The Influence of Constructionist Learning Environments on the Development of Global Citizenship Education Among K-12 Students

Constructionist Learning and Global Citizenship in K-12

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Abstract

While theoretical studies suggest that constructionist learning environments can cultivate skills essential to Global Citizenship Education (GCE), empirical research exploring this intersection is limited. This study investigates how constructionist learning environments impact the development of GCE among K-12 students. A qualitative research design, focusing on document analysis, was employed. A total of 177 student project reports generated over a one-year period during the 2023 academic year were collected. Trimester 1 included 51 projects (28.81%), Trimester 2 contained 53 projects (29.94%), and Trimester 3 encompassed 73 projects (41.24%). Through thematic analysis of the project titles, abstracts, and keywords, 150 representative codes were identified. The findings revealed that four distinct themes emerged: Environmental Sustainability, Technological Innovation, Social Responsibility, and Cultural Awareness. This study contributes to the growing body of research at the intersection of constructionism and GCE. By integrating constructionist methodologies into K-12 curricula, educators and policymakers can create transformative learning experiences that prepare students to act as informed and empathetic global citizens.

Keywords and Phrases: Constructionism, Constructionist Learning Environments, Global Citizenship Education, K-12 Education

1. Introduction

In today's connected world, education plays a crucial role in preparing individuals to confront global concerns such as environmental degradation, social inequality, and cultural conflict (Kioupi & Voulvoulis, 2019). Global Citizenship Education (GCE) has developed into a framework that enhances competencies like cultural empathy, environmental responsibility, and social justice (Hajisoteriou et al., 2024; Waghid, 2023). It enables learners to act as responsible members of a shared global community (Noddings, 2005). UNESCO describes GCE as a comprehensive approach that integrates cognitive, socio-emotional, and behavioral dimensions to promote a sense of global belonging and encourage individuals to address global issues (UNESCO,

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2015; Yanniris, 2021). These dimensions emphasize knowledge of global issues, respect for cultural diversity, and the ability to act toward social justice and sustainability (Akkari & Maleq, 2020). GCE has become a key framework for preparing learners to meet the demands of a rapidly globalizing society (UNESCO, 2015).

Despite the increased attention on GCE, questions remain about how best to integrate its principles into teaching practices, particularly in K-12 education (Guo, 2014; Rapoport, 2015). Constructionism, introduced by Seymour Papert, is a pedagogical approach that emphasizes hands-on, experiential learning through making and problem-solving (Papert, 1984, 1987, 1991). Evolving from constructionism theory, project-based learning (PBL) allows students to actively construct knowledge by engaging in meaningful projects that address real-world issues (Khambuo et al., 2024; Papert, 2020; Tep & Tanprasertkul, 2022). These environments encourage collaboration, critical thinking, and active engagement, aligning well with the goals of GCE (Reysen & Katzarska-Miller, 2013).

While theoretical studies suggest that constructionist learning environments can cultivate skills essential to global citizenship, such as critical thinking, empathy, and collaboration (Holbert et al., 2020; Hyde, 2020; Papert, 1991), empirical research exploring this intersection is limited. Most studies focus on higher education, leaving significant gaps in understanding how constructionist practices can influence younger learners in K-12 settings (Schutte et al., 2017). Moreover, standardized methods for assessing the development of GCE in these environments are lacking (Yanniris, 2021).

This study investigates how constructionist learning environments impact the development of GCE among K-12 students. By analyzing PBL reports, this study aims to identify common themes and patterns that reflect competencies such as cultural awareness, environmental sustainability, and social responsibility. The findings will provide practical insights for educators and policymakers, demonstrating the potential of constructionist approaches to foster global citizenship in early education.

