Wu, Y.-T., & Wang, L.-J. (2023). Advancing University EFL Students' Argumentative Essay Writing Performance through Knowledge-Building-based Holistic Instruction. *Educational Technology & Society*, *26*(3), 115-128. https://doi.org/10.30191/ETS.202307_26(3).0009

Advancing University EFL Students' Argumentative Essay Writing Performance through Knowledge-Building-based Holistic Instruction

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(Submitted April 13, 2022; Revised September 23, 2022; Accepted October 3, 2022)

ABSTRACT: Previous research has revealed that university students have multiple learning difficulties in argumentative essay writing (AEW). To address this issue, Knowledge building (KB) pedagogy that aims to create holistic learning environments highlighting idea-refinement, learner agency, and collaborative discourse could be promising. Therefore, this study designed and implemented two KB-based holistic AEW instructions integrating KB pedagogy and explicit instruction on argumentative essay structure and writing conventions. A quasi-experimental design explored the effects of the two holistic KB-based AEW instructions on university EFL students' AEW learning. Two classes of university EFL students were assigned to two instruction groups: The Constant agency enhancement (AE) Instruction group (n = 34) and the Progressive opportunistic collaboration (OC) Instruction group (n = 32). The treatments were two different KB-based holistic AEW instructions for 16 weeks. The participant's perception of learning environments was assessed before and after the instructions to examine if the learning environments created by the two instructions were aligned with KB pedagogy. To investigate the effects of the two instructions on students' AEW performance, the students' argumentative essays were evaluated before, in the middle, and after the instruction. It was found that the two KB-based holistic AEW instructions did align with KB pedagogy but provided university EFL students with distinct and unique learning contexts and opportunities. More importantly, this study also revealed that, compared with the Constant AE instruction, the Progressive OC instruction significantly benefited students more in their argumentative essay writing performance in both the structure and the quality of essays ($p < .05$).

Keywords: Knowledge building, Knowledge building pedagogy, Argumentative essay writing, University students, EFL

1. Introduction

1.1. Argumentative essay writing

In the rapidly developed knowledge-based economy, the ability to make good arguments has become more crucial in today's society (Lam et al., 2018; Matos, 2021). For university students, the ability to write compelling arguments is the defining characteristic of a good student at the undergraduate level (Mitchell, 2000). Educators also advocated that argumentation is a crucial component of university students' academic success and conducted related research (e.g., Liu & Stapleton, 2020; Muller Mirza & Perret-Clermont, 2009).

During the past two decades, research on argumentative essay writing at the university level has been growing (e.g., Awada et al., 2020; Barrot & Gabinete, 2021). For a long time, relevant research on the assessment of argumentative essay writing was mainly conducted along with Toulmin's (1958) model in which a sound argument should consist of five critical elements (including claim, data, warrant, backing, and rebuttal). Based on Toulmin's works, some research focused on analyzing the overall quality of argumentative essays (e.g., Nussbaum & Kardash, 2005; Wolfe, 2011), while others focused on assessing the soundness of argument in argumentative essays in terms of acceptability, relevance, and adequacy (e.g., Hughes & Lavery, 2008; Means & Voss, 1996). To provide more insights into learners' argumentative essay writing, some researchers further advocated the importance of integrating the analyses of the structure of argumentative essays into argumentative essay assessment. For example, Erduran et al. (2004) proposed a revised five-level coding scheme by integrating three elements of data, warrant, and backing into one element – grounds to solve the ambiguities in identifying the data, warrant, and backing have often been found in students' writing when using Toulmin's framework. However, Simon (2008) pointed out that the coding scheme above did not define and consider the quality of claims, grounds, and rebuttals in an argumentative essay. To address this issue, Kathpalia and See (2016) further developed a successful rubric for assessing the quality of argumentative essays in terms of claims, grounds, and rebuttals (for the details of the rubric, please refer to the method section). The rubric developed by Kathpalia and

See (2016) could be used to evaluate students' argumentative essays from both the macro aspect (i.e., the structure of argumentative essays) and the micro aspect (i.e., the quality of argumentative essays), and hence could provide a complete picture of an individual learner's argumentative essay writing performance.

Previous research has advocated that argumentative essay writing is complicated and challenging for university students to learn (Lam et al., 2018; Rapanta et al., 2013). With various argumentative essay assessments, relevant studies have revealed learners' challenges in argumentative essay writing, including (1) poor or missing argumentative essay structure when writing argumentative essays (e.g., Hirose, 2003; Liu & Stapleton, 2014; Osborne, 2010); (2) lacking relevant content knowledge for making arguments and writing conventions (e.g., Bacha, 2010; Barrot & Gabinete, 2021; Butler & Britt, 2011; EI-Henawy et al., 2012; Liu & Stapleton, 2020; Rapanta et al., 2013); (3) showing substantial personal favors but ignoring the counterarguments or having difficulties challenging others' stances (e.g., Toplak et al., 2013; Liu & Stapleton, 2020; Osborne et al., 2013). To enhance students' argumentative essay writing performance, implicit instructions have been largely proven helpful in previous studies to solve the first and the second challenges (e.g., Fan & Chen, 2021; Latifi et al., 2021; Prata et al., 2019). Besides, relevant studies with various instructional strategies have been utilized to address the third challenge. Among the studies addressing the third challenge, some obtained rewarding results (e.g., Hsieh, 2017; Wingate, 2012; Wolfe, 2011; Thompson & Wittek, 2016), while others did not (e.g., Putra et al., 2021). It suggests that more research is needed to examine ways to help students overcome difficulties in constructing counterarguments and rebuttals. In recent relevant research, some pioneer studies on essay writing have revealed collaborative discourse in identifying writing ideas (i.e., Chang & Windeatt, 2016) and facilitating learner autonomy (i.e., Hsieh, 2017). These studies have provided some initial evidence for the effectiveness of collaborative discourse in improving the quality of general writing (i.e., Chang & Windeatt, 2016) and topic-oriented writing (i.e., Hsieh, 2017). Similar to general writing and topic-oriented writing, idea generation and learner autonomy are crucial to argumentative essay writing, suggesting that collaborative discourse could be a helpful strategy to facilitate argumentative essay writing. Moreover, it should be noted that university students may have multiple learning challenges in argumentative essay writing. However, relevant studies addressing helping students overcome multiple learning challenges in argumentative essay writing are still rare.

In short, writing a compelling argumentative essay is a crucial skill that university students need. Research on argumentative essay writing has been conducted to help students to write. However, as mentioned earlier, argumentative essay writing is complicated and challenging for university students. Most empirical studies focused on solving one or two challenges simultaneously; no studies addressed this issue by considering multiple learning challenges with new pedagogies. Therefore, innovative pedagogies are needed to facilitate argumentative essay writing.

