

Psychological Behavior of Students by Interaction and Cognition in Online Learning Platforms: A Review

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Abstract

Online learning has become popular as it provides more flexible access to content and instruction everywhere and at all times. Currently, this field has witnessed a surge of interest to examine the efficiency of this medium as an educational model. For this study, the researchers reviewed the literature by examining changes implemented by practitioners and researchers in their online courses, with regard to the content, to successfully implement online learning. The study focused on the cognitive level, for questions asked in the classroom by the instructor, as a significant variable to be investigated. The cognitive factor has received keen interest from scholars and practitioners in online learning, to improve interaction in online classroom discussions. Therefore, the study focused on scales that are used to assess cognition and interaction in the classroom. Based on the review, different scales have been implemented to assess the cognitive factor in the online classroom. However, the study found that previous studies have reached inconsistent findings due to different scales that have been implemented to assess cognition and interaction. This review integrates the types of cognitive skills essential to facilitate online interaction and theoretically examines the conflict in the literature. Therefore, both theoretical and practical issues are addressed in this research to provide recommendations for developing teacher-instruction materials in online learning with recommendations as operationalized in practice.

Keywords: Questions, Cognitive level, Classroom discussion, Online learning

1. Introduction

Online learning has a growing presence in the field of language learning. Currently, we have started to recognize some educational institutions that have total virtual courses; like the university of the people, which started to be recognized globally in the fall of 2019. This growth has been reflected in the research orientations, especially in the field of online learning. Scholars have exerted analogous efforts to cope with the current transformation, from the traditional-based to the online-based, to promote a successful online learning environment and provide a constructive environment.

Several studies have investigated online learning to cope with different pedagogical pitfalls and adapt suitable online materials, different from traditional-based learning. The main principle behind all these studies is that communication via this technology is different from ground-based learning (Herring et al., 2004) i.e. medium variables such as channel of interaction and their synchronicity have an impact on computer-mediated communication (CMC) (Herring, 2007). In the same vein, questions are considered an important and significant pedagogical means that are used as a significant stimulus for classroom interaction whether online or traditional-based. Instructors use questions to improve and keep the pace of their classroom interaction and stimulate the level of thinking (Blosser, 2000). Marzano (1993) found that teachers use questions to enhance students' thinking. Sanders (1966) stated that teachers need to prepare questions to stimulate the type of thinking that is appropriate for a particular context. Therefore, questions must be adapted in accordance with the context.

Questions, as significant stimuli, should be evaluated and analyzed. The analysis of these questions should focus on the cognitive level of thinking activities in which the students are required to engage by answering the

assigned question. For example, when the question asks the students to remember something that happened in the past, such a question will be cognitively low (Figure 1). In contrast, questions that ask students to produce something new require high mental engagement and are considered cognitively high-level.

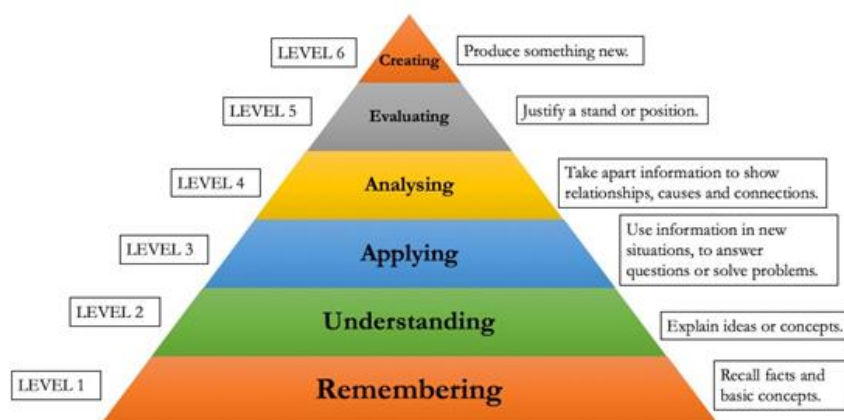


Figure 1: Cognitive levels of classroom activities (Adapted from Bloom, 1987)

As it is widely acknowledged in the literature, the cognitive level of each question has a significant impact on classroom interaction. According to situated cognition, which views thinking and engagement as interconnected with surrounding contextual factors, different contexts need different cognitive considerations (Yahya, 2013).

