in the theory of information and communication technology in education. British Journal of Educational Studies. Vol. 52, No 2, pages 138-150.

Fabos, B., & Young, M. D. (1999). Telecommunications in the classroom: Rhetoric versus reality. Review of Educational Research, 69 (3), 217-260.

Falcão, T. P., & Price, S. (2011). Interfering and resolving: How tabletop interaction facilitates co-construction of argumentative knowledge. International Journal of Computer-Supported Collaborative Learning, 6(4), 539-559.

Fischer, M. (1998). Work process knowledge and its impact on vocational education and training. In Mulder, Martin (ed.). European vocational education and training research. Proceedings of the VETNET program at the ECER conference in Ljubljana, Slovenia, on 17-20 September 1998, pp. 175-184.

Fischer, F., & Mandl, H. (2005). Knowledge convergence in computer-supported collaborative learning: The role of external representation tools. The Journal of the Learning Sciences, 14(3), 405-441.

Henri, F. (1992). Computer conferencing and content analysis. In A. Kaye, ed, Collaborative Learning Through Computer Conferencing (pp. 117–136). Berlin: Springer-Verlag.

Gokhale, A. (1995). Collaborative Learning Enhances Critical Thinking. Journal of Technology Education 7: 22-30. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.77.1338&rep=rep1&type=pdf#page=23.

Jamaludin, A., Chee, Y.S. and Ho, C.M.L. (2009). Fostering argumentative knowledge construction through enactive role play in second life. Computers & Education, 53, 317-329.

Jeong, A., Clark, D. B., Sampson, V. D., & Menekse, M. (2011). Sequential analysis of scientific argumentation in asynchronous online discussion environments. In Analyzing Interactions in CSCL (pp. 207-233). Springer US.

Jingyan Lu, Ming Ming Chiu, and Nancy WaiYing Law. (2011). Collaborative argumentation and justifications: A statistical discourse analysis of online discussions. Comput. Hum. Behav. 27, 2 (March 2011), 946-955.

Jonassen, D.H., & Kim, B. (2010). Arguing to learn and learning to argue: Design justifications and guidelines. Educational Technology Research and Development, 58(4), 439-457.

Jonassen, D., Mayes, T., & McAleese, R. (1993). A manifesto for a constructivist approach to uses of technology in higher education. In T.M. Duffy, J. Lowyck, & D.H. Jonassen (Eds.), Designing environments for constructive learning (pp. 231–247). Heidelberg: Springer-Verlag.

Kajian TIMMS dan PISA – Status Pencapaian Malaysia (2012). Retrieved on May 2015 from http://apps2.moe.gov.my/kurikulum/v2/download/HOTs/Status%20Pencapaian%20Malaysia%20Dalam%20TIMSS%20dan%20PISA.pdf

Kim, H. (2012), June. Impact of computer-supported scaffolding on argumentation. In World Conference on Educational Multimedia, Hypermedia and Telecommunications (Vol. 2012, No. 1, pp. 946-949).

Littlefield, R.S. (1995). Teaching argumentation and debate skills to young children: Bridging theory and practice. In F.H. van Eemeren, R. Grootendorst, J.A. Blair & References 169 C.A. Willard, eds, Proceedings of the Third ISSA Conference on Argumentation. Reconstruction and Application. Vol. III (pp. 287–296). Amsterdam: International Centre for the Study of Argumentation.

Loureiro, M. J., & Neri de Souza, F. (2009). ARGUQUEST: Argumentation and Questioning as base to Active e-Learning. Paper presented at the Challenge 2009: International Conference on Information and Communication Technologies for Education, Minho, Portugal.

Lucas, M., & Moreira, A. (2010). Knowledge construction with social web tools. In M. D. Lytras et al. (Eds.), 1st International conference on reforming education and quality of teaching, CCIS 73 (pp. 278–284). Springer Verlag.

Marttunen, M. & Laurinen, L. (1999). Learning of argumentation in face-to-face and email environments. In F.H. Van Eemeren, R. Grootendorst, J.A. Blair & C.A.Willard, eds, Proceedings of the Fourth International Conference of the International Society for the Study of Argumentation (pp. 552–558). Amsterdam: Sic Sat, International Centre for the Study of argumentation.

