

# Using technology to create virtual and remote language courses in the context of education and sustainable development

Prodhan Mahbub Ibna Seraj<sup>1\*</sup> Arsakaeva Khapta<sup>2</sup>

<sup>1</sup>*Department of English, American International University-Bangladesh (AIUB), Dhaka, Bangladesh*

<sup>2</sup>*Kadyrov Chechen State University, Grozny, Rissia*

**Abstract.** Nowadays, Technology is commonly used in language classrooms for learning and teaching. As teachers get assistance and make language classes real, so do learners. On the other hand, keeping the environment clean and fresh for future generations is one of the time-demanding concepts for using technology as environment-friendly in language classrooms. Thus, this systematic review paper will investigate how the conceptual framework of green technology materializes in language classrooms by researchers and leave insights for further research. To do this, the researcher investigated published research works in Google Scholar, Scopus, Emerald, and ScienceDirect. The results of this study identified different conceptual frameworks for integrating green technology in language pedagogies, e.g., Green Social Media in Language Teaching (GSMLT) and Green Language Teaching Approach (GLTA). Context-aware ubiquitous language learning (CAULL), Green Pedagogy (GP), Project-based Language Learning with Technology (PBLLT), Green Screens (GS), and Online Language Pedagogy (OLP). The findings also emphasized increasing awareness of GT among ELT stakeholders. In a nutshell, the study's findings will contribute to the literature on GT in ELT (English language teaching and learning).

## 1 Introduction

In general, the term "technology" denotes the implementation of diverse methodologies, expertise, processes, and skills for practical purposes or to accomplish specific goals, including scientific inquiry or research. Technology is a field that involves the application of scientific knowledge from both art and science to solve practical challenges[1]. This is the process of utilizing tools, crafts, and systems to assemble, modify, and manipulate machines to achieve a desired end. It has a profound impact on the ability of humans and other organisms to control and adapt to their natural surroundings [2]. From this point of view, Green Technology (GT), or simply Green Tech, is the abbreviation for a technology whose production, supply chain, or utilization does not negatively impact the environment. Green technology is an umbrella term that encompasses the ongoing development of equipment,

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\*Corresponding author: [mahbub.seraj@aiub.edu](mailto:mahbub.seraj@aiub.edu)

systems, and products, and its resources restrict and mitigate the adverse impacts of human activities on the natural environment. The global environment is endowed with finite natural resources, commonly known as nonrenewable resources or those that are susceptible to depletion over time[3].

The primary function of the Education Institutions (EIs) is to facilitate the teaching-learning process, which involves the participation of faculty members and students. Here, technology is being used in different forms, shapes, and ways. During the operation of EIs, power is utilized by various appliances such as ceiling fans, air-conditioning units, electric fans, electrical lighting fixtures, television sets, laptops, and liquid crystal displays that are used in the classrooms or laboratory area. The support services utilized electricity and employed resources such as supplies, materials, and printing/copying equipment. Food services and food laboratories employed liquefied petroleum gas. The transportation service provided for faculty members, non-teaching professionals, students, and cars uses petroleum-based fuel, resulting in Carbon Dioxide emissions. Carbon dioxide is emitted into the air as a result of the production of solid waste [4].

On the other hand, Green technology aims to reduce the negative impact of human activities on the environment by using environmentally friendly methods and practices [5]. Policymakers at EIs are trying to implement the concepts and process of GT in different levels of education or even in different disciplines for the sustainability of the natural resources of a country [6-10]. This study will investigate the activities of English Language Teaching (ELT) practitioners and researchers in the published literature in different databases like Scopus, Google Scholar, and ScienceDirect. The literature survey will provide insights for practitioners and researchers who want to adopt GT in their classrooms.

## **2 Literature Review**

### **2.1 Green Technology**

Green technology, often known as GT, refers to the production and utilization of goods, equipment, and systems that aim to protect and preserve the natural environment and resources. Its primary objective is to minimize and mitigate the adverse effects caused by human activity[11]. Green technology is implemented by including a "green concept" that encompasses elements of ZEB (Zero Energy Building) and 3R (Reuse, Reduce, Recycle). The key attributes of Green Technology encompass sustainability, utilization of reclaimed natural resources, production of reusable products, reduction of waste and pollutants, compatibility with recycling processes, innovation, non-toxicity to health and the environment, and creation of environmentally beneficial activities and products that safeguard the Earth [3], [12].