Accordingly, this can be explained further by referring to the constructivism and sociocultural theories that link the thinking process with learning as mediated by language. Accordingly, knowledge constructions could not be understood apart from the tools and artefacts, which shaped this interaction, i.e, language (Leont'ev, 1982). Knowledge construction must be associated with authentic learning contexts, tasks, and activities that suit the mediated context. However, researchers need to take advantage of these new possibilities to attain the ultimate goals of this new educational practice, i.e., online learning.

To this end, this study reviews different studies that have investigated online learning and implemented some pedagogical changes related to the cognitive factor in trying to attain a successful online learning environment. Therefore, there are two main objectives; one is at the level of research, where we will argue that interaction in online learning has evolved beyond simple integration and the other is at the level of design, where we will suggest some instructional practices. Specifically, this review assesses the role of questioning in online learning by reviewing various studies that have an interest in the cognitive factor of activities implemented in online learning. To be more specific, the focus is limited to studies that tried to adapt suitable stimuli, represented by questions, for this online platform by looking at the cognitive adaptation that has been implemented in the online environment. The main issue that has yielded those studies was the negative perception reported in online-based classrooms. Hence, all of their efforts aimed to attain the ultimate use of this online platform by facilitating and improving students' engagement.

2. Background

2.1 From Ground-Based to Online-Based

Traditionally, any changes in education evolve slowly, but the new development in technology, driven by the current pandemic of Covid19, is increasing the pace of these changes. Many educational institutions have developed their capacity and thrived by offering exclusively online programs by co-locating educational settings. Accordingly, online education has grown tremendously in terms of student enrollment (Allen & Seaman, 2013; Clark & Mayer, 2007). Online course-delivery methods have maintained a substantial interest that retains a

significant element of ground-based content while augmenting the class with appropriate online-based elements to compile and influence the beneficial features that are unique to traditional courses. However, they use different interactional modes with diverse learning tools, adopted from the traditional-based classroom, which may overwhelm learners and result in communicative breakdowns (Cunningham et al., 2010). Teachers mostly do not pay attention to the cognitive factor in their questions when they experienced a shift from the traditional to the online classroom.

Accordingly, online interaction has become a challenge for those who have to implement interactional approaches (Covelli, 2017). Therefore, studies have stated to focus on the nature of verbal interaction to balance and enhance instructor-student interaction taking place in the online classroom (Palomeque & Pujolà, 2018). Several studies have investigated this learning mode to cope with adequate pedagogical practices different from ground-based and lay out the essential pedagogical foundations in online learning.

2.2 Interaction in language learning

Students usually develop language competence when they are offered an authentic and communicative environment. According to the theorists, interaction is an essential feature of an effective classroom experience. Briefly, the classroom must be interactive to attain ultimate learning goals (Jones et al., 2006). This can be explained within the work of sociocultural theory that focuses on language as a semiotic tool that mediates learning. The Russian scholar Lev Vygotsky was the first who postulated the notion of internalization to capture the intangible relation between our social and cognitive planets. Also, Long (1996, 1985, 1983) focused on input and output as important concepts within the notion of interaction. Long (1996) emphasised output as an important tool for learning. It is important to mention that students' output, whether in the form of writing or speaking, serves the purpose of social interaction as a means for learning.

Brown et al., (1989) state that learning is linked to the activities and actual context in which they are used. Additionally, Leont'ev (1982) takes the notion of internalization a step further and states that knowledge constructions through interaction could not be understood apart from the tools and artefacts that shape this interaction. Accordingly, the current study reviews the recent attempts that have been conducted to redeem the current problem of online interaction by investigating instructor-student verbal interaction in the online environment, and by looking into questions as an important stimulus for such uses.