1.2. Knowledge building pedagogy

One popular or promising way to solve the challenges that the university students are facing is the use of knowledge building pedagogy. To address language learners' various learning needs as they work towards acquiring good language competence, holistic approaches to design instructions have been adopted in relevant studies, and satisfactory findings were revealed in these studies (e.g., Chiu, 2009; Elovskaya et al., 2019; Goh & Burns, 2012; Tomele, 2015). However, relevant research on applying a holistic approach to AEW instruction is still underexplored. Therefore, this study initially attempted to adopt a holistic approach to AEW instruction design. Goh and Burns (2012) proposed a holistic approach to addressing language learners' cognitive, affective (or emotional), and social needs to help learners acquire good language competence. This holistic approach adopts a socio-cognitive perspective, which considers language learning not only a cognitive but also a social process. In accordance with Goh and Burns (2012), the holistic approach in designing AEW instruction in this study also considered learners' cognitive, affective, and social needs. As a result, the current study adopted Knowledge- building (KB) pedagogy that aims to create a learning environment highlighting idea-refinement, learner agency, and collaborative discourse in the community, which may meet university learners' various needs in the AEW learning process. As Scardamalia and Bereiter (2003) proposed, a KB environment is any environment that enhances collaborative efforts to create and continually improve ideas. The learning environment created by KB pedagogy is also a vibe.

The KB pedagogy was proposed by Scardamalia and Bereiter (2003) to meet the challenges and needs of educating knowledge practitioners in the current knowledge society. The KB pedagogy is based on the premise that authentic creative knowledge work (i.e., the practice of knowledge practitioners) can take place in school classrooms (Bereiter & Scardamalia, 2014). Unlike traditional classroom teaching mainly focuses on acquiring knowledge, the KB pedagogy aims to prepare students as knowledge practitioners through authentic creative knowledge work, such as collaborative inquiry or problem-solving. Based on Popper's (1972) epistemology on

ideas, the KB pedagogy emphasizes that all *ideas* proposed by students are of value and should be treated as improvable in creative knowledge work (Bereiter, 2002; Popper, 1972). According to KB pedagogy, the purpose of creative knowledge work in school is to advance the state of knowledge in the *classroom community* through progressive and collective discourse. The teacher becomes a guide rather than a director, and allows students to take over a significant portion of the responsibility for their own learning (Scardamalia & Bereiter, 1991). Students are epistemic agencies that actively engage in negotiation and dialogue to fit personal ideas with others (Scardamalia & Bereiter, 2006). The definition of an agency in KB is a learner who is expected to take a more active role in knowledge advancement or idea refinement. (Scardamalia & Bereiter, 2003). To support the implementation of KB pedagogy, an online platform, Knowledge Forum (KF), was designed and developed. Learners could create, refine, and integrate ideas by writing notes on KF. The KF platform was developed to facilitate learners to contribute ideas, rise above their pre-existing understandings, and improve their community knowledge (Hong & Scardamalia, 2015; Sun et al., 2010; Wu & Wang, 2016). Similar to other collaborative learning software or online learning platforms, the KF also provides a set of scaffolds (similar to openers utilized in other collaborative or argumentation learning software) to support students in developing the content of notes. These scaffolds could help students clarify and organize their ideas or arguments when writing notes for different aspects of knowledge building processes (Scardamalia, 2004). A set of scaffolds has also been designed and used for supporting collaborative argumentation learning in previous research (e.g., Wu et al., 2017).

1.3. KB-based holistic argumentative essay writing instructions

To help students overcome learning challenges in argumentative essay writing, two holistic instructions integrated KB pedagogy and explicit instruction on argumentative essay structure and writing conventions were designed, implemented, and examined in this study. In relevant studies, researchers have developed two different types of KB-based instructions, agency-enhancement KB-based instruction (e.g., Hong et al., 2020; Zhang et al., 2009) and opportunistic-collaboration KB-based instruction (e.g., Hung & Hong, 2017; Sawyer, 2007; Zhang et al., 2009). In KB pedagogy, a classroom community may be broadly or narrowly defined (Scardamalia & Bereiter, 2006). Agency-enhancement KB-based instruction is usually implemented with fixed and small student groupings, and each student group is viewed as a classroom community. It mainly focuses on promoting students' agency to engage in idea-centered learning actively and has been advocated as an effective method of transferring more responsibility to students (e.g., Zhang et al., 2009). As it is easier to be implemented in traditional classroom settings, it is the most common KB-based instruction in previous studies. Moreover, to provide students with a more authentic KB experience (i.e., the practice of knowledge practitioners), some relevant studies also implemented opportunistic-collaboration KB-based instruction (e.g., Siqin et al., 2015). It emphasizes working with ideas, assuming agency, and fostering a highly culture-related community-wide collaboration. In opportunistic-collaboration KB-based instruction, the whole class is viewed as one community, and all students are invited and seen as a part of the classroom community (i.e., all students are in one big group and have the same responsibility to collaborate with others). Based on the two KB-based instructions above, two holistic instructions on argumentative essay writing (AEW), Constant Agency-enhancement Instruction (Constant AE Instruction) and Progressive Opportunistic-collaboration Instruction (Progressive OC Instruction) were designed in this study. Typically, Taiwanese students receive test-oriented and teacher-centered instructions in high schools. As a result, first-year university students often lack agency and become less active learners (Hsu, 2015). Besides, most of them had the experience of discussing in groups rather than in a big community of students in the classroom. Based on students' prior learning experience above, an agency-enhancement KB-based instruction focusing on improving student agency could be suitable to be implemented in the freshman AEW courses. Therefore, the first holistic AEW instruction (called Constant AE Instruction) was designed by integrating agency-enhancement KB-based instruction with fixed-small grouping and explicit instruction on argumentative essay structure and writing conventions. Moreover, previous research has advocated that opportunistic collaboration instruction could provide more authentic knowledge building experiences (e.g., Siqin et al., 2015; Zhang et al., 2009). In Siqin et al. (2015), a progressive KB-based instruction in which fixed-group collaboration was combined with opportunistic collaboration was designed for a KB-based undergraduate course. They divided the 16-week course into two equal phases. During the first phase (8 weeks), students were randomly assigned to groups of five or six and discussed their ideas with their group members. During the second phase (8 weeks), all students formed one big group but were allowed to form various collaborative groups at their discretion. As most first-year university students in Taiwan do not have experience in community-based discourse, this study designed the second holistic AEW instruction (called Progressive OC Instruction) to enculturate students into a knowledge building paradigm gradually. This holistic AEW instruction integrated the explicit instruction on argumentative essay structure, writing conventions, and progressive KB-based instruction adapted from Siqin et al. (2015).

In this study, the two KB-based holistic AEW instructions were implemented and evaluated in two university AEW courses, respectively. Besides, in contrast with learning that is focused on knowledge acquisition in traditional classrooms, a knowledge building environment encourages learners to produce diverse ideas and develop, refine or elaborate the ideas through progressive discourse. Therefore, to examine if the learning environments created by the two KB-based holistic AEW instructions developed in this study were aligned with KB pedagogy, the student's perceptions of their conventional EFL learning environments were assessed before and after the two holistic AEW instructions. In sum, two major research questions were proposed in this study:

- What are the effects of the two different KB-based holistic AEW instructions on university EFL students' perceptions of learning environments?
- What are the effects of the two different KB-based holistic AEW instructions on university EFL students' argumentative essay performance?