Marttunen, M., & Laurinen, L. (2001). Learning of argumentation skills in networked and face-to-face environments. Instructional Science, 29(2), 127-153.

McLaren, B. M., Scheuer, O., & Mikšátko, J. (2010). Supporting collaborative learning and e-Discussions using artificial intelligence techniques. International Journal of Artificial Intelligence in Education, 20(1), 1-46.

Mukama, E.(2010). Strategizing computer-supported collaborative learning towards knowledge building," in IST-Africa, vol., no., pp.1-11, 19-21 May 2010.

Noroozi, O., Weinberger, A., Biemans, H. J., Mulder, M., & Chizari, M. (2013). Facilitating argumentative knowledge construction through a transactive discussion script in CSCL. Computers & Education, 61, 59-76.

Noroozi, O. (2012). Argumentation-Based Computer Supported Collaborative Learning (ABCSCL): A synthesis of 15 years of research. Educational Research Review, 7(2), p.79-106.

O. Scheuer, B. M. McLaren. (2013). CASE: A Configurable Argumentation Support Engine. IEEE Transactions on Learning Technologies, vol.6, no. 2, pp. 144-157, April-June 2013, doi:10.1109/TLT.2013.3

Osborne, J. (2012). The role of argument: Learning how to learn in school science. In Second international handbook of science education (pp. 933-949). Springer Netherlands.

Petersen, K., Feldt, R., Mujtaba, S., & Mattsson, M. (2008), Systematic mapping studies in software engineering. In 12th International Conference on Evaluation and Assessment in Software Engineering (Vol. 17, No. 1). sn.

Richardson, W. (2006). Blogs, wikis, procasts, and other powerful web tools for classrooms. Thousand Oaks: Corwin.

Schafersman, S. D. (1991). An introduction to critical thinking. Retrieved on May, 2015 from http://facultycenter.ischool.syr.edu/wp-content/uploads/2012/02/Critical-Thinking.pdf

Scheuer, O., McLaren, B. M., Harrell, M., & Weinberger, A. (2011). Scripting collaboration: What affects does it have on student argumentation. In Proc. of ICCE (pp. 181-188).

Schellens, T., Van Keer, H., De Wever, B., & Valcke, M. (2009). Tagging Thinking Types in Asynchronous Discussion Groups: Effects on Critical Thinking. International Journal of Interactive Learning Environments, 17(1), 77-94.

Schellens, T., & Valcke, M. (2006). Fostering knowledge construction in university students through asynchronous discussion groups. Computers and Education, 46(4), 349-370.

Scheuer, O., McLaren, B. M., Weinberger, A., & Niebuhr, S. (2013). Promoting critical, elaborative discussions through a collaboration script and argument maps. Instructional Science, 41(3), 2.

Scriven,M. & Paul,R. (2008). Our Concept of CriticalThinking, Foundation for Critical Thinking. Retrieved on May, 2015 from http://www.criticalthinking.org/aboutCT/ourConceptCT.cfm

Seyler, D. U. (1994). "The Greenhouse Blues: Keep Cool about Global Warming." Understanding Argument: A Text with Readings. New York: McGraw-Hill. 457-62. Print.

Shukor, N. A., Tasir, Z., Van der Meijden, H., & Harun, J. (2014). Exploring Students' Knowledge Construction Strategies in Computer-Supported Collaborative Learning Discussions Using Sequential Analysis. Journal of Educational Technology & Society, 17(4), 216-228.

Snyder, L. G., & Snyder, M. J. (2008). Teaching critical thinking and problem solving skills. The Delta Pi Epsilon Journal, 50(2), 90-99.

Stegmann, K., Weinberger, A., & Fischer, F. (2007). Facilitating argumentative knowledge construction with computer-supported collaboration scripts. International Journal of Computer-Supported Collaborative Learning, 2(4), 421-447.

Steinberg, E.R. (1992). The potential of computer-based telecommunications for instruction. Journal of Computer-Based Instruction 19: 42–46.

Stegmann, K., Wecker, C., Weinberger, A., & Fischer, F. (2012). Collaborative argumentation and cognitive elaboration in a computer-supported collaborative learning environment. Instructional Science, 40(2), 297-323.