2. Literature Review

Global citizenship is a multidimensional construct defined through diverse perspectives. The neoliberal perspective aligns global citizenship with economic competencies such as adaptability and competitiveness in the global workforce (Bosio & Schattle, 2023; Neoh, 2020). Conversely, the critical perspective emphasizes social justice, equity, and advocacy, encouraging individuals to challenge systemic inequalities (Bosio & de Wit, 2024; Pashby et al., 2020; Shultz, 2018). Despite differing definitions, common dimensions include environmental responsibility, cultural empathy, digital literacy, and civic engagement (Gaudelli, 2016; UNESCO, 2015). These dimensions emphasize the importance of preparing individuals to act at both local and global levels.

In terms of competencies associated with global citizenship, they are notably diverse, reflecting the need for holistic skill development. For instance, critical thinking enables learners to analyze complex global issues and evaluate diverse perspectives (Hancock, 2023). Empathy and cultural sensitivity foster inclusivity, enabling individuals to engage respectfully with diverse communities (Reysen & Katzarska-Miller, 2013). Environmental responsibility promotes sustainable practices and awareness of

ecological challenges (Goodale et al., 2024). Moreover, agency and collaboration empower students to address global challenges through teamwork and informed action (Yanniris, 2021).

Many studies demonstated that constructionist environments enhance critical global competencies (Goodale et al., 2024; Handa, 2018). Sustainability-focused projects, for example, foster environmental awareness by engaging students in addressing ecological challenges like climate change and resource management (Goodale et al., 2024). Similarly, projects centered on cultural exploration help students develop intercultural understanding and empathy (Handa, 2018). Social responsibility is cultivated through projects addressing community needs, encouraging students to take active roles in local and global contexts (Engel et al., 2016).

This review highlights the potential of constructionist learning environments to advance GCE by fostering critical thinking, collaboration, and environmental responsibility. However, the limited empirical evidence underscores the need for further research, particularly in K-12 settings. By addressing these gaps, this study seeks to contribute to the growing body of knowledge on the intersection of constructionism and GCE.

3. Methods

This study uses a qualitative research design, focusing on document analysis, to explore how constructionist learning environments impact the development of GCE among K-12 students. Thematic analysis of document is particularly suited for this research as it systematically examines student PBL reports to identify ongoing themes and patterns related to GCE. Unlike other methods, thematic analysis is not tied to a specific theoretical framework and does not impose particular epistemological or ontological assumptions (Braun & Clarke, 2013). Its flexibility makes it suitable for a wide range of studies, allowing researchers to choose a research design that aligns with their interests and expertise (Braun & Clarke, 2006).

3.1 Context

Darunsikkhalai School of Innovative Learning (DSIL) in Bangkok, Thailand, is committed to fostering compassionate innovators and global citizens (Tep & Tanprasertkul, 2022). DSIL applies a constructionist approach and offers three trimesters each academic year (Joshi & Darasawang, 2017; Khambuo et al., 2024). According to Tep and Tanprasertkul (2022), DSIL encourages students to explore their passions and abilities, helping them achieve their full potential. A notable innovation at DSIL is the FabLearn Lab, a makerspace equipped with digital fabrication tools like 3D printers, laser cutters, hand tools, microcontroller boards, and computers. This environment enhances learning, especially in making and makers' culture (Blikstein & Krannich, 2013), promoting the development of compassionate innovators.

The curriculum at DSIL is divided into three main parts: core subjects, personal and physical development, and project creation. For core subjects, DSIL adheres to the Thai National Curriculum. The personal and physical development component focuses on enhancing students' mental and physical health. DSIL aims to cultivate innovative traits in students, teaching them to think critically, act responsibly, and

solve problems, while inspiring them to become global citizens with a strong sense of social and ethical responsibility. Activities in this part include exercise, sports, clubs, counselling, scouting, and volunteer work.

Furthermore, the project creation part involves individual or group projects. DSIL offers project houses based on fields and themes such as engineering, science, and art. In each trimester, DSIL students can select a house. They can work on projects in various fields, driven by their interests and self-direction, with support from facilitators. The project space is open for all students to explore, interact, and collaborate. At the end of each trimester, students showcase their projects at a school exhibition.