2. Methods

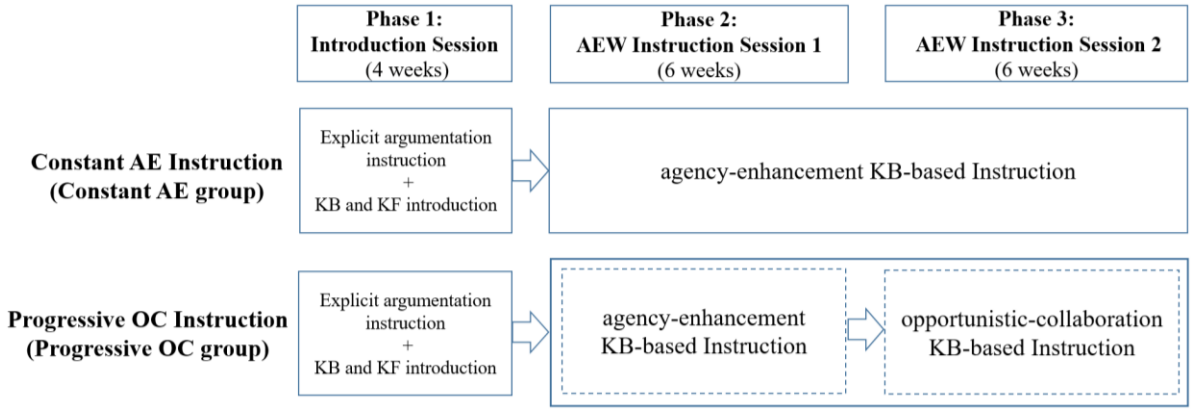
2.1. Participants

The participants were two classes of first-year non-English majors (n = 66) at a university in northern Taiwan. The participants' English proficiency levels were at CEFR B1 to B2, meaning they understand the main ideas when reading a complex text, as well as contemporary literary prose, articles, and reports. Also, they could write clear, detailed texts on subjects related to their interests or expertise. They were voluntarily enrolled in a Freshman English focusing on argumentative essay writing taught by the same instructor who has had the experience of adopting KB-based instructions at the university level for over five years. The instructor played the role of guidance and gave instructions and feedback to the students in the study. The classes were face-to-face and met once a week for 2 hours. The participants were required to attend the in-class and after-class learning tasks. They were native speakers of Mandarin Chinese and had studied English for approximately six years or above. The study's participants had never taken courses focusing on argumentative essay writing. However, they had been taught to write a variety of genres, such as narrative, description, and exposition, in senior high school. The participants have been randomly placed into the two classes in this study. Because they had only experience with general English writing or topic-oriented writing in senior high school, their English argumentative essay writing abilities were reasonably poor, and they had not received any KB instructions before the courses.

2.2. Research design

This study adopted a quasi-experimental research method. The treatment of this study was two different KB-based holistic AEW instructions, and the two classes of students were assigned to two different instruction groups: The Constant AE group (n = 34) and the Progressive OC group (n = 32). Both the two different KB-based holistic AEW instructions included an introduction session and two AEW instruction sessions (please see Figure 1). The power shortage issue in Taiwan and the use of genetic-modified food were selected as the topics for the two AEW instruction sessions, respectively. As university students in Taiwan have studied the introduction of various energy power and genetic modification in high school science class, the participants in this study had a basic understanding of various energy power and genetic modification. Besides, the power shortage issue in Taiwan and the use of genetically-modified food are daily issues relevant to them. Therefore, all the participants had basic prior knowledge and shared an interest in the two topics.

Figure 1. KB-based holistic AEW instructions



Before this study, the students were asked to write an individual argumentative essay regarding The power shortage issue in Taiwan as the pre-test. Then, after the first AEW instruction session, they were asked to write an individual argumentative essay regarding the same topic again as the middle test. Finally, in the post-test, each student was asked to write an argumentative essay regarding the use of genetic-modified food as the post-test after the second AEW instruction session. The three argumentative essays were evaluated to examine the effects of the two different KB-based holistic AEW instructions on students' argumentative writing essay writing performance. Besides, to examine if the learning environments created by the two KB-based holistic AEW instructions developed in this study were aligned with KB pedagogy, the two groups of students' perceptions of learning environments were assessed before and after the KB-based holistic AEW instructions.

2.3. KB-based holistic AEW instructions

As shown in Figure 1, the two holistic AEW instructions included three phases. For the two holistic AEW instructions, in the first phase (i.e., Introduction Session), the instructor gave lectures about the elements of argumentation and the structure of the argumentative essay. The knowledge building theory and Knowledge Forum were briefly introduced to the students. After Phase 1, two KB-based AEW Instruction sessions were implemented in Phase 2 and Phase 3. For the Constant AE group, agency-enhancement KB-based instruction was constantly implemented in the two AEW instruction sessions. In contrast, in the Progressive OC group, the Progressive OC instruction was implemented to progressively enculturate students with discourse-based idea refinement and knowledge advancement within a KB community. The students in the Progressive OC group received an agency-enhancement KB-based instruction in the first AEW Instruction session (i.e., Phase 2). Then the KB-based instruction was transformed into an opportunistic-collaboration KB-based Instruction in the next session (i.e., Phase 3). At the end of Phase 2 and phase 3, each student in the two groups was required to finish a five-paragraph argumentative essay on the power shortage issue in Taiwan and the use of genetic-modified food, respectively (at least 500 words or above).

Both agency-enhancement KB-based instruction and opportunistic-collaboration KB-based instruction implemented in the AEW instruction session were designed based on the constructive alignment framework proposed by Biggs (2003). According to Biggs' (2003) framework, when designing instruction, it should start with the desired learning outcomes that we intend students to learn, and the learning activities and assessment have to be aligned with the desired outcomes. Thus, learners could construct meaning from what they do to learn. Based on Biggs' (2003) framework, the desired learning outcome in the AEW instruction session in this study is a satisfactory individual argumentative essay regarding a specific issue. To this end, the learners were asked to obtain relevant information with collaborative inquiry activity, generate personal arguments and learn arguments from alternative perspectives with idea-centered collaborative argumentation, integrate arguments from various perspectives with group reports and reflection, and eventually write individual argumentative essays as their learning outcomes. In this study, both agency-enhancement KB-based instruction and opportunistic-collaboration KB-based instruction implemented in the AEW instruction session involved four major learning activities in a row: (1) *Collaborative inquiry activity*: To improve students' relevant content knowledge regarding the topic for making arguments and writing conventions, students were guided to search for relevant information on the internet and shared what they learned about the topic on KF within the classroom community in and out of class. (2) *Idea-centered collaborative argumentation*: To improve students' ability to generate arguments and allow them to argue from different perspectives, students had to produce their ideas regarding the issue and generate relevant arguments with their prior knowledge and the relevant information found. They were also asked to generate and share and construct various arguments to respond to others' arguments collaboratively in and out of class. They were guided to propose their evidence-based arguments actively on KF, which provides various argumentation prompts as scaffolds for argument generation. Then, through collaborative discourse for integrating and advancing community knowledge, they could clarify and refine the ideas proposed by community members. During the process, arguments from different perspectives could be proposed, and strong personal favors might be diminished. (3) *Group report and reflection*: After the idea-centered collaborative argumentation activities, students were required to give oral reflective reports regarding their knowledge building and collaborative argumentation practice every week. Based on that, they were also asked to reflect on how to generate the arguments and organize the structure of their argumentative essays. (4) *Individual essay writing*: Finally, each student had to write an individual argumentative essay based on the information and argumentation regarding the topics. They were required to write a five-paragraph argumentative essay with at least 500 words.