2.4 Question as a pedagogical mean

Online learning makes it possible for L2 teachers to create an optimal task that is interactive, contextualized, and authentic for this environment (Lee, 2016). Online implemented-task has received a surge of interest in the field of computer-mediated communication (CMC). Researchers have conducted several studies to implement tasks across different online instructional contexts (e.g., Lee & Markey, 2014; Thomas & Reinders, 2010). Creating an effective task improves classroom participation, interaction, and collaboration (Hampel, 2010). Several studies have provided valuable insights into the use of online tasks for online learning and its benefits and drawbacks related to learner autonomy, to find how these tasks can be implemented effectively to provide students with an interactive environment similar to that of traditional-based learning.

However, questions, as an essential pedagogical means, are the cornerstone of an effective teaching classroom (Conderman & Morin, 2002). Investigating and adapting appropriate questions can increase learner interactivity (Wilen & Clegg, 1986) and enrich the process of learning by evaluating knowledge acquisition, motivating students, attracting their attention, and assessing understanding (Bond, 2007; Levin & Nolan, 2004). In addition, an effective questioning strategy improves classroom interaction and immediately enhances classroom interactivity (Bernstein, 2013; Goossen, 2002). As a pedagogical strategy, questioning is of immense importance for classroom interaction, in which student engagement depends on the questions formulated by teachers that concomitantly prompt and guide thinking processes (Wilen, 1991). Indeed, there is a current interest in developing questioning strategies as an indispensable principle of second language classrooms (Klem

& Connell, 2004; Marzano et al., 2001; Miciano, 2004). Accordingly, designing and improving an interactive online classroom does not happen by accident. Glance & Rely (2013) stated that online classrooms require clear, planned, and well-crafted questions that suit this online environment. Therefore, this study will investigate different amendments that have been conducted to adjust suitable questions that suit online learning.

2.4 Cognitive load and online learning

Cognitive load refers to the cognitive resources that are focused on and used throughout the learning process (Chandler & Sweller, 1991). This aspect has been built upon a limited Working Memory and a vast long-term memory capacity. Working memory consists of independent processors with different sensory channels. To some extent, any conscious cognitive activity requires working memory capacity. According to Sweller (2005), any instructional design needs to consider working memory and its limitations to prevent an overloaded working memory that may deteriorate learning.

The cognitive load theory suggests three types of cognition, intrinsic, extraneous and germane cognitions. Intrinsic cognition through element interactivity is determined by an interaction between the nature of the material to-be-learned and the expertise of the learner (Sweller et al., 1998). Moreover, the intrinsic load is solely determined by the nature of the learning materials that are inherent to the desired learning outcome and cannot be reduced through instructional design (Sweller & Chandler, 1994). On the other hand, extraneous cognitive load is imposed due to ill-structured design and organization of the learning materials rather than the intrinsic nature of the task (Sweller & Chandler, 1994). Extraneous load occurs when learners engage in irrelevant activities that are not directed toward schema acquisition and automation (Sweller & Chandler, 1994; Sweller et al., 1998). Hence, course designers can facilitate schema acquisition and automation by eliminating irrelevant cognition to facilitate the process of learning (Sweller & Chandler, 1994; Sweller et al., 1998). Whilst the germane load refers to the number of mental resources devoted by the addresser or student who is solving the assigned problem or question. However, when students are interested, they experience a motivating environment, hence devote more mental resources to deal with the assigned activity. However, the three loads are modelled to be additive in nature (Paas, Tuovinen, Tabbers, & Van Gerven, 2003).

Schnotz and Kürschner (2007) assert that amending the intrinsic load without looking at the germane load may deteriorate learning as well. However, a balance needs to be provided between both, because a free capacity in working memory can be used for germane load only to a limited extent. (Galy and Mélan, 2015).

Due to the various activities that do not directly facilitate schema acquisition and automation, online-based learning places an additive load on learners than ground-based learning (Gerjets & Scheiter, 2003; Mayer & Chandler, 2001). These irrelevant cognitive loads contribute to creating an extraneous cognitive load, splitting the learner's attention and increasing the extraneous cognitive load (Eveland & Sharon, 2000; Harter, 1986; Niederhauser et al., 2000). Especially, when they are not directed to schema acquisition (Sweller & Chandler, 1994). Based on this, it can be argued that online learning offers a great deal of flexibility, while cognitively it poses a great amount of load on students.

