Enhancing university EFL students' informal reasoning on the social scientific issues related to sustainable development goals by adopting a collaborative argumentation CALL environment

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Abstract

In the 21st century, educators need to develop students' argumentation skills for addressing Social Scientific Issues (SSIs). The Sustainable Development Goals (SDGs) proposed by the United Nations (UN) align well with SSIs argumentation. Informal reasoning plays a crucial role in this process, but existing research focuses mainly on individual learners and subjective opinions. Recently, the collaborative learning environment of Knowledge Forum has been highlighted as a potential enhancer of students' informal reasoning, but its effectiveness in language teaching remains understudied. Thus, this study examined a collaborative argumentation Computer Assisted Language Learning (CALL) environment to enhance informal reasoning skills of university English as a Foreign Language (EFL) students. The experimental group (n=25) utilized the collaborative argumentation CALL environment with Knowledge Forum, while the control group (n=30) used a conventional argumentation environment. The results showed that the experimental group outperformed the control group in informal reasoning quality, including counterarguments and rebuttals. These findings suggest that collaborative argumentation CALL environments may enhance EFL students' informal reasoning, providing valuable insights for educators seeking to improve students' informal reasoning skills.

Keywords: CALL, collaborative argumentation, informal reasoning, social scientific issues, sustainable development goals.

1. Introduction

In the 21st century, a multitude of challenges has arisen as a result of human activities. To address these challenges, the UN introduced the SDGs in 2015. These challenges, commonly referred to as SSIs (Azumah & Marlizayati, 2023; Nilay & Ozgul, 2017; Sadler, 2004; Sadler & Zeidler, 2005; Wu & Tsai, 2007), are characterized by their reliance on scientific concepts or problems, controversial nature, public discourse, and the influence of political and social factors (Sadler & Zeidler, 2005, p.113). Within educational settings, researchers have emphasized the significance of developing university students' informal reasoning skills to facilitate their ability to discuss and address SSIs (Sadler, 2004; Sadler & Zeidler, 2005; Wu, 2013). Furthermore, university students are expected to engage in negotiation and resolution of contentious issues, such as SSIs, by providing supporting evidence for their claims and refuting counterarguments. Consequently, informal reasoning serves as a valuable tool for discussing SSIs within university classroom settings (Cerbin, 1988; Kuhn, 1993). From the perspective of SDG-related SSIs, the majority of empirical studies on SSIs argumentation have primarily focused on examining

relevant issues from the standpoint of individual learners. However, only a limited number of studies have investigated SSIs argumentation from the angles of social interaction, dialogue theory, or cooperative learning (Azimah & Marlizayati, 2023). Training in collaborative argumentation highlights the potential of adopting the knowledge-building theory as an effective teaching approach. This approach encourages collaboration, dialogue, and a puzzle-like learning approach that enables university students to share and co-create knowledge from various perspectives. To enhance the comprehensibility and applicability of knowledge-building in education, Scardamalia (2002) proposed twelve principles of the knowledge-building theory and her team developed an online collaborative knowledge-building platform called *Knowledge Forum*.

The Knowledge Forum platform aims to establish a collaborative environment for knowledge building, enabling university students to contribute with their ideas, share them, and engage in discussions with fellow students. What sets this platform apart from general online discussion forums or web blogs is its incorporation of built-in knowledge-building scaffolds. These scaffolds assist users in evaluating the attributes of their speech and selecting appropriate scaffolds as annotations before posting or responding. To put it briefly, this knowledge-building, theory-based platform can function as an online collaborative argumentation online platform, aiding different kinds of students in improving their informal reasoning abilities in various subjects. So far, there has been no research conducted in the domain of language learning regarding this matter. In the context of higher education, the development of EFL university students' ability to propose potential solutions to SDG-related SSIs is of paramount importance. Nevertheless, the integration of SSI-based argumentation in EFL classrooms has not received substantial research attention nor has it been adequately incorporated into EFL university courses. The objective of this study is therefore to investigate whether EFL university students can utilize Knowledge Forum as a collaborative argumentation CALL environment for engaging in informal reasoning on SDG-related SSIs. The research question in this study is: "Do university students perform better informal reasoning skills in the collaborative argumentation CALL environment?"