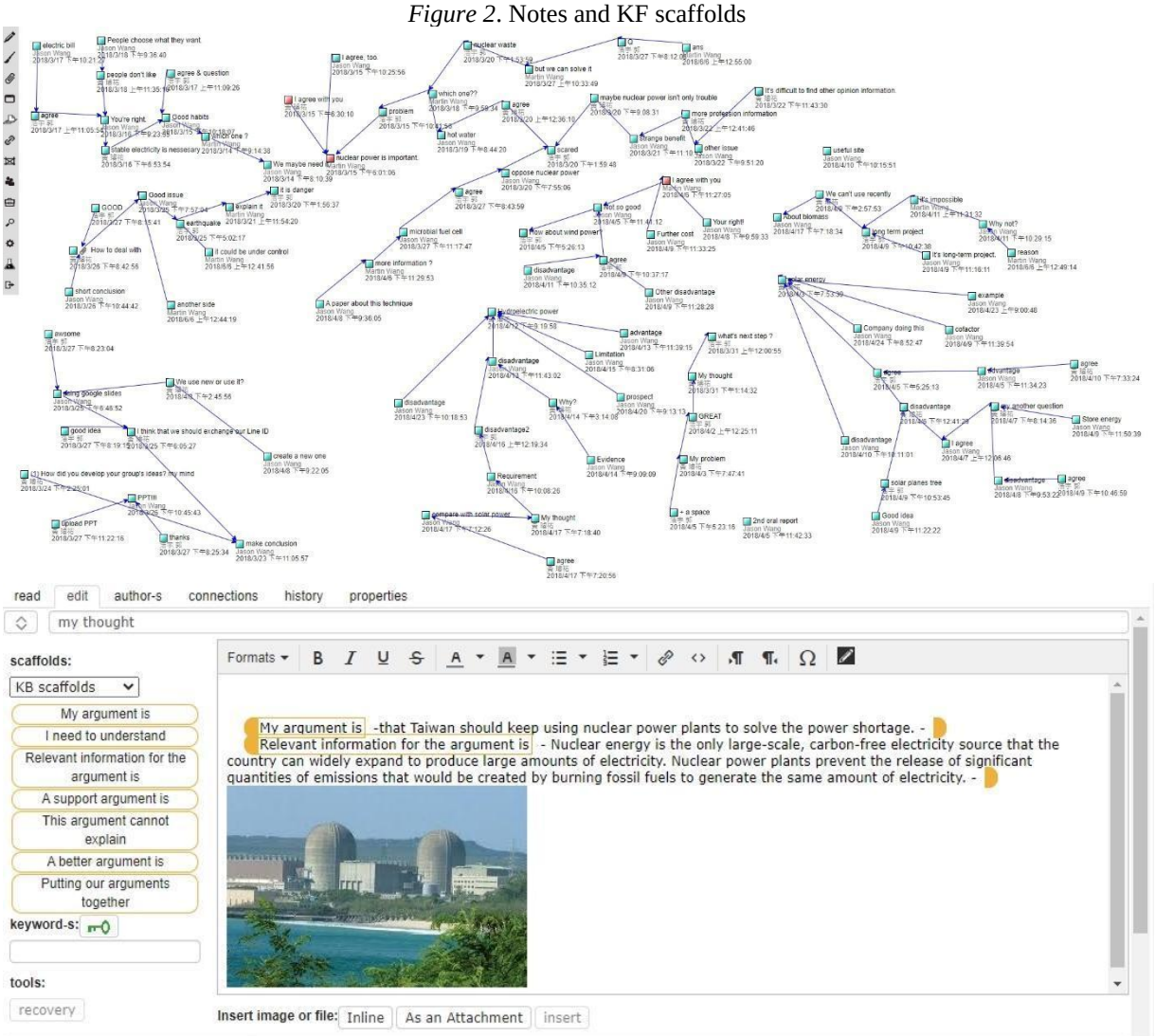
Similar to Zhang et al. (2009), the agency-enhancement KB-based instruction in the AEW instruction session was implemented with fixed and small student groups (3 to 4 students), and each student group was viewed as a classroom community. It highlighted to transfer more responsibility to students during the learning activities. As a result, the instructor's guide for the learning activities during the instruction session mainly focused on

promoting students' agency to engage in idea-centered learning activities. The opportunistic-collaboration KB-based instruction in the AEW instruction session aimed to mainly focus on advancing the state of knowledge in the class while situating it within the broader societal effort to build knowledge. The whole class is viewed as one community, and all students are invited and seen as a part of the classroom community. To this end, the instructor's guidance during the instruction session focused on working with ideas, assuming agency, and fostering a highly culture-related community-wide collaboration.

2.4. Knowledge Forum (KF) as an online collaboration platform

This study adopted Knowledge Forum (KF) as an online collaboration platform. KF was designed to support idea work and move it to higher levels. As shown in Figure 2, the seven scripted scaffolds embedded in KF included: My argument is, I need to understand, Relevant information for the argument is, A supportive argument is, and This argument cannot explain; A better argument is, and Putting our arguments together. First, students made the notes themselves, and other group members built on the notes with scaffolding annotations. Then, students needed to explain their purposes for responding using the scripted scaffolds embedded in KF. During KB-based holistic AEW instructions, students could have opportunities to share and further enhance their content knowledge by taking notes, and their tendency to show personal favoritism could be reduced during community discourse. Also, the scaffolds provided by KF could make students propose arguments purposefully when making a note on KF. It could help improve the quality of students' arguments.

Figure 2. Notes and KF scaffolds



2.5. Instruments

2.5.1. Knowledge Building Environment Scale (KBES)

To evaluate the participants' perception of learning environments created by the two KB-based holistic AEW instructions, the Knowledge Building Environment Scale (KBES) was used. The KBES was developed by Lin et al. (2014) to evaluate university students' perception of learning environments from the perspectives of KB pedagogy. The KBES was a four-point Likert scale, and it consists of three subscales echoing the KB pedagogy, including working with ideas, assuming agency, and fostering community. There is a total of 24 items in the KBES. Through a series of confirmatory factor analyses (CFA), the validity of KBES was confirmed by Lin et al. (2014). Besides, they also reported the Cronbach's alpha coefficients for the three subscales of KBES as 0.85, 0.91, and 0.94, respectively, revealing that the KBES was deemed to be sufficiently reliable for assessing students' perception of learning environments from the perspectives of KB pedagogy. Thus, the KBES was an effective tool for measuring perceptions of a knowledge building environment among students and was therefore employed in this study. In this study, the Cronbach's alpha coefficients for the three subscales of KBES were 0.82, 0.84, and 0.90, respectively, and the overall Cronbach's alpha coefficient for the 24 items was 0.91.

2.5.2. Coding scheme of argumentative essay structure and quality

With the coding scheme in Kathpalia and See (2016), the three argumentative essays completed in the pre-test, middle-test, and post-test were evaluated from the two aspects, including the structure (Macro view) and the quality (Micro view) in this study. First, for the Macro view aspect, the three-level coding scheme in Kathpalia and See (2016) was used for evaluating the structure of argumentative essays, namely, Lower level: simple claim or grounds only; Intermediate level: claim with valid grounds; Higher level: rebuttal with a clear claim but partial evidence in the form of a warrant, rebuttal with a clear claim and grounds, or extended argument with a claim supported by grounds with more than one rebuttal. For the micro view aspect, the participants' argumentative essay quality was assessed with the rubric developed in Kathpalia and See (2016), as shown in Table 1.