Sthapornnanon, N., Sakulbumrungsil, R., Theeraroungchaisri, A., & Watcharadamrongkun, S. (2009). Social Constructivist Learning Environment in an Online Professional Practice Course. Social Constructivist Learning Environment in an Online Professional Practice Course, 73(1), Article 10.

Scardamalia, M., & Bereiter, C. (2006). Knowledge building: Theory, pedagogy, and technology. In K. Sawyer (Ed.), Cambridge Handbook of the Learning Sciences (pp. 97-118). New York: Cambridge University Press.

Sethi, Ricky J., and Gil, Yolanda K., A. (2011). Social Collaboration Argumentation System for Generating Multi-Faceted Answers in Question and Answer Communities, AAAI CMNA.

Tsovaltzi, D., Weinberger, A., Scheuer, O., Dragon, T., & McLaren, B. M. (2013). Collaborative learning in Facebook: Can argument structure facilitate academic opinion change? In N. Rummel, M. Kapur, M. Nathan, & S. Puntambekar (Eds.), To See the World and a Grain of Sand: Learning across Levels of Space, Time, and Scale: CSCL 2013 Conference Proceedings Volume 2 – Short Papers, Panels, Posters, Demos & Community Events (pp. 177–180). International Society of the Learning Sciences.

Tawfik, A., & Jonassen, D. (2013). The effects of successful versus failure-based cases on argumentation while solving decision-making problems.Educational Technology Research and Development, 61(3), 385-406.

Tsai, P. S., & Tsai, C. C. (2014). College students' skills of online argumentation: The role of scaffolding and their conceptions. The Internet and Higher Education, 21, 1-8.

Tempelaar DT. (2006). The role of metacognition in business education. Ind. High. Educ., 20(5): 291-297.

Tsovaltzi, D., Puhl, T., Judele, R., & Weinberger, A. (2014). Group awareness support and argumentation scripts for individual preparation of arguments in Facebook. Computers & Education, 76, 108-118.

Veerman, A., & Veldhuis-Diermanse, E. (2001). Collaborative learning through computer-mediated communication in academic education. In P. Dillenbourg, A. Eurelings, & K. Hakkarainen (Eds), Proceedings of European Perspectives on Computersupported Collaborative Learning (pp. 625-632), Maastricht, Netherlands: University of Maastricht Press.

Veerman, A. L., Andriessen, J. E., & Kanselaar, G. (2000). Learning through synchronous electronic discussion. Computers & Education, 34(3), 269-290.

Veerman, A.L. (2000). Computer-supported collaborative learning through argumentation. Ph.D.Thesis, Utrecht University, The Netherlands.

Veerman, A., Andriessen, J. & Kanselaar, G. (2002). Collaborative argumentation in academic education. Instructional Science, 30(3), p.155-186.

Voithofer, R. J.; Foley, A. (2007). Digital dissonances: Structuring absences in national discourses on equity and educational technologies. Equity and Excellence in Education. Vol. 40, No 1, pages 14-25.

Vrasidas, C. (2000), "Constructivism versus objectivism: implications for interaction, course design, and evaluation in distance education", International Journal of Educational Telecommunications, Vol. 6 No. 4, pp. 339-62.

Vygotsky, L.S. (1978). Mind in society: The development of higher mental processes. Cambridge, MA: Harvard University Press.

Weinberger, A., & Fischer, F. (2006). A framework to analyze argumentative knowledge construction in computer-supported collaborative learning. Computers & Education, 46, 71-95. SSCI: 0,968.

Wilen, W. W. (2004). Refuting misconceptions about classroom discussion. The Social Studies, (95)1, 33-39. doi:10.3200/TSSS.95.1.33-39.

Weinberger, A. and Stegmann, Karsten and Fischer, Frank. (2010). Learning to argue online: Scripted groups surpass individuals (unscripted groups do not). Computers in human behavior, 26 (4). pp. 506-515. ISSN 0747-5632

Yannis B., Stavros D. (2012). Peer-monitoring vs. micro-script fading for enhancing knowledge acquisition when learning in computer-supported argumentation environments. Comput. Educ. 59, 2 (September 2012), 236-249.