2. Method

2.1. Research design and participants

This study employed a quasi-experimental research methodology. The participants consisted of two classes (n=55) enrolled in an 'English Reading and Writing' course at a university in Taiwan in 2022. The duration of the course was 16 weeks, with two hours per week, and it was taught by the same experienced instructor who has been incorporating the CALL environment into the curriculum. All participants, including 35 males and 20 females, were Mandarin native speakers (L1) with similar levels of English proficiency (CEF B2 to C1). They were at least 20 years old and provided written consent. They were randomly assigned to either the experimental group (n=25) or the control group (n=30). The research design is presented in Figure 1. The study spanned an eight-week period, representing half of the course duration. Both the experimental and control groups underwent a pre-test in week one and a post-test in week eight to assess their Informal Reasoning (IR) skills before and after the intervention. Both the pre-test and the post-test implemented the same open-ened informal reasoning performance paper questionnaire, which was sent to the participants in class to investigate the changes of the participants' informal reasoning skills (see section 2.3.). In weeks 2 and 3, the experimental group received instruction on collaborative argumentation, focusing on knowledge-building theory and operational training utilizing the Knowledge Forum platform. In contrast, the control group received conventional argumentation instruction through teacher-led lectures. During this phase, both groups were assigned an SDG-related SSI topic (specifically, the nuclear power issue, linked to SDG 7: affordable and clean energy). Additionally, all participants were assigned various learning tasks, such as reading articles on the nuclear power issue and learning how to retrieve credible online information. Weeks 4 to 7 encompassed classroom-based discussions on the assigned topic, with the two groups operating in different environments. The experimental group engaged in collaborative argumentation within the CALL environment, utilizing the Knowledge Forum platform for their collaborative discussions. On the other hand, the control group participated in conventional argumentation discussions.
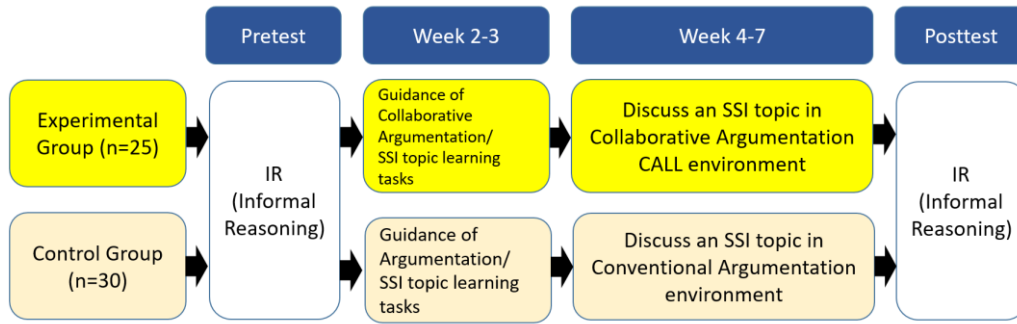
Figure 1. Research design.

2.2. Two learning environments for discussing the SDG-realted SSI

In this study, the collaborative argumentation CALL environment was facilitated by the Knowledge Forum platform, providing a multimedia-based knowledge space for community members to contribute ideas and enhance their initial understandings (Hong et al., 2014; Hong & Chiu, 2015; Sun, Zhang, & Scardamalia, 2010). It is worth noting that the scaffolds aid students in clarifying and organizing their conceptual writings in notes. Figure 3 demonstrates the six predefined scaffolds integrated into the platform. Students were required to employ the scripted scaffolds embedded in the platform to explain their purposes for responding (see Figure 2). This process was similar to informal reasoning. In contrast, the control group engaged in face-to-face group discussions on the SSI topic within the conventional argumentation environment, without utilizing any online platforms.
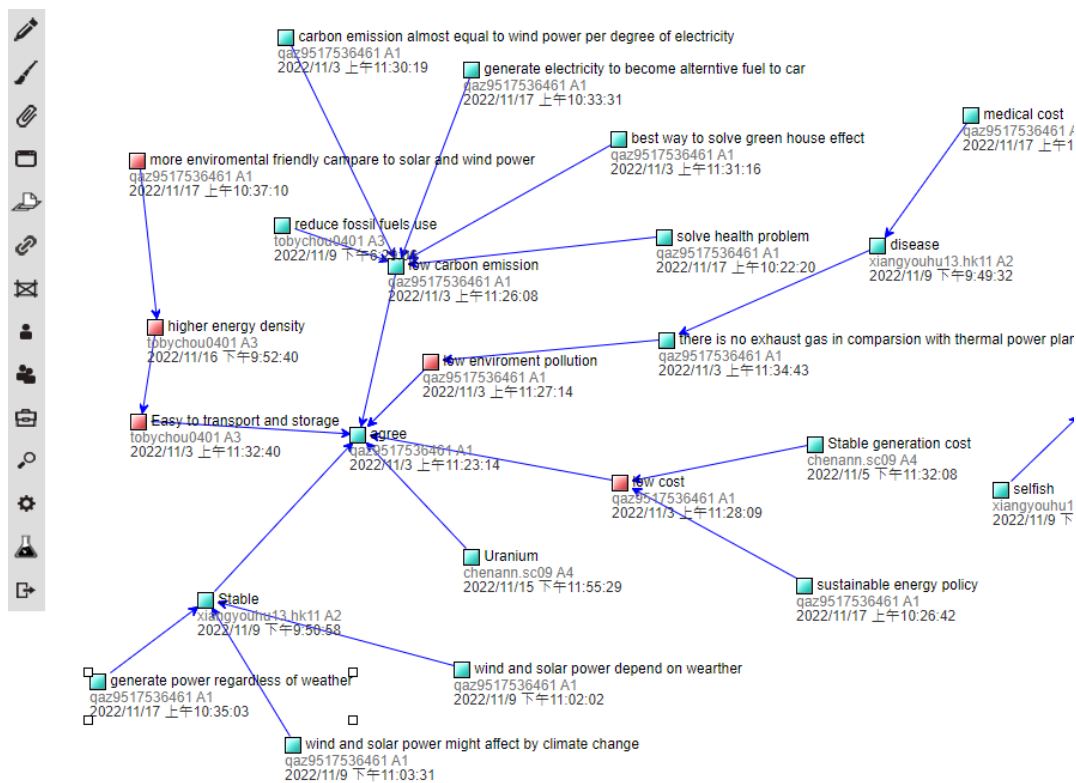