Table 1. Argumentation quality of elements coding scheme

Rubrics		Description	Score
Claims	Weak claim	One that fails to address the proposition mentioned in the argumentative essay	1
	Strong claim	One that addresses the proposition mentioned in the argumentative essay	2
Grounds	No evidence	Just personal opinions	0
	Faulty evidence	Weak evidence refers to faulty evidence	1
	Personal only	Intermediate evidence refers to personal evidence	2
	Attributive only	Intermediate evidence refers to attributive evidence	3
	Attributive & personal	Strong evidence refers to an attributive or a combination of attributive and personal evidence	4
Rebuttals	No rebuttal	no counter-view	0
	Weak rebuttals	Only contains a counter-view without a rebuttal	1
	Strong rebuttals	Contains a counter-argument and rebuttal	2

The authors and one of their colleagues (another EFL lecturer at one of the authors' university) coded and assessed the data independently regarding the argumentation structure and quality of elements based on the two coding schemes mentioned above. Their coding results were compared, and the inter-coder reliability in each coding category was higher than 0.87, showing a high consistency in the researchers' coding of the data set. Then, all the differences were resolved through discussions.

3. Results

3.1. The effects of holistic KB-based AEW instructions on students' perceptions of learning environments

As shown in Table 2, in the Constant AE group, significant differences between the students' responses in all the three subscales of the KBES in the pretest and the post-test were revealed ($p < .001$). Similar results were also found in the Progressive OC group ($p < .001$). It indicated that, compared with the instruction in the participants' previous courses, both the Constant AE instruction and Progressive OC instruction did provide relatively more opportunity for students to work with ideas and engage in exploring the issues of argumentative essays actively

to work collaboratively as a community. The two KB-based holistic AEW instructions in this study did align with knowledge building pedagogy.

Table 2. The students' perception of learning environments before and after the KB-based AEW instructions

		Pretest		Post-test		*t* value
		Mean	*SD*	Mean	*SD*	
Working with ideas	AE group (n = 34)	2.34	0.29	3.25	0.40	11.98***
	OC group (n = 32)	2.33	0.26	3.47	0.23	19.10***
Assuming agency	AE group (n = 34)	2.70	0.35	3.15	0.43	5.05***
	OC group (n = 32)	2.81	0.31	3.30	0.30	7.86***
Fostering community	AE group (n = 34)	2.66	0.32	3.12	0.37	4.78***
	OC group (n = 32)	2.73	0.31	3.42	0.17	9.60***

Note. $^{***}p < .001$.

Also, a one-way ANCOVA (the students' responses on the KBES in the pre-test were used as the covariate) was conducted to compare the effects of the two KB-based holistic AEW instructions on the students' experiences of knowledge building. As shown in Table 3, significant differences were found in the two subscales, working with ideas and fostering community ($p < .01$), suggesting that compared with the Constant AE instruction, the Progressive OC instruction provided students more opportunities to work with ideas and have broader community collaboration among students. However, there was no significant difference between the two groups in Assuming agency, suggesting that the two holistic instructions could equally help students become more active learners.

Table 3. The results of ANCOVA in the students' perception of learning environments

		Mean (adjusted)	Standard error	*F*-value
Working with ideas	AE groups (n = 34)	3.26	0.53	7.1**
	OC groups (n = 32)	3.46	0.54	
Assuming agency	AE groups (n = 34)	3.15	0.42	2.29
	OC groups (n = 32)	3.30	0.29	
Fostering community	AE groups (n = 34)	3.12	0.37	15.41***
	OC groups (n = 32)	3.42	0.16	

Note. $^{**}p < .01$; $^{***}p < .001$.

3.2. The effects of holistic KB-based AEW instructions on students' argumentative essay performance

3.2.1. Argumentation structure level

In this study, as Kathpalia and See (2016), the students' argumentative essay structure level was categorized into three levels: lower, intermediate, and higher. Three chi-square tests were conducted in the pretest, middle-test, and post-test to examine whether the students in the two instruction groups have the same proportions at the three argumentative essay structure levels.

Table 4. Group comparisons on the students' writing skills in organizing the structure of argumentative essay

		Lower (n, %)	Intermediate (n, %)	Higher (n, %)
Pretest	Constant AE group	17 (50%)	15 (44%)	2 (6%)
	Progressive OC group	16 (50%)	13 (41%)	3 (9%)
	X^2 value		0.31 (n.s.)	
Middle-test	Constant AE group	2 (6%)	4 (12%)	28 (82%)
	Progressive OC group	1 (3%)	4 (12%)	27 (85%)
	X^2 value		0.29 (n.s.)	
Post-test	Constant AE group	0 (0%)	7 (21%)	27 (79%)
	Progressive OC group	0 (0%)	1 (3%)	31 (97%)
	X^2 value		4.72*	

Note. n.s.: non-significant; $^{*}p < .05$.

As shown in Table 4, no significant difference was found in the pre-test and middle-test ($p > .05$). It indicated that the two groups of students did not have significant differences in the argumentation structure levels of their essays before the conduct of two instructions (i.e., phase 1). Also, they have no significant difference in the argumentation structure levels of their essays after the AEW instruction session 1 (i.e., phase 2). However,

significant differences were found in the post-test ($p < .05$). It should be noticed that almost all of the students who received Progressive OC instruction (97%) achieved a higher level, while only about three-quarters of the students who received Constant AE instruction (79%) achieved a higher level and about a quarter (21%) of them achieved an intermediate level. It suggested that compared with the Constant AE instruction, the Progressive OC instruction could benefit EFL students more in improving their performance in arranging the structures of argumentative essays.

3.2.2. Argumentation quality

The students' argumentative essay quality was assessed in three elements: claims, grounds, and rebuttals. According to the coding scheme used in this study, students' quality of claims revealed in their argumentative essays was classified into two levels (i.e., weak and strong). The quality of grounds was divided into four levels (i.e., faulty evidence, personal only, attribute only, attributive and personal). The quality of rebuttals was classified into two levels (i.e., weak and strong). Three chi-square tests were conducted to examine whether the students in the two instruction groups had the same proportions of their quality of claims as each other in the pre-test, middle-test, and post-test. As revealed in Table 5, there were no significant differences between the two groups on the quality of claims in the pre-test ($\chi^2 = 0.96$, $p > .05$), the middle-test ($\chi^2 = 0.29$, $p > .05$), and the post-test ($\chi^2 = 1.61$, $p > .05$). It should be noticed that very high proportions of students in both groups (82% for the Constant AE group and 91% for the Progressive OC group) could generate claims of higher quality (i.e., strong claims). After instruction, the high proportions of strong claims remained in both student groups.

Table 5. Group comparisons on the quality of claims in the three argumentative essays

		Weak claim	Strong claim	X^2
Pre-test	Constant AE group	6(18%)	28(82%)	0.96 (n.s.)
	Progressive OC group	3(9%)	29(91%)	
Middle-test	Constant AE group	2(6%)	32(94%)	0.29 (n.s.)
	Progressive OC group	3(%)	29(91%)	
Post-test	Constant AE group	7(21%)	27(79%)	1.61 (n.s.)
	Progressive OC group	3(%)	29(91%)	

Note. n.s.: non-significant.