Sentamu (2003) educational designers need to understand how tools interplay with cognition, and this understanding guides the innovation of this technology. Therefore, adopting the pedagogical practices from traditional to online one does not provide an interactive and effective environment. To this end, several studies have investigated this learning mode to offer sufficient and authentic learning. Thus, the current study aimed to present a review of the previous studies that have tried to amend the content for the online classroom in trying to offer an effective learning environment. Particularly, the following research questions guide this review:

1. How questions have been classified cognitively in online learning studies in online learning?
2. What is the role of cognitive factors in facilitating classroom interaction in online learning?

3. Method

To be included in this review, the articles had to adapt cognitive levels of instructor activities that are used as a task-based for online learning, with special attention to questions. Also, the study should target interaction as an outcome from students. These criteria were selected to reach studies that have been implemented to adapt suitable questioning strategies in this online environment for better online interaction. The review includes studies that have been conducted by using multiple research designs and covering different participants from elementary to advanced levels. This review depends on journal articles, while not Conference publications, since some are not peer-reviewed, which may influence the quality of the study. Moreover, all the studies were in the English language, conducted to investigate synchronous and asynchronous interactions that were conducted from 2010 to 2022.

Table1: the inclusion criteria

Criteria type	Inclusion criteria
Topic	Studies must be conducted to investigate questions in online classrooms.
Context	Online synchronous and asynchronous interaction
Year	Studies must have been published between 2010 and 2022.
Language of the article	English
Participants	From elementary to advanced graduate levels
Research design	Various research designs

4. Result

This study reviewed related studies following Arksey and O'Malley's framework. Arksey and O'Malley's framework entails conducting a review including five steps: (1) identifying the research questions, (2) identifying relevant studies, (3) study selection, (4) charting the data, and (5) collating, summarizing, and reporting the results. This framework helped to carefully select appropriate studies which primarily concerned with articles published in peer-reviewed journals.

To do so, the authors used the following boolean: interaction AND question OR activities OR task AND cognition OR cognitive load. The literature shows that 352 studies have focused on interaction in online learning between 2010 and 2022. In the first phase, 53 studies were selected, as they focused on interaction in the online environment. In the second phase, 11 studies were selected as they directly fulfilled the aforesaid criterion. The studies were found to be conducted in different learning contexts and levels, from primary to graduate level, while the majority have been conducted to investigate graduate and postgraduate levels (Table 1).

4.1 Cognition and its classification

Using adequate stimuli, such as a question, is an essential means to improve and enhance online learning output and attain users' satisfaction (Yang, 2017). However, online learning platforms have to accommodate and initiate a successful interactive environment (Vonderwell & Boboc, 2013). However, 10 studies have addressed cognitive levels of classroom activities, to create an online interactive environment.

Amongst the most important classification is the Bloom taxonomy. Bloom has been used by several scholars, after being adapted to suit educational uses in different instructional fields and science. Several studies (Boulter, 2010; Hong & Jacob, 2012; Yang, et al., 2005) have implemented this classification to assess the impact of online learning on student engagement and performance.

Improving online discussion has commonly been approached by looking into questions that spur student participation. Accordingly, several studies (Ertmer et al., 2011; Zingaro, 2012; Richardson and Ice, 2013; Rusdi & Umar, 2015) have employed a cognitive classification that was developed by Andrews (1980). Ertmer, Sadaf and Ertmer (2011) used Andrew's classification, to assess the use of different questioning strategies in this environment and their impact on classroom interaction. Accordingly, they classified questions into Playground, Brainstorm, Focal question, General invitation, Lower-level divergent, Analytic convergent, Quiz show, Multiple consistent, and Shotgun/funnel questions. Also, they used bloom's taxonomy to classify questions by their critical thinking level. Both were used to assess questions and manipulate student responses to reach a suitable outcome.

Using Andrews' classification may bring some clarity to the inconsistent results. Andrew's classification is an extremely powerful predictor in several instructor-focused studies (Bradley et al., 2008; Ertmer et al., 2011). While bloom was used to improve classroom participation and facilitate high thinking levels.