3.2 Data Collection

The dataset comprises student project reports generated over a one-year period during the 2023 academic year. These reports were written by all upper DSIL students, ranging from grade 7 to grade 12. As part of the Project House, each student is required to complete a project and subsequently write a 5-chapter report detailing their project. Data were gathered from eleven distinct project houses (see Table 1), with a total of 177 reports collected. As shown in Figure 1, Trimester 1 includes 51 projects (28.81%), Trimester 2 contains 53 projects (29.94%), and Trimester 3 encompasses 73 projects (41.24%). This sampling technique was employed to ensure a diverse representation of projects from all trimesters, thus providing a comprehensive view of the themes and competencies. Each report offers insights into the students' engagement with global themes and the skills they developed during their projects. The reports include titles that summarize the project focus, abstracts that detail the project's objectives, scope, and outcomes, and keywords that highlight the core themes and concepts associated with each project.

#	House Name	Number of Reports	Percentage
1	Engineering	42	23.73%
2	Compassionate Innovator	23	12.99%
3	Innovator's Journey	9	5.08%
4	Art	17	9.60%
5	MMAD	25	14.12%
6	So-Sci ty	7	3.95%
7	Health and Well-being	7	3.95%
8	Pinto	12	6.78%
9	Film Hou2e	19	10.73%
10	Dramatic	11	6.21%
11	Pen and Lens	5	2.82%

Table 1: Distribution of Reports Across Learning Houses (n = 177).

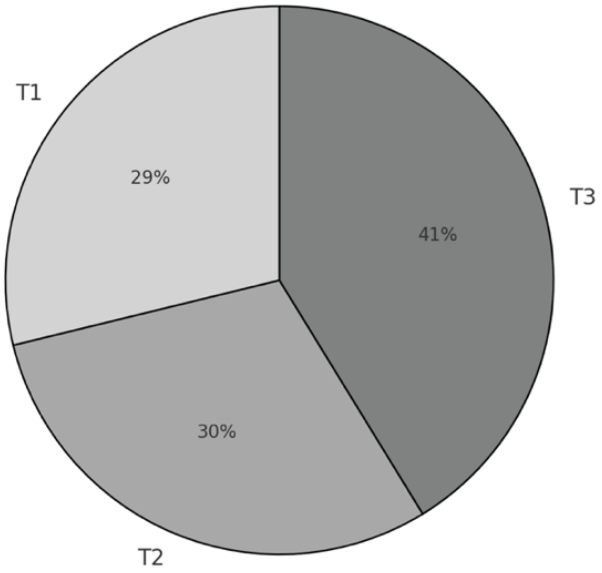

Figure 1: Distribution of Reports Across Trimesters.

3.3 Thematic Analysis

The analysis employed a thematic analysis approach (Braun & Clarke, 2006, 2013). The thematic analysis process consisted of six phases: Familiarizing yourself with the data, Generating initial codes, Searching for themes, Reviewing themes, Defining and naming themes, and Producing the report (Braun & Clarke, 2006, 2013). A coding scheme was developed from all reports to categorize themes related to GCE, including environmental awareness, cultural sensitivity, social responsibility, and digital literacy. Each student project report was examined based on its title, abstract, and keywords. The title, keywords, and abstract were analyzed to identify the alignment of the projects with these themes. The codes were then grouped into themes according to the presence of these global citizenship dimensions.

3.4 Data Analysis

The analysis was conducted using R for text analysis and categorization (R Core Team, 2021). It involved a systematic review of each project report to identify the presence of global citizenship themes. The reports were manually coded to ensure consistency and accuracy in theme categorization. Patterns and trends across the dataset were analyzed to determine how constructionist environments foster specific GCE.

4. Results

The analysis of the student PBL reports revealed significant insights into how constructionist learning environments contribute to the development of GCE. Through thematic analysis of the project titles, abstracts, and keywords of 177 project reports, 150 representative phrases (codes) that best capture the essence of the excerpts were identified (see Table 2). From these 150 codes, four distinct themes were developed: Environmental Sustainability, Technological Innovation, Social Responsibility, and Cultural Awareness (see Figure 2).