Put differently, green technology works to counteract or lessen the negative environmental effects of human activity. This guarantees the preservation of the environment. The most significant advantage of green technology is that it promotes a cleaner, more environmentally friendly way of life for humans in addition to the environment[4]. Green Technology is a form of healing technology that is growing in our current state of technological and communicative development. It aims to reduce the environmental damage caused by human activities in order to enhance the comfort of human life. Green technologies often mitigate any form of environmental degradation. As it is environmentally benign and contributes to reducing our ecological impact, it is actively improving the lives of people by making it more convenient and better. This includes reducing carbon emissions, minimizing ICT waste, optimizing energy consumption, and conserving natural resources. The goal is to achieve cost effectiveness, ensure the longevity of ICT systems, and contribute to the preservation of our planet [13].

In this regard, green technology refers to being employed in academic institutions and industry to maintain the process of sustainable development. As per the credentials of the International Association of TEFL (IATEFL), both individuals and organizations must develop effective responses to the climate emergency. In order to participate in global climate actions, a number of initiatives have been implemented in EIs, including the substitution of printed for digital papers, the use of eco-wrappers, and the prohibition of plastic materials. In contrast, ecological pedagogy and EE pedagogy are intricately intertwined. It is based on an educational framework in which both instructors and learners are actively involved and interconnected in the pursuit of resolutions for ecological challenges [14]. This study explores the fact that there is still a gap in implementing GT in ELT

## **2.2 Green technology in education**

The research shows that different EIs respond in different ways to GT. Some studies pointed out obstacles to implementing GT in education. For example, [13] mentioned that policymakers lack the desire and rationale for adopting GT. High adoption costs, a lack of environmental knowledge and green consciousness, skepticism regarding adoption, the rate of adoption within institutions, and transitioning barrier issues have been identified as significant obstacles, too [15]. The academic resources should be guaranteed by top administrators, building facilities, and teachers who have confidence in green ideology. Some studies emphasized the green education program that promotes charitable principles and generates enthusiasm among students. The Green Education program is the sole means of fostering awareness and cultivating the minds of future generations. Thus, this level of consciousness can be achieved through the dissemination of knowledge and advocacy for the use of environmentally friendly technology [2].

However, the success of implementing green technology at EIs is positively influenced by technology. To effectively integrate green technology into public universities, the government must take into account the technological aspects. By utilizing simpler and more suitable green technology, the likelihood of adopting green technology will be enhanced [11]. Moreover, sustainability in ELT through integrating green technology is a matter of concern now [16-20].

Likewise, a unique educational approach is required to enhance students' consciousness and foster their environmental concerns by developing a learning communication model that introduces green technology and promotes a stronger green ethos among students. The findings indicate the necessity of disseminating information on the operational framework of green technology in order to enhance students' knowledge and engagement in environmental conservation efforts through the use of green technology [12]. It necessitates the development of strategies to enhance students' understanding of both the theoretical and practical aspects of deploying green technology [5]. The students and faculty should emphasize the importance of education and the need for responsible global citizens to contribute actively to implementing and adopting green technology. Doing so can ensure the development of a healthy and harmonious ecosystem, which will ultimately benefit everyone in the future. Additionally, it will offer an understanding of how certain educational institutions worldwide are implementing innovative strategies to attain environmental sustainability [9].

This study will investigate how and in what ways ELT researchers use GT concepts. As researchers, policymakers, and education authorities are concerned about global environmental problems and how to address them by implementing GT, the English language teaching field is not left behind in this regard. Therefore, after reviewing the research in this field, this study will leave insights for incorporating GT in ELT.

3 Method

This study employed the methodology of a systematic literature review. The researcher searched extensively through Google Scholar, ScienceDirect, Scopus, and Emerald databases to identify the target research works. The following codes demonstrate how Scopus' search engine scans the content (including article title, abstract, and keywords) in a specific subject TITLE-ABS-KEY ("Green technology\*" AND "Language learning\*" OR "language teaching\*". For the other databases, e.g., Google Scholar, ScienceDirect, and Emerald, the search keywords were “Green technology” and “language teaching and or learning”. For selecting the research works, this study followed the guidelines of the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) model Figure- [21], [22]