Aydemir (2016), Aziza (2021), and Bingolbali and Cevik (2022) investigated questions and participation in the online classroom to improve student participation and interaction. By using Jones (1995), Guilford's (1956), Hargreaves's (1984), Rivera et al. (2005), and Kwon et al. (2006), they analyzed questions into the information covered in each question to reach the anticipated outcome. They classified questions into high cognitive level questions, open-ended questions, and low cognitive level, close-ended questions. In another study, Tsai, and Tsai (2013) tried to understand and improve student interaction in an online argument. Accordingly, they classified questions based on a model of argument developed by Toulmin to improve and manipulate online learning outcomes. This model includes claims, grounds, warrants, backings, and rebuttals. Questions were classified to find their impact on students' conceptions and approaches to online argumentation. Sharing the same interest, Caroline (2010) investigated the virtual classroom by categorizing questions into direct, indirect rhetorical, closed, recast, and scaffolding questions in the online environment to promote critical thinking and argumentation. However, despite that, all of these frameworks integrate the principles of the Bloom Taxonomy, but they are not that consistent in reflecting adequate results.

4.2 Interaction as a unit of analysis

Since interaction was considered a means of learning through the process of internalization, classroom interaction was targeted as a goal to be enhanced in classroom activities. Accordingly, several studies have investigated different types of stimuli to enhance learning by seeking better interaction. Since online interaction has been investigated as an issue, several studies have examined, analyzed and classified different types of interaction regarding its quantity or quality in the classroom. In the reviewed studies, seven out of ten have developed clear interaction categories as a benchmark to capture the meaning of good or bad interaction. Some focused on the quantity of classroom interaction, while others focused on the quality of interaction. Some provided accounts of rates to argue for engagement in constructive discussions that facilitate meaning construction. Other researchers provided accounts of the quality of interactions by analyzing different aspects of the meaning of construction processes.

With regards to the quantity of interaction, several studies alleged that teachers should offer their students the

chance to produce the target language by giving more opportunities and much more practice time to students during the process of language learning. Accordingly, in online discussion Ertmer, Sadaf and Ertmer, (2011), used Andrews' "mileage" as an indicator of the average number of responses, the number of students–students per question, and the average number of discussion threads and posts within a thread for each question. Then patterns of interaction were compared to different levels of critical thinking elicited by each prompt to find questions that led to the greatest amounts of interaction at the higher levels of critical thinking. Hrastinski, Stenbom, Benjaminssonb, Jansson (2019) also assessed the length of classroom interaction by using time as a quantitative indicator of response. They developed an online text-based measurement. Conversation intensity was calculated as the ratio between the number of characters and duration.

Adymier (2016) used two types of answers: quickest answer and whole-class answer: quickest and all learner answers. Lee (2012) investigated language use among students in response with regard to three linguistic features: Verbal Productivity (Measured by the Total Number of Words in a response), Lexical Diversity (Measured by the Number of Different Words in a response), and Syntactic Complexity (Measured by the Number of clauses in a response) while controlling students' language skills.

With regards to the quality assessment for interaction in the language classroom, several studies used different classifications to assess the quality of the interaction taking place, to show the agreement between the instructor's questions and student's responses. Yang (2018) assessed classroom discussion to instructor questions by using the cognitive level in each response. Yang used Bloom's taxonomy (1956) to distinguish between six levels of thinking within the cognitive domain. This taxonomy classified thinking into knowledge, comprehension, application, analysis, synthesis, and evaluation. By following the bloom taxonomy, the first three levels are often viewed as constituting low thinking and the last three as constituting high thinking levels (Notar, Wilson & Montgomery, 2005; Schrire, 2006). While Tsui and Tsui developed five qualitative approaches to classify students' argumentation in online learning. They distinguished between four conceptions of online argumentation, namely "expressing ideas," "discussing ideas," "negotiating ideas" and "reflecting on and extending ideas," and five approaches to online argumentation, namely "posting different ideas," "finding the related information for supporting ideas," "replying to postings for adding to ideas," "getting responses for enhancing understanding" and "evaluating postings for challenging ideas and making careful reflections" were identified. These categories represent qualitatively different and hierarchically related conceptions of and approach to online argumentation as experienced by the students. In another study, Zingaro (2012) used the Andrews-based typology of Bradley et al. (2008) to measure thinking order in discussions. In this study, the coding scheme is framed on Bloom's taxonomy. This typology has been followed to assess the message posting as a unit of analysis. However, most of these studies used a quantitative measurement which is considered a superficial assessment. Therefore, there is a need for more qualitative assessment that delves deep into detecting the quality of the transmitted language.