#	Code	Theme
1	Reforestation Efforts, Climate Change Mitigation, Smart Farming System, Electric Bike Modification, Portable Air Purifier, Rain Cloud Creation, Agricultural RC Plane, Trash Can Design, Plastic Extrusion Machine, UAV Launch Systems, Sustainable Car Design, Wastewater Treatment, Sustainable Office Design, Modular Vehicle Design	Environmental Sustainability
2	Smart Air Purifier, Autonomous Delivery Robot, International Robotic Competition, Industrial Process Optimization, Fruit Sorting System, Soft Robotic Gripper, Line Following Robot, Rescue Robot Development, Cargo Delivery Robots, RC Plane Construction, Aircraft Stabilization, Robotic Arm Control, LED Matrix Control, Animatronic Robot Development, Web Development Skills, Cold Air Intake Design, PID Control Robot, Knowledge Management Application, Book Lending Application, Plant Tissue Study, Bio-cellulose Production, Insomnia Alleviation Device, Avian Anatomy Drawing, Natural Perfume Development, Evolutionary Study, Cross-Species Medicine, 3D Printed Masks, Animation Emotion, Jewelry Making, Production Internship, Scene Design, Film Editing, Special Effects Makeup, Stage Lighting Design, Facial Equipment Design	Technological Innovation
3	Stroke Patient Assistance, Stroke Animation, Depression Documentary, Health Awareness Comic, Exercise Application, Board Game Design, Research Methodology, Tutoring Application, Unity and Teamwork Game, Mathematical Skills Game, Global Warming Awareness, Gluten Test Kit, Antimicrobial Activity, Steam Distillation, Clothing Donation Application, Remembrance Application, Elderly Product Design, Healthy Snack Development, Protein Cookie Marketing, Taco Development, Chocolate Gift Box, Prop and Scene Design, Graphic Design, Actor and Cameraman, Movie Fundraising, Souvenir Creation, PR Management, Financial Management, Premium Product Design, Actor Management, Cameraman Role, Strategic Planning, Costume Design, Script Development, Event Management, Content Creation, Short Film Creation, Novel Writing, Art Block Vlog	Social Responsibility
4	Automotive Heritage Preservation, Jewelry Advertising, Customer Analysis Techniques, Freshness Tracker, Service Design, Video Promotion, Microfinance Model, Clothing Upcycling, Packaging Design, Diet Culture Study, Cookbook Writing, Taiwanese Nougat Making, Matcha Cookie Development, Spaghetti Bolognese Cooking, Greek Yogurt Production, Tart Making, Japanese Cheesecake, Fried Banana Making, Keychain Making, Urban Planning, Digital Painting, Mythical Creatures, Guide Book Creation, Photo Book Production, Traditional Thai Art, Clay Keychains, Sign Language Media, Tea Packaging Design, Community Video Promotion, Logo Design, Earring Design, Garment Upcycling, Manga Creation, Vocabulary Retention, Acrylic Painting, Website Revamping, Product Design for Disabled, Crochet Yarn Bags	Cultural Awareness

Table 2: Themes and Codes from Data Analysis.

4.1 Environmental Sustainability

This theme includes projects that focus on promoting sustainable practices and addressing environmental challenges. The projects under this theme aim to mitigate climate change, enhance reforestation efforts, and develop eco-friendly technologies.

They emphasize the importance of incorporating environmentally friendly practices across various areas of life to create a healthier and more sustainable future. For instance, a few abstracts from the reports are presented as follows:

> *"This project emphasizes the application of Micro:bit technology and IoT systems to develop a smart farming system aimed at efficient and sustainable agriculture."* – Abstract from Project: Micro:bit Smart Farming Assistant

> *"Reforestation is vital for mitigating deforestation and climate change impacts. This abstract explores using remote-controlled (RC) planes to revolutionize reforestation efforts."* – Abstract from Project: Development of RC JAS-39 Seeding Plane

> *"Inspired to modify the bike to be an electric bike to make it comfortable to travel. To be part of reducing the use of cars to solve traffic jams and the environment"* – Abstract Project Title: Tranformation of the BMX Bike into Electric Drive.