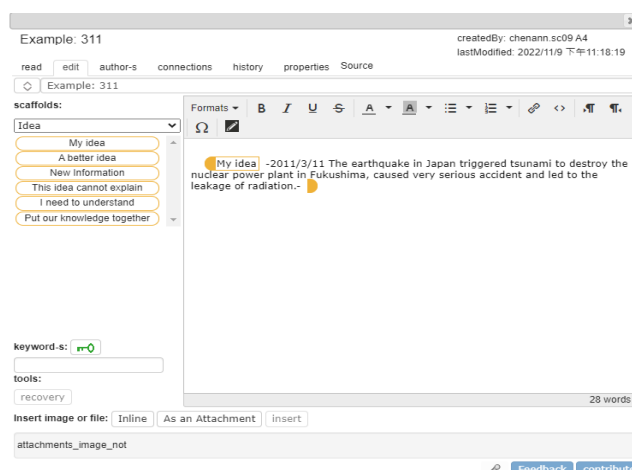Figure 2. Students' Knowledge Forum notes.

Figure 3. Knowledge Forum embedded scaffolds.

2.3. Instruments

An open-ended informal reasoning performance questionnaire developed by Wu and Tsai (2013) incorporating elements of argumentation was adapted to collect data and to evaluate students' informal reasoning on the SDG-related SSI topic. The questionnaire consisted of four questions, each serving a different purpose: Q1:*Understanding claim: "Do you agree or disagree with the use of nuclear power to address Taiwan's power supply problem?"*; *Q2: Proposing arguments: "Please provide your arguments and evidence supporting your position on this issue."*; *Q3: Considering counterarguments: "If someone holds a different position from yours, what counterarguments might be raised to challenge your arguments in the previous question?"*; *Q4: Rebuttals: "How would you rebut the counterarguments with supporting evidence?"*

2.4. Data collection and analysis

The pre-test and post-test responses were analyzed qualitatively and quantitatively using the analytical framework adapted from Wu and Tsai (2007). They developed an informal reasoning quality indicator for their analytical framework, as shown in Table 1. Further descriptions are provided in Table 2. The data from participant students' responses were read and coded separately by the author and an experienced colleague. An initial agreement between the raters was 83%. A 100% agreement rate was eventually achieved between the two raters after several face-to-face and virtual discussions to clarify their understanding of the categories.

Table 1. Description of reasoning quality level.

Level	Description
None	Only claim provided
Lower	Claim and supportive argument OR counterargument provided
Medium	Claim, supportive argument, and counterargument provided
Higher	Claim, supportive argument, counterargument, and rebuttal provided

Table 2. Description of claim, supportive argument, counterargument, rebuttal, and evidence.