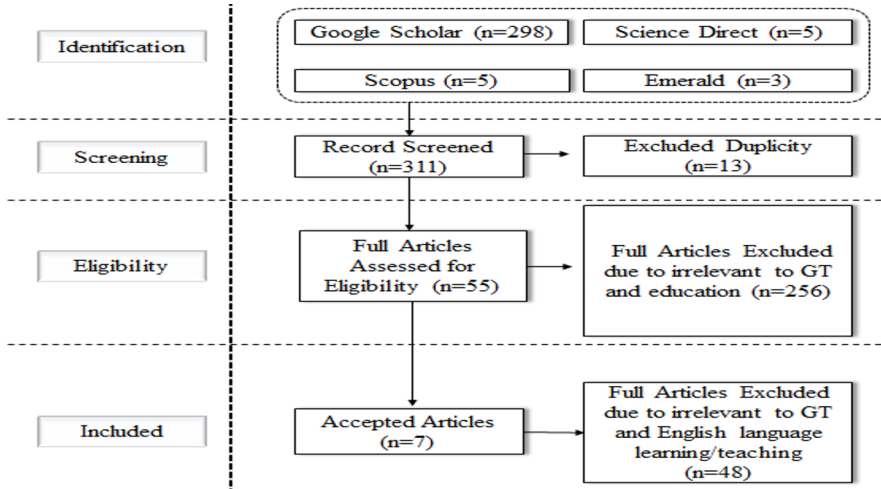


Fig.1. PRISMA Model for Selecting Research Works

The initial search results were 311, excluding duplicity. After studying the titles, 256 articles were excluded as they were not directly investigating GT in education. To reach the specific objective of the study, the researcher studied the abstracts of 55 articles and found 7 articles in this regard. These seven articles were reviewed rigorously to conclude the objective of this study.

Moreover, to study these articles in depth, the researcher used 3 software to align the themes of this study. Mendeley was employed to prepare the database and reference at the end. VOS viewer was employed for presenting networking and visualizations of the themes after analyzing keywords of authors, titles and abstracts [22], [23]. For textual analysis, the NVIVO-14 was utilized.

4 Result

Table 1 presents the review matrix of 7 research papers found in alignment with the objectives of this study. Of 7, 4 research papers were conducted in the light of empirical studies employing quantitative, qualitative, and mixed methods. The empirical papers aim to examine the impact, perceptions, and evaluation of GT in ELT. This research also emphasizes increasing awareness of GT among ELT teachers, students, and practitioners. The remaining 3 are the conceptual papers proposing how green technology can be used in ELT.

Table 1: Review matrix

Author	Doc type	Method	Objectives	Findings
[24]	Empirical Articles	Mixed Method	Focusing on assessing online foreign language instruction satisfaction and the major influencing elements based on the new background of green technology.	The findings demonstrate that college students are highly satisfied with online instruction of foreign languages, as evidenced by the satisfaction index, which is above level 2 and based on the entropy weight technique.
[15]	Conceptual Papers	Document analysis	Aiming to provide an in-depth analysis of the significant obstacles that could prevent higher education from implementing green technology.	High adoption costs, a lack of environmental knowledge and awareness, a lack of trust, adoption skepticism, institution adoption rates, and switching barrier concerns are some of the main obstacles that have been found.
[25]	Conceptual Papers	Document analysis	Aiming to provide an in-depth analysis of primary school teachers' awareness and motivation about the use of green technology.	Based on a thorough examination of the literature, researchers have discovered that teachers' knowledge of and motivation for using green technology practices are still poor.
[26]	Empirical Articles	Qualitative	Ascertaining how English teachers felt about using green screens in the classroom.	The results demonstrated that most educators created video content for English courses using green screens. The green screen was also a helpful tool that improved student learning and made teaching more manageable.
[14]	Empirical Articles	Qualitative	Increasing the knowledge of EE (Environmental Education) and green pedagogy in ELT among language teachers and students.	The results illustrated 1) incorporating environmental concerns into creating language curricula, syllabuses, and textbooks; 2) offering environmentally relevant materials and resources; 3) offering professional development for environmental language teachers; and 4) speeding up environmental literacy initiatives at all educational levels.
[27]	Empirical Articles	Mixed Method	A green-building English-learning application (GBELA) that uses sensing technologies was developed to improve users' English hearing and reading skills	The outcomes demonstrated the GBELA's efficacy for high-achievement (HA) and low-achievement (LA) groups. The relationships between learner perceptions and self-efficacy show that learners can improve their

			utilizing smartphones and QR codes. This application aimed to examine the impacts and learner perceptions of context-aware ubiquitous language learning (CAULL).	self-efficacy in CAULL mode with a well-designed context-aware learning system.
[28]	Book chapter	Document analysis	Examining the effectiveness of teaching English language proficiency and environmental education within the same framework.	This method entails teaching terminology associated with the environment and environmental issues to instill eco-friendly behaviour in young minds while also expanding their vocabulary.