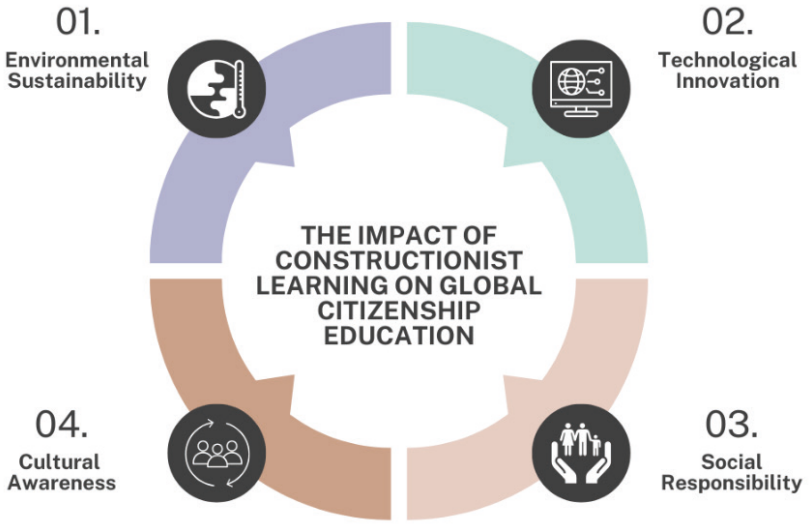

Figure 2: Four Distinctly Developed Themes.

4.2 Technological Innovation

This theme consists of projects that utilize advanced technologies to solve complex problems and improve efficiency. The projects range from developing smart air purifiers and autonomous delivery robots to participating in international robotics competitions and optimizing industrial processes. These projects demonstrate the potential of technological innovation to drive progress and create solutions that enhance productivity, safety, and convenience. The projects also emphasize the importance of continuous learning and adaptation in the rapidly evolving technological environment. For instance, a few abstracts from the reports are stated as follows:

> *"This project aims to develop a smart air purifier using three main different tools: microcontroller NodeMCU ESP8266, ArduinoIDE program, and sensor PMS7003 to detect the dust in the air and control working of a fan."* – Abstract from Project: Smart Air Purifier

> *"An autonomous delivery robot designed to address traffic congestion, carbon emissions, and high delivery expenses. The robot promotes customer satisfaction and reduces the environmental impact of logistics operations."* – Abstract from Project: Autonomous Delivery Robot

> *"The project study on making a sorting machine by using image processing is intended to test the use of our innovations. To develop an automatic and intelligent Thai fruit sorting system."* – Abstract from Project: The Development of an Image Processing Project for Sorting Object by Color

4.3 Social Responsibility

Projects under this theme focus on addressing social issues and promoting the well-being of communities. For instance, these projects include developing applications to assist stroke patients, creating educational board games to raise awareness of health issues, and producing documentaries to highlight mental health challenges, among others. All projects aim to foster a sense of social responsibility in students by encouraging them to develop solutions that benefit society. By addressing real-world problems, these projects contribute to the development of empathetic and socially conscious individuals. For instance, a few abstracts from the reports are presented as follows:

> *"Stroke is the second leading cause of death in Thailand, with 36,214 patients dying in 2021, according to the Ministry of Public Health."* – Abstract from Project: Developing an application to Minimize Decision Delays in Ensuring Timely Stroke Patient Transport to Hospitals

> *"This academic report endeavors to delve into the realm of Ischemic Stroke and present crucial information in a visually engaging format through comic cartoons."* – Abstract from Project: Comic Stroke of Awareness: Contest Edition

> *"This project aims to learn about depression and to produce a video explaining information about depression to help people who are suffering from depression or have a risk of depression."* – Abstract from Project: Understanding Depression: A Documentary on Depression Causes