4.3 Cognition and interaction in online language learning

Altogether, there were 9 studies that investigated and described the impact of different activities, which carry different cognitive levels on classroom interaction. Herewith, we present those studies and their results in Table 1. It should be pointed out that only the studies that targeted interaction as a means of learning were included in this study. Moreover, the study also focused on previous works that targeted the cognitive levels of instructors' activities to adapt to a suitable cognitive level for online learning to promote online interaction. Relatedly, the meaning of interaction here refers to both written and spoken as it is shown in table 1. Moreover, as far as the level of education is concerned, the current review investigated different educational levels starting from kindergarten to the graduate level.

Firstly, all of those studies found that interaction varies due to cognitive variation in instructor activities, especially questions. Also, the current review found that there is a wide consensus on the importance of high cognition in online interaction to achieve a sustainable online interactive classroom. In addition, most of the studies were conducted at the graduate and university levels (Aydemir, 2012; Ertmer, Sadaf, & Ertmer, 2011;

Tsai and Tsai, 2013; Yang, 2018).

Ertmer, Sadaf and Ertmer (2011) showed that high cognition improves classroom interaction as it encourages more students to participate in the classroom and express their opinion. Despite that high thinking level activities do not generate responses all at the higher levels of critical thinking, but to some extent improve classroom participation. Zingaro (2012) found that high thinking levels yielded inference answers that in turn address high thinking levels such as analyzing, synthesizing and evaluating as well. In addition, Liu (2019) also found that divergent thinking, which stimulates high processing levels, promotes online synchronous discussion, by eliciting various perspectives and enhancing student participation, as well, to assess students' thinking ability and responding abilities. Yang (2017) found that, by using questions involving analysis, synthesis, and evaluation skills, participants had the opportunity to reflect on, analyze, and even challenge their own thinking, and process the response they received while thinking about the direction for subsequent discussion. In addition, using a high number of low cognition may restrict a student's discussion to be brief and concise, which is not preferred in any learning environment that considers interaction as a learning means.

Despite the wide agreement about the high cognitions, Tsai and Tsai contrasted this by alleging that triggering high thinking levels does not have an impact on students' approach to online argumentation in online interaction. In addition, Cho et al. (2011) found that using deep reasoning questions and knowledge integration responses had no significant impact on learning outcomes since participants are homogenous with similar age and educational backgrounds. Hrastinski, Stenbom, Benjaminssonb, and Jansson (2019) also stated that there is no question that led to positive effects on learning.

However, it can be seen that there is no agreement about the impact of cognition in online media. Some have asserted that high cognitive activities carry a positive impact in classroom interaction, while others contrasted this view by asserting the positive impact of low-level activities. On another hand, some have asserted that this factor carries no impact on classroom interaction.

Researchers have used a variety of classification schemes to categorize the types of questions teachers ask. Therefore, the inconsistency in the results can be attributed to different scales implemented by different studies to assess cognition in classroom activities. Therefore, studies need to carefully consider and assess activities in classroom cognition by adopting authentic and reliable cognitive scales. Accordingly, more studies can be conducted to investigate this field by considering students with different abilities.

5. Discussion

Several studies have been conducted to assess the level and type of questions due to the importance of these stimuli in classroom interaction. The literature shows that the majority have been conducted on ground-based instruction. However, it is clear that there is a dearth of studies online-based. This review shows that 9 studies have been conducted in this regard. However, by aligning classroom activities with these cognitive taxonomies, we can facilitate more challenges and help ensure a constructive learning environment.