Structure	Description
Claim	To show stance, proposition, or assertion about an issue
Supportive argument	The statement contains reasons and evidence to support a claim
Counterargument	Alternative assertion to a person's claim with accompanying evidence
Rebuttal	Valid rejection of a reason that is in support of a counterargument with accompanying evidence

Evidence	Evidence can be from students' knowledge or own experience, numerical or descriptive data, and concrete examples or facts

Adapted from Azimah & Marlizayati (2023)

3. Results

As shown in Table 3, after the conduct of this study, both the control group and the experimental group with different argumentation learning environments have shown an increase from the pre-test to the post-test. Table 4 further shows the frequency of informal reasoning quality levels generated by participant students in the pre-test and post-test are presented. It is observed that the none level of the control and the experimental groups decreased slightly from 10 % (pre-test) to 6 % (post-test), and from 8 % (pre-test) to 4 % (post-test) respectively. The lower level of the control group decreased from 40 % (pre-test) to 30 % (post-test), while the experimental group dramatically decreased from 44 % (pre-test) to 8 % (post-test). Moreover, the frequencies of medium level of both the control and the experimental groups increased from 20 % (pre-test) to 33 % (post-test), and from 28 % (pre-test) to 36 % (post-test) respectively. The most remarkable finding is the significant increase of the experimental group in the frequency of higher reasoning quality levels from 20% (pre-test) to 52% (post-test), although the control group has shown the same trend from 20% (pre-test) to 30% (post-test).

Table 3. The frequency of claim and type of argument.

Claim and type of argument	Control group		Experimental group	
	Frequency		Frequency	
	Pre-test	Post-test	Pre-test	Post-test
Claim Agree	26	26	22	22
Claim Disagree	4	4	3	3
Supportive argument	28	32	27	29
Counterargument	14	19	13	25
Rebuttal	6	10	7	25
Total number of argument	48	61	47	79

Table 4. Participant students' reasoning quality level during the pre-test and the post-test.

Reasoning quality level	Control group		Experimental group	
	Frequency (%)		Frequency (%)	
	Pre-test	Post-test	Pre-test	Post-test
None	3 (10%)	2 (6%)	2 (8%)	1 (4%)
Lower	12 (40%)	9 (30%)	11 (44%)	2 (8%)
Medium	9 (30%)	10 (33%)	7 (28%)	9 (36%)
Higher	6 (20%)	9 (30%)	5 (20%)	13 (52%)

4. Discussion

It is found that no matter which argumentation learning environment, our university students did improve their frequency of claim and type of argument. It is noted that students performed better informal reasoning skills in the collaborative argumentation CALL environment in terms of the frequency of claim and type of argument, and their reasoning quality. The experimental group could generate more arguments. This finding confirms that the collaborative argumentation CALL environment did advance students' knowledge and discourse and assist them in generating and refining their ideas (Hong & Scardamalia, 2015). In terms of the level of reasoning quality, a noticeable decline in the none level and lower level of reasoning quality, as well as an increase in the higher level of reasoning quality, can be observed in both the control and experimental groups. Scholars have posited that constructing counterarguments and rebuttals poses a cognitive challenge for university students (Erduran, et al.,

2004; Azimah & Marlizayati, 2023). It is noteworthy that students in the experimental group exhibited a tendency towards achieving higher reasoning quality compared to the control group. This observation potentially validates the effectiveness of the collaborative argumentation CALL environment, which may foster a setting where university students can generate reasoning artifacts of higher quality. While the current study has generated outcomes that bear significance for both theory and practice, it is essential to acknowledge the limitations inherent in its design. Primarily, the study's sample size of 55 participants restricts the extent of its contribution to the existing research literature. Consequently, the study's results and implications should be viewed as preliminary, tentative, and exploratory, rather than yielding a definitive conclusion. In order to validate the effectiveness of the collaborative argumentation environment, more samples may be needed to provide a deeper analysis. Additionally, the analysis did not incorporate an examination of the patterns of informal reasoning as the past studies did (Sadler & Zeidler, 2005). Consequently, future research endeavors should incorporate classroom observation as part of the data collection process, as previous studies have indicated that such an approach can provide more extensive and meaningful data (Dawson & Carson, 2020; Dawson & Venville, 2010).

5. Conclusions

In conclusion, this study represented preliminary research aimed at enhancing the informal reasoning abilities of EFL university students. This objective was achieved by implementing a collaborative argumentation CALL environment. The results of this study demonstrated that our university students, who utilized the collaborative argumentation CALL environment, exhibited superior quality of informal reasoning skills compared to those in a traditional argumentation environment. It can be inferred that this CALL environment, Knowledge Forum, facilitated the generation of a greater number of arguments, including counterarguments and rebuttals, among students. These findings hold potential for the application of collaborative argumentation CALL environments in the field. Further research is warranted to investigate the efficacy of different teaching contexts or methods.

Acknowledgements

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