4.1 Conceptual Frameworks of GT in ELT

4.1.1 Green Social Media in Language Teaching (GSMLT)

In the present scenario, social media is emerging as a new platform for higher education to raise environmental sustainability awareness among academicians and students. Social media is now commonly employed in ELT. The multiplicity of social media existing in the technology provides options for ELT practitioners in the classrooms. Thus, it has the potential to generate awareness in the wider society regarding the initiatives taken by academic institutions and organizations towards greening society. In the age of social media, little study focuses on utilizing platforms like Twitter or Facebook to raise awareness about ecological sustainability among academics, students, and higher education administration. The failure to utilize social media as a powerful tool to promote awareness of environmental sustainability is a squandered opportunity in language teaching and learning [1]. Thus, GSMLT should be incorporated with language teaching tools and resources in ELT.

4.1.2 Green Language Teaching Approach (GLTA)

Integrating environmental education and consciousness into the English language curriculum is called "green English language teaching. This approach aims to establish a connection between language proficiency and ecological comprehension. It attempts to connect the realms of education and environmentally conscious conduct. The instruction of green languages emphasizes the significance of ecological education within the language curriculum. It advocates for environmental literacy initiatives at both the primary and tertiary levels of education. This method teaches vocabulary terms associated with the environment and ecological issues in order to instill in young minds the value of eco-friendly behaviour while simultaneously supplementing their lexicon. It is a revolutionary method of language learning and environmental consciousness promotion. By implementing this innovative strategy, learners can become more involved in local issues and ecosystems. This entire strategy is designed to facilitate language learning while fostering students' ability to discuss ecological issues. Green language instruction transforms the function of language from that of a simple means of communication to one that addresses environmental concerns.

The green language teaching approach primarily relies on three key areas such as language curriculum, learning tools and resources. Curriculum plays a vital role in ensuring the success of green language instruction. The English language curriculum should be structured in order to tackle environmental issues effectively. Consider devoting a few chapters of the English language textbook to topics such as sustainable development, climate change, and so forth. It is imperative that the instructor proficiently elucidate each of these chapters, require the students to peruse them, and assign essay-writing tasks at home. In the

light of learning tools, Content-based instruction (CBI) and content and language-integrated learning (CLIL) are the foundations of green language teaching. For Green Language Teaching to be successful, certain pedagogical imperatives, including digital photovoice, vodcasting, digital poster creation, and presentation, can be adhered to. Additionally, teacher-student collaboration projects are strongly encouraged in environmental English courses. Lastly, textbooks play a crucial and indispensable role in fostering environmental consciousness among students and enhancing their ecological literacy [29]. The foundation of Green Language Teaching is the introduction of specialized vocabulary associated with environmental issues. This includes phrases and terms such as "conservation," "sustainable development," and "ozone depletion," among others. By incorporating these terms into the language curriculum, educators can enable students to delve into a wide range of environmental concerns. The students will acquire a novel term to supplement their current vocabulary repertoire while also being directed towards the environment [28].

#### **4.1.3 Context-aware ubiquitous language learning (CAULL)**

Context-aware ubiquitous language learning (CAULL) plays a vital role in implementing GT in ELT. For CAULL, different language learning applications can be used. In order to evaluate the impact and perspectives of context-aware ubiquitous language learning (CAULL), in the study of Wang [20] an English-learning application (GBELA) for green buildings was developed. This application utilized sensing technology and involved the use of smartphones and QR codes to enhance the reading and listening abilities of the participants in English. CAULL, which provides an interactive environment with digital and contextual learning materials, enhances the learning experience and improves learning effectiveness. The purpose of the GBELA is to provide users with information regarding an ecological building that is carbon-free and showcases a variety of real-life implementations of green technology. Thus, CLIL can be implemented in this context, as GBELA will allow students to acquire content knowledge of green building technology and environmental issues while improving their reading and listening abilities. A user-learning system was developed in accordance with the HCI (human-computer interaction) principles of learner attitudes, satisfaction, usability, and utility, as well as self-efficacy in the learning process. The specifically designed Green Building English Study Activity (GBELA) 's objective was to enhance university students' reading and receptive listening abilities. Learner perceptions of the GBELA were another objective of this research. The efficacy of GBELA in fostering English receptive skill development among HA learners was established, with usability emerging as a significant factor in this regard. In the case of HA and LA learners, specific correlations were also found between variables pertaining to learner perceptions and learning self-efficacy in relation to the utilization of smartphones and the GBELA[27].