In talking about the cognitive level of any classroom activities, Bloom's taxonomy comes as the sole answer to assess any mental activity in the classroom. Nevertheless, several subcategories have emerged in the literature (like Andrew 1980; Guilford's 1956, Hargreaves's 1984, Rivera et al., 2005). All of the nascent classifications have been built on six levels of bloom taxonomy. These classifications came as a solution to the difficulties of applying Bloom's taxonomy, in assessing classroom activities as some can fall into more than one thinking level, especially in descriptive studies when the researcher has no authority to create and use intervention in the class (Ertmer, Ertmer, and Sadaf, 2011). Using bloom in any descriptive study may help in assessing a wide range variety of levels of classification, but to some extent, the result may not reveal the exact and accurate thinking levels used by the instructor.

The consensus view holds that a high thinking level augments classroom interaction and facilitates learning.

Nevertheless, the literature shows a clear conflict. As an apt stimulus in classroom interaction, Zingaro, (2013) and Ertmer Sadaf and Ertmer (2011) stated that high thinking level is an effective means of constructive interaction. While others concluded that the cognitive aspect is not an effective factor in classroom interaction, (Hrastinski et al., 2019; Tsui and Tsui, 2013).

This conflict, in the literature, is attributed to the three types of loads suggested by the Cognitive Load Theory CLT that exist in any mental activity. According to the CLT, the three types are modelled to be addictive. However, when students are engaged in high mental activities, represented by the intrinsic load, this may, in return, raise the germane load, as well. To this end, those who stated that high cognitive level may improve classroom interaction can be interpreted by stating that classroom interaction has been improved due to a rise in students' germane load that improves the devoted mental activities for successful interaction. However, students usually tend to participate when they are challenged with adequately high mental ability.

Additionally, even those who stated that the cognitive aspect is not an effective factor in classroom interaction can be interpreted by referring to the cognitive load theory as well. A high intrinsic load, that may exceed their devoted mental resources, may cause a drop in the germane load and interaction as well. Also, most of the studies that have been reviewed are descriptive studies in nature. Accordingly, this may affect the accuracy of assessing cognitive levels. Using Bloom's taxonomy, as the most ubiquitous one, in any descriptive study may affect the accuracy of the assessment, i.e., the cognitive levels of classroom activities as some activities can be classified in more than one slot of Bloom or some do not fit any of them. Accordingly, most of the studies have used alternative classifications to distinguish between high and low cognition in classroom activities. However, it is proper to use Bloom's taxonomy to account for an accurate meaning of cognitive levels, but experimentally when the researcher has the authority to design his intervention based on Bloom's classification. Also, the aforesaid studies have assessed classroom interaction by looking into the intrinsic load, not the germane load, as an essential variable in classroom interaction.

6. Conclusion

This review integrates the types of cognitive skills essential to facilitate online interaction and theoretically examines the conflict in the literature. In doing so, it addresses both theory and practice and provides recommendations for developing teacher instruction in online learning programs and illustrates the recommendations as operationalized in practice. However, many of the reported findings were not experimentally researched to investigate the appropriate cognitive load. In addition, few studies have addressed the range of mental skills that result in effective online interaction. Finally, the implications of the findings are not limited to any branch of science. Therefore, wherever mental activities are required, these findings are applicable.

7. Directions for future studies

Despite the importance of cognitive demands in any classroom interaction, this review shows that there is a conflict regarding the required cognition in online learning. Theoretically, this conflict has emerged as research has solely depended on interactionist theories. According to Hubbard and Levy (2016), CALL results in a new type of interaction. Therefore, the term situated learning is essential to account for the meaning of the new type of interaction. According to this study, the cognitive load theory needs to be considered while investigating interaction mediated online as a learning means. Methodologically, most of the studies that have investigated online interaction as an issue have adopted a qualitative descriptive design to account for online interaction and examine this mediation, while there is a scarcity of research with an experimental design. In line with the cognitive level, classroom interaction needs to be assessed with accurate measurements to reach a precise meaning for suitable cognition to create an interactive classroom.

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