Table 6 revealed that no significant differences were found between the two groups on the quality of grounds in both the pre-test ($\chi^2 = 4.56$, $p > .05$) and the middle-test ($\chi^2 = 3.47$, $p > .05$). It indicated that the two groups of students did not have significant differences in the quality of grounds in their essays before the conduct of two instructions (i.e., phase 1). Also, they have no significant differences in the quality of grounds after the AEW instruction session 1 (i.e., phase 2). However, significant differences were found in the post-test ($\chi^2 = 17.06$, $p < .05$). It is worth noting that over half of the students who received Progressive OC instruction (60%) cited both attribute and personal grounds, which is a more persuasive approach for supporting a claim. In contrast, only one-third of the students who received Constant AE instruction (30 %) adopted this approach. Therefore, it seems that, compared with the Constant AE instruction, the Progressive OC instruction could be more capable of improving university students' quality of grounds in their argumentative essays.

Table 6. Group comparisons on the quality of grounds in the three argumentative essays

		Faulty evidence	Personal only	Attribute only	Attribute and personal	X^2
Pre-test	Constant AE group	8(23%)	22(65%)	4(12%)	0(0%)	4.56 (n.s.)
	Progressive OC group	6(19%)	26(81%)	0(0%)	0(0%)	
Middle-test	Constant AE group	1(3%)	12(35%)	8(24%)	13(38%)	3.47 (n.s.)
	Progressive OC group	0(0%)	6(19%)	10(31%)	16(50%)	
Post-test	Constant AE group	1(2%)	17(50%)	6(18%)	10(30%)	17.06*
	Progressive OC group	0(0%)	2(6%)	11(34%)	19(60%)	

Note. n.s.: non-significant; *$p < .05$.

As shown in Table 7, no significant differences were found between the two groups on the quality of rebuttals in both the pre-test ($\chi^2 = 0.29$, $p < .05$) and the middle-test ($\chi^2 = 0.23$, $p < .05$). However, similar to their quality of grounds, significant differences between the two groups of students were only found in the post-test ($\chi^2 = 4.18$, $p < .05$). Most students who received Progressive OC instruction (91%) discovered how to provide counterarguments and rebuttals, which is a more compelling way to support their positions. Comparatively, three-fourths of the students receiving Constant AE instruction (76 %) adopted this approach and learned to use

rebuttals to enhance their essays. It seems that the Progressive OC instruction could benefit university students more in improving the quality of rebuttals in their argumentative essays.

Table 7. Group comparisons on the quality of rebuttals in the three argumentative essays

		Weak rebuttals	Strong rebuttals	X^2
Pre-test	Constant AE group	32(94%)	2(6%)	0.29 (n.s.)
	Progressive OC group	29(91%)	3(9%)	
Middle-test	Constant AE group	8(24%)	26(76%)	0.23 (n.s.)
	Progressive OC group	6(19%)	26(81%)	
Post-test	Constant AE group	8(24%)	26(76%)	4.18*
	Progressive OC group	3(9%)	29(91%)	

Note. n.s.: non-significant; $^{*}p < .05$.

4. Discussion

In this study, two different KB-based holistic AEW instructions were developed, and the effects of the two AEW instructions on university EFL students' perceptions of learning environments were investigated. KB pedagogy was applied in the two KB-based holistic AEW instructions to help students overcome AEW learning challenges with collaborative discourse. Both instructions were confirmed to align with KB pedagogy and be capable of cultivating learning environments that shared major features of KB pedagogy for AEW learners. However, this study also revealed major significant differences between the learning environments created by the two instructions. In particular, the Progressive OC instruction provided students with a better AEW learning environment than the Constant AE instruction. More opportunities were provided for students to have community collaboration and collaborative discourse. It suggests that the Progressive OC instruction design that gradually enculturates students into a knowledge building paradigm could be implementable and effective for EFL university learners in learning argumentative essay writing.

Moreover, this study revealed the effectiveness of the two AEW instructions on university EFL students' argumentative essay performance. In this study, an integrated coding scheme with both macro and micro aspects was used to assess students' argumentative essays. The major findings regarding the effects of the two AEW instructions on university EFL students' argumentative essay performance are discussed from the two aspects, respectively. As for the macro aspect, it was found that the two KB-based holistic AEW instructions could improve students' writing skills in organizing the structures of their argumentative essays. Matos (2021) claimed that engagement in this collaborative writing process could offer a promising path to enhancing argumentative essay structure. Also, Resnick et al. (2015) advocated that the collaborative writing process could allow individual learners to advance their thinking and writing by deeper engagement, and collaborative writing could build a bridge between peer discourse and personal writing, providing rich cognitive context for developing argumentation skills. In this study, during the KB-based holistic AEW instructions with KF, students had undergone a collaborative writing process in which they were required to discuss and generate their arguments and evidence with their peers before writing their argumentative essays. In addition, they needed to propose their claims with concrete arguments, provide both subjective and objective grounds, and offer counterarguments and rebuttals. Therefore, similar to the collaborative writing process mentioned in Matos (2021) and Resnick et al. (2015), the online collaborative discourse process on the KF in this study seemed to provide the students with opportunities to identify the crucial elements of argumentative essay structure (i.e., claims, grounds, and rebuttals). Consequently, the students' macro views regarding argumentative essays could be shaped and developed, contributing to the improvement of their individual argumentative essay writing structure. Regarding the micro aspect, this study found that the KB-based holistic AEW instructions in the Constant AE and Progressive OC groups could enhance students' argumentative essay quality. Moreover, it should be noticed that in each session of both the AEW instructions in this study adopted four consistent learning activities step by step. As Biggs (2003) suggested, "The students are 'entrapped' in this web of consistency, optimizing the likelihood that they will engage in appropriate learning activities, but paradoxically frees students to conceal their own learning" (p. 26). The results have proved that the four-step progressive design for the explicit AEW instruction sessions benefited students' performance in AEW.

This study also revealed that the Progressive OC instruction progressively engaging the students in group-based collaboration to community-based collaboration could benefit students more than the Constant AE instruction. As aforementioned, first-year university students in Taiwan typically receive test-oriented and teacher-centered instructions in high schools. Moreover, most of them have experience in fixed small group discussions but do not have experience in community-based discourse. Undoubtedly, it would be a better way to progressively design

learning activities based on students' prior experiences and knowledge. Therefore, based on the participants prior learning experience in high school, an explicit AEW instruction with a fixed-small grouping was implemented in the first session of the Progressive OC Instruction to promote students' agency to engage in idea-centered learning activities. After the first session of the Progressive OC Instruction, students' learning experience in idea-centered and group-based collaboration was advanced, which could serve as an essential foundation of an idea-centered and community-wide collaboration. Furthermore, Putra et al. (2021) have confirmed that opportunistic collaboration writing could facilitate students' grounds and rebuttals in their argumentative essays. Moreover, Kathpalia and See (2016) also advocated that students with more freedom and responsibility could engage in different ideas and expand the diversity of their ideas in their argumentative essay writing. The Progressive OC instruction allowed the students more freedom and responsibility to propose, refine and integrate ideas from diverse perspectives when generating arguments on KF. Hence, their understanding regarding grounds and rebuttals could be gradually better shaped and developed during the Progressive OC instruction, and then it could serve as a superior foundation for proposing more insightful grounds and rebuttals in their argumentative essay writing.