#### **4.1.4 Green Pedagogy (GP)**

Green Pedagogy (GP) refers to environmentally based Language Teaching. Environmental education is one of the content-based language learning pedagogies utilized to heighten students' consciousness regarding environmental issues and their impact on both human beings and animals (EE). Its objective is to increase students' and language instructors' understanding of the significance of EE and green pedagogy in ELT. However, the EE imperatives' multimodal discourse through the lens of content and language integrated learning (CLIL) can 1) incorporate environmental concerns into the creation of language curricula, syllabuses, and textbooks; 2) offer environmentally relevant materials and resources; 3) offer professional development for environmental language teachers; and 4) speed up environmental literacy at all educational levels. In another way, it should be widely accepted that environmental sustainability programs and GP are integral parts of ELT. It is more probable that students will simultaneously develop and enhance their content

knowledge and language skills, thereby embracing the tenets of content-based instruction (CBI). In contrast, environmental language curricula incorporate the operational tenets of CLIL and CBI, respectively [14].

#### ***4.1.5 Project-based Language Learning with Technology (PBLT)***

One of the numerous pedagogical approaches that can incorporate environmental concerns into language education is project-based learning. Participatory learning was employed, in which both instructors and learners engaged in the endeavour. Furthermore, they can acquire genuine experiences through social interaction outside of the classroom environment. They can establish social connections with local community members, environmentalists, policymakers, and fundraisers who share a concern for environmental protection. A pedagogical approach known as "Photovoice" incorporates documentary photography. It promotes the utilization of students' social-semiotic sense for self-expression [30]. Utilizing a digital camera or smartphone was mandatory to capture images of environmental concerns in their immediate vicinity. As a result, they generated visual representations of the consequences of sanitation, water pollution, soil degradation, and air pollution. Then, a digital photo gallery was created to assist students in developing their social semiotic sense and comprehending their surroundings. Students gained knowledge of ecological terminology and developed their capacity for critical thought through this endeavor [14].

#### ***4.1.6 Green Screens (GS)***

Green screens are among the most recent technologies considered advantageous for teaching and learning. By utilizing this technology, educators can superimpose their pupils onto virtual backdrops, relocate them across dynamic digital backgrounds, or transport them to a sanctuary in the desert. In addition to facilitating interactions that mimic the real world, green screen technology fosters genuine learning experiences. As it employs synthetic graphics, green screen technology can revolutionize education at all levels, according to Pantelidis [25]. Therefore, by utilizing green screen technology, instructors can incorporate the outside world into learning and instruction without departing the classroom. This technology offers individuals a smooth and uninterrupted experience and has received widespread recognition as a significant technological breakthrough capable of efficiently generating and delivering lesson content. According to the findings, most instructors utilized green screens to create video content for English classes. In addition, the green screen served as a valuable instructional aid that improved students' learning and facilitated instruction [26].

#### ***4.1.7 Online Language Pedagogy (OLP)***

The promotion of green and low-carbon development is a critical component in the pursuit of sustainable social progress. The online foreign language education model is a vital digital technology component in advancing the transition to educational activities with lower carbon emissions. The online foreign language education model facilitates convenient instructional interaction between instructors and learners. An illustration of how online education can optimize the use of social resources is by minimizing the occupancy of conventional meeting rooms through the implementation of virtual conference rooms. Online foreign language education can facilitate the exchange and dissemination of knowledge while effectively reducing traffic, paper waste, and other associated costs. Digital technology-enabled online foreign language instruction has emerged as a significant instrument of social-ecological transformation [17].

#### ***4.1.8 Awareness of students and teachers***

Implementing green technology practices is deemed crucial due to its suitability as a remedy for climate change and environmental degradation. Developing equipment and systems that conserve the environment and natural resources constitutes green technology. As a result,



each educator must initially possess the knowledge and drive to identify and implement green technologies in their everyday activities. Teachers' motivation and awareness for green practices are contingent on their knowledge and comprehension of green technology, according to the study [15].