5. Conclusion

As one of the initial attempts, this study applied KB pedagogy in designing KB-based holistic AEW instruction. The findings derived from the current study provide some important implications for educational practice. Collaboration activities, such as collaborative writing in Kathpalia and See (2016) or online collaborative argumentation activities in this study, could improve the quality of students' argumentative essays. The findings of this study highlight the feasibility of KB pedagogy in argumentative essay writing instruction. EFL teachers could design AEW learning activities emphasizing the three core dimensions of KB pedagogy. Learning activities should provide opportunities for students to work closely with ideas, actively explore the issues of argumentative essays, and aggressively form a community.

6. Limitations

One may be interested in comparing the effectiveness of KB-based holistic AEW instruction with conventional AEW instruction. However, this study is limited to provide insights into the aforementioned issue. This study only investigated the effectiveness of KB-based holistic AEW instruction by comparing the effects of two different KB-based holistic AEW instructions. The effectiveness of the KB-based holistic AEW instructions was not compared with conventional AEW instruction in this study. To address this issue, a follow-up quasi-experimental study could be conducted with adding a conventional AEW instruction group.

7. Suggestions for future research

This study provides some important directions for future research. First, future practical work could focus on developing other specific holistic AEW instructional strategies or modifying this study's holistic AEW instruction design based on KB's twelve principles. One may be also curious about how students engage in Progressive OC instruction and transform their artifacts from their collaborative argumentation on the KF into their argumentative essay writing. To address this issue, future research could be conducted. Also, how students collaborate during KB-based holistic AEW learning and their individual learning process are still underexplored.

Acknowledgment

The funding of the research work was supported by National Science and Technology Council, Taiwan, under grant numbers MOST 107-2628-H-008 -003 -MY4 and MOST 111-2410-H-008 -004 -MY3.

References

Awada, G., Burston, J., & Ghannage, R. (2020). Effect of student team achievement division through WebQuest on EFL students' argumentative writing skills and their instructors' perceptions. *Computer Assisted Language Learning*, *33*(3), 275-300. https://doi.org/10.1080/09588221.2018.1558254

Bacha, N. (2010). Teaching the academic argument in a university EFL environment. *Journal of English for Academic Purposes, 93*, 229–241. https://doi.org/10.1016/j.jeap.2010.05.001

Barrot, J., & Gabinete, M. K. (2021). Complexity, accuracy, and fluency in the argumentative writing of ESL and EFL learners. *International Review of Applied Linguistics in Language Teaching, 59*(2), 209-232. https://doi.org/10.1515/iral-2017-0012

Bereiter, C. (2002). *Education and mind in the knowledge age.* Lawrence Erlbaum Associates. https://doi.org/10.4324/9781410612182

Bereiter, C., & Scardamalia, M. (2014). Knowledge building and knowledge creation: One concept, two hills to climb. In S. C. Tan, H. J. So, & J. Yeo (Eds.), *Knowledge creation in education* (pp. 35-52). Springer.

Biggs, J. B. (2003). *Teaching for quality learning at university* (2nd ed.). Open University Press/Society for Research into Higher Education.

Butler, J. A., & Britt, M. A (2011). Investigating instruction for improving revision of argumentative essays. *Written Communication, 28*(1),70-96.

Chang, H., & Windeatt, S. (2016). Developing collaborative learning practices in an online language course. *Computer Assisted Language Learning, 29*(8), 1271-1286. http://doi.org/10.1080/09588221.2016.1274331

Chiu, Y. J. (2009). Exploring pedagogical strategies to integrate a holistic approach to education into ESL classes. *Asia Pacific Education Review, 10*(2), 261-270.

EI-Henawy, W. M., Dadour, E.-S. M., Salem, M. M., & EI-Bassuony, J. M. (2012). The Effectiveness of using self-regulation strategies on developing argumentative writing of EFL prospective teachers. *Journal of the Egyptian Association for Reading and Knowledge, 27*(1), 1-28.

Elovskaya, S., Stanchuliak, T., & Karandeeva, L. (2019). The Holistic approach to teaching English as a foreign language. In *INTED2019 Proceedings* (pp. 1253-1258). IATED. http://doi.org/10.21125/inted.2019.0402

Erduran, S., Simon, S., & Osbrne, J. (2004). TAPping into argumentation: developments in the application of Toulmin's argument pattern for studying science discourse. *Science Education, 88*(6), 915-933. http://doi.org/10.1002/sce.20012

Fan, C. Y., & Chen, G. D. (2021). A Scaffolding tool to assist learners in argumentative writing. *Computer Assisted Language Learning, 34*(1-2), 159-183. http://doi.org/10.1080/09588221.2019.1660685

Goh, C. C. M., & Burns, A. (2012). *Teaching speaking: A Holistic approach.* Cambridge University Press.

Hirose, K. (2003). Comparing L1 and L2 organizational patterns in the argumentative writing of Japanese EFL students. *Journal of Second Language Writing, 12*, 181-209. https://doi.org/10.1016/S1060-3743(03)00015-8

Hong, H.-Y., & Scardamalia, M. (2015). Community knowledge assessment in a knowledge building environment. *Computer & Education, 71*(2014), 279-288. https://doi.org/10.1016/j.compedu.2013.09.009

Hong, H.-Y., Ma, -L., Lin, P.-Y., & Lee, Y.-H. (2020). Advancing third graders' reading comprehension through collaborative knowledge building: A Comparative study in Taiwan. *Computers & Education, 157*(11), 1-11. https://doi.org/10.1016/j.compedu.2020.103962

Hsieh, Y. C. (2017). A Case study of the dynamics of scaffolding among ESL learners and online resources in collaborative learning. *Computer Assisted Language Learning, 30*(1-2), 115-132. http://doi.org/10.1080/09588221.2016.1273245

Hsu, W.-H. (2015). Transitioning to a communication-oriented pedagogy: Taiwanese university freshmen's views on class participation. *System, 49*, 61-72. https://doi.org/10.1016/j.system.2014.12.002

Hughes, W., & Lavery, J. (2008). *Critical thinking: An Introduction to the basic skills* (5th ed.). Broadview Press.

Hung, G. T., & Hong, H.-Y. (2017). Fostering innovation-oriented cultural views among college students through knowledge-building pedagogy. *Learning: Research and Practice, 3*(2), 168-182. https://doi.org/10.1080/23735082.2017.1341053

Kathpalia, S. S., & See, E. K. (2016). Improving argumentation through blog. *System, 58*(2016), 25-36. https://doi.org/10.1016/j.system.2016.03.002

Lam, Y. W., Hew, K. F., & Chiu, K. F. (2018). Improving argumentative writing: Effects of a blended learning approach and gamification. *Language Learning & Technology, 22*(1), 97-118. https://dx.doi.org/10125/44583

Latifi, S., Noroozi, O., Hatami, J., & Biemans, H. J. A. (2021). How does online peer feedback improve argumentative essay writing and learning? *Innovations in Education and Teaching International, 58*(2), 197-208. http://doi.org/10.1080/14703297.2019.1687005

Lin. K. Y., Hong, H.-Y., & Chai, C. S. (2014). Development and validation of the knowledge-building environment scale. *Learning and Individual Differences, 30*, 124-132. https://doi.org/10.1016/j.lindif.2013.10.018

Liu, F., & Stapleton, P. (2014). Counterargumentation and the cultivation of critical thinking in argumentative writing: Investigating washback from a high-stakes test. *System, 45*, 117-128. http://doi.org/10.1016/j.system.2014.05.005

Liu, F., & Stapleton, P. (2020). Counterargumentation at the primary level: An Intervention study investigating the argumentative essay writing of second language learners. *System, 89*(2020), 102-198. https://doi.org/10.1016/j.system.2019.102198

Matos, F. (2021). Collaborative writing as a bridge from peer discourse to individual argumentative writing. *Reading and Writing, 2021*(34), 1321-1342. https://doi.org/10.1007/s11145-020-10117-2.

Means, M. L., & Voss, J. F. (1996). Who reasons well? Two studies of informal reasoning among children of different grade, ability, and knowledge levels. *Cognition and Instruction, 14*, 139-178. https://doi.org/10.1207/s1532690xci1402_1

Mitchell, S. (2000). Putting argument into the mainstream. In S. Mitchell & R. Andrews (Eds.), *Learning to argue in higher education* (pp. 146–154). Boyton/Cook.

Muller Mirza, N., & Perret-Clermont, A. (Eds.) (2009). *Argumentation and education: Theoretical foundations and practices.* Springer.

Nussbaum, E. M., & Kardash, C. M. (2005). The Effects of goal instructions and texts on the generation of counterarguments during writing. *Journal of Educational Psychology, 97*(2), 157-169. http://doi.org/10.1037/0022-0663.97.2.157

Osborne, J. (2010). Arguing to learn in science: The Role of collaborative, critical discourse. *Science, 328*(5977), 463-466. http://doi.org/10.1126/science.1183944

Osborne, J., Simon, S., Christodoulou, A., & Howell-Richardson, K. (2013). Learning to argue: A Study of four schools and their attempt to develop the use of argumentation as a common instructional practice and its impact on students. *Journal of Research in Science Teaching, 50*(3), 315-347. https://doi.org/10.1002/tea.21073

Popper, K. (1972). *Objective knowledge: An Evolutionary approach*. Clarendon Press.

Prata, M. J., de Sousa, B., & Oliveira, A. L. (2019). Cooperative methods and self-regulated strategies development for argumentative writing. *Journal of Educational Research, 112* (1), 12-27. https://doi.org/10.1080/00220671.2018.1427037

Putra, J. W. G, Teufel, S., & Toknaga, T. (2021). Annotating argumentative structure in English-as-a-Foreign-Language learner essay. *Natural Language Engineering*, 1-27. http://doi.org/10.1017/S1351324921000218

Rapanta, C., M. Garcia-Mila, & Gilabert, S. (2013). What is meant by argumentative competence? An Integrative review of methods of analysis and assessment in education. *Review of Education research, 83*(4), 483-520. http://doi.org/10.3102/0034654313487606

Resnick, L. B., Asterhan, C. S. C., & Clarke, S. N. (Eds.). (2015). *Socializing intelligence through academic talk and dialogue*. American Educational Research Association. https://doi.org/10.3102/978-0-93530 2-43-1.

Sawyer, R. K. (2007). *Group genius: The Creative power of collaboration*. Basic Books.

Scardamalia, M. (2004). CSILE/Knowledge forum. In *Education and technology: An encyclopedia* (pp. 183-192). ABC-CLIO.

Scardamalia, M., & Bereiter, C. (1991). Higher levels of agency for children in knowledge building: A Challenge for the design of new knowledge media. *The Journal of the Learning Science, 1*(1), 37-68.

Scardamalia, M., & Bereiter, C. (2003). *Knowledge building*. In J. W. Guthrie (Ed.), *Encyclopedia of Education* (2nd ed., pp. 1370-1373). Macmillan.

Scardamalia, M., & Bereiter, C. (2006). Knowledge building: Theory, pedagogy, and technology. In R. K. Sawyer (Eds.), *Cambridge handbook of the learning sciences* (pp. 97-118). Cambridge University Press.

Simon, S. (2008). Using Toulmin's argument pattern in the evaluation of argumentation in school science. *International Journal of Research and Method in Education, 31*(3), 277-289. http://doi.org/10.1080/17437270802417176

Siqin, T., Van Aalst, J., & Chu, S. K. W. (2015). Fixed group and opportunistic collaboration in a CSCL environment. *International Journal of Computer-Supported Collaborative Learning, 10*, 161-181. https://doi.org/10.1007/s11412-014-9206-7

Sun, Y., Zhang, J., & Scardamalia, M. (2010). Knowledge building and vocabulary growth over two years, Grades 3 and 4. *Instructional Science, 38*, 147-171.

Thompson, I., & Wittek, L. (2016). Writing as mediational tool for learning in the collaborative composition of text. *Learning, Culture and Social Interaction, 11*, 85-96. http://doi.org/10.1016/j.lcsi.2016.05.004

Tomele, G. (2015). The Multi-structural model of speech and language development in the aspect of holistic approach. In *Society. Integration. Education. Proceedings of the International Scientific Conference* (Vol. 3, pp. 222-232). https://doi.org/10.17770/sie2015vol3.392

Toplak, M. E., West, R. F., & Stanovich, K. E. (2013). *Assessing the development of rationality.* In H. Markovits (Ed.), The developmental psychology of reasoning and decision-making (pp. 7-35). Psychology Press.

Toulmin, S. (1958). *The Uses of argument.* Cambridge University Press.

Wingate, U. (2012). Argument! Helping students understand what essay writing is about. *Journal of English for Academic Purposes, 11*(1), 145-154. https://doi.org/10.1016/j.jeap.2011.11.001

Wolfe, C. R. (2011). Argumentation across the curriculum. *Written Communication, 28*(2), 193-219. https://doi.org/10.1177/0741088311399236

Wu, Y.-T., & Wang, L.-J. (2016). Research trends in technology-enhanced knowledge building pedagogies: a review of selected empirical research from 2006 to 2015. *Journal of Computer Education 3*(3), 353-375.

Wu, Y.-T, Wang, L.-J., & Cheng, T.-Y. (2017). A Preliminary study of university students' collaborative learning behavior patterns in the context of online argumentation learning activities: the role of idea-centered collaborative argumentation instruction. In B. K. Smith, M. Borge, E. Mercier, & K. Y. Lim (Eds.), *Making a Difference: Prioritizing Equity and Access in CSCL, 12th International Conference on Computer Supported Collaborative Learning (CSCL)* (Vol. 2, pp. 640-643). International Society of the Learning Sciences. https://dx.doi.org/10.22318/cscl2017.98

Zhang, J., Scardamalia, M., Reeve, R., & Messina, R. (2009). Designs for collective responsibility in knowledge-building communities. *The Journal of the Learning Sciences, 18*(1), 7-44. https://doi.org/10.1080/10508400802581676