4.2 Keywords Analysis

4.2.1 Keywords from the titles and abstracts analysis

The titles and abstracts of the gathered documents are subjected to analysis in this study. VOSviewer is utilized to quantify the frequency and establish relationships between terms. The co-occurrence network in this analysis was constructed using a binary counting technique to provide greater specificity. The binary counting methodology employed by VOSviewer, as stated by Van Eck [26], disregards the frequency of noun phrases in the title and abstract of a publication. This study found 226 keywords from the titles and abstracts, considering a minimum number of occurrences of a keyword three times each. There are 23 keywords that meet the threshold (Figure 2). Of 23 keywords, 5 keywords, e.g., Malaysia, paper, students, study, and data, were excluded as they are not relevant to the objectives of the study.

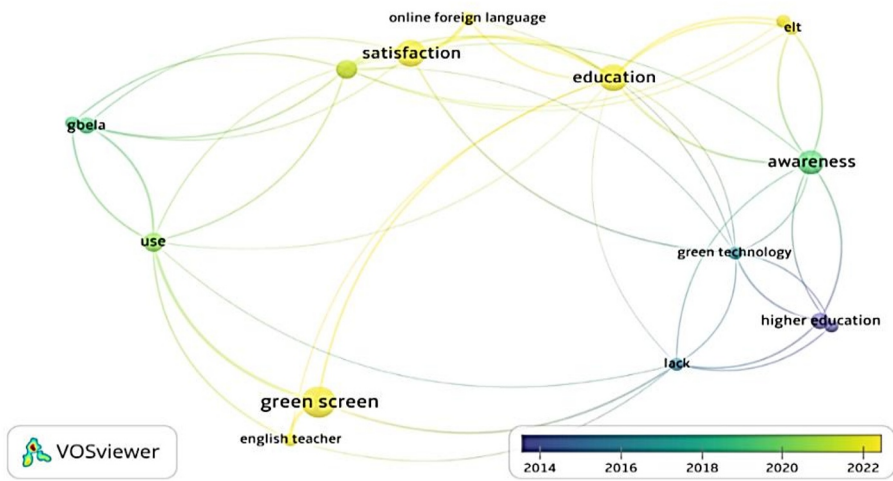


Figure 2 Visualization of networking of the keywords

4.2.2 Keywords from the Texts

Figure 3 presents the most frequently used 50 words that appeared at least 5 times each in the selected studies. With NIVO-14, the word cloud contains “Exact Matches” words. The most weighted words are “language”, “teaching”, “learning”, “green”, “technology”, “English”, “education”, “satisfaction”, “environmental”, and “online”. The words stem language”, “teaching”, “learning”, “foreign “, and “English” represent “English Language learning and teaching” or “Foreign Language learning and teaching”, Whereas the word stems “green” and “technology” indicate “green technology”. Similarly, “environmental” illustrates “environmental impact. Thus, the weighted stems extracted from the studies show that the concept of green technology is very relevant in the field of English language teaching and learning.



**Figure 3** Word cloud of most frequent 50 words from the texts

#### 4.2.3 Authors' Keywords Analysis

VOSviewer has been employed to identify and visualize the authors' keywords' link strengths and co-occurrence network. 21 keywords were used in all these scrutinized studies. Among 21 keywords, 3 keywords, e.g., “perception”, “primary teachers”, and “confirmatory factors”, are excluded from the list due to inconsistency with the objectives of the study. Figure 3 illustrates the network visualization of the author keywords to show the co-relationship of the authors' keywords. According to Sweileh [24], network visualization presents the correlation between keywords through the utilization of color, circle size, text size, and connecting line thickness.

## 5 Conclusions

This study investigated the conceptual frameworks employed in existing literature for instrumenting GT in English language teaching and learning. As the environmental problem is increasing its zenith point, there is no alternative way for implementing green concepts in all spheres of life. This study found that ELT researchers are trying to innovate pedagogy and strategy to cope with environmental change issues. Thus, this study explored different conceptual frameworks of language pedagogies, e.g., Green Social Media in Language Teaching (GSMLT) and Green Language Teaching Approach (GLTA). Context-aware ubiquitous language learning (CAULL), Green Pedagogy (GP), Project-based Language Learning with Technology (PBLLT), Green Screens (GS), and Online Language Pedagogy (OLP). Table 1 suggests that both teachers and students should be aware of climate change and can take preventive through ELT materials and pedagogy. Further research is needed to implement these frameworks and identify the impact of GT on ELT. The keywords analysis supports the constructs of the frameworks. Moreover, these frameworks will help to innovate environment-friendly teaching methods too. The findings also emphasized increasing awareness of GT among ELT stakeholders. Overall, the findings suggest that there is a lack of research work and ample opportunities to explore GT in ELT from different aspects.

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