4.4 Cultural Awareness

This theme highlights projects that promote cultural understanding and appreciation. For instance, the projects include restoring classic vehicles to preserve automotive heritage, designing 3D jewellery advertisements, and creating video content to promote local communities. These projects emphasize the importance of cultural awareness in fostering a sense of identity and belonging. By exploring and celebrating diverse cultural practices, students develop a deeper understanding of their own culture as well as the cultures of others, promoting inclusivity and respect. For instance, a few abstracts from the reports are presented as follows:

> *"This project aims to use the power of videos to bring the people of Bangmod together, engage the community, and celebrate its rich cultural heritage."* – Abstract from Project: Promoting Bangmod Community through Videos

> *"To study the lacquer and gilding technique, a traditional Thai art form, preparations were made. It is also crucial to learn how to cooperate with classmates and produce a work of art inspired by traditional Thai art."* – Abstract from Project: Artisanal Accessories

> *"Teach sign language with a short duration of 3-5 minutes in order to prevent viewers from getting bored. Everything must be done quickly and excitingly at all times."* – Abstract from Project: Sign Language

5. Discussion

The findings of this study demonstrate the potential of constructionist learning environments to foster GCE among K–12 students. The analysis of PBL reports revealed common themes aligned with GCE, including Environmental Sustainability, Technological Innovation, Social Responsibility, and Cultural Awareness. These findings emphasize the transformative potential of constructionist approaches in cultivating the skills required to address complex global challenges.

5.1 Environmental Sustainability

The theme of environmental sustainability is central to the literature, emphasizing the critical role of education in fostering GCE that promotes sustainable practices. The reviewed studies emphasize the importance of integrating environmental responsibility into GCE, encouraging students to take responsible actions toward protecting the environment. For instance, the concept put forward by Goodale et al. (2024) highlights the need for individuals to understand their role within global ecological systems and to engage in actions that address pressing socio-ecological issues. This aligns with the projects identified in the current study, such as the development of smart farming systems using IoT technology and the modification of bicycles into electric bikes to reduce car usage. These projects demonstrate how constructionist learning environments can effectively foster environmental sustainability among K-12 students by providing hands-on experiences that connect local actions to global ecological health.

5.2 Technological Innovation

Technological innovation is another key theme in the literature, highlighting the potential of advanced technologies to address complex global challenges. The reviewed studies emphasize the importance of developing competencies in technological innovation as part of GCE. For example, the integration of smart technologies in environmental and social projects is seen as a way to enhance problem-solving skills and promote sustainable development (Akkari & Maleq, 2020). This is reflected in the projects identified in the current study, such as the development of smart air purifiers and autonomous delivery robots. These projects illustrate how constructionist learning environments can foster technological innovation by providing students with opportunities to engage in hands-on, technology-driven projects that address real-world problems.

5.3 Social Responsibility

The theme of social responsibility is central to the concept of GCE, as highlighted in the literature. Studies emphasize the need for education to cultivate a sense of responsibility toward addressing social issues and promoting the well-being of communities. This includes developing competencies such as empathy, critical thinking, and ethical engagement (Akkari & Maleq, 2020). The projects identified in this study—for instance, developing applications to assist stroke patients, creating educational board games to raise awareness about health issues, and producing documentaries to highlight mental health challenges—align with this theme. These projects illustrate how constructionist learning environments can foster social responsibility by encouraging students to develop solutions that benefit society and address real-world problems.

5.4 Cultural Awareness

Cultural awareness is a key dimension of global citizenship, as it fosters respect for diversity and promotes intercultural understanding. The literature emphasizes the importance of developing cultural awareness through education, highlighting how it can lead to more inclusive and harmonious societies (Handa, 2018). The projects identified in this article, such as restoring classic vehicles to preserve automotive heritage, designing 3D jewelry advertisements, and creating video content to promote local communities, reflect this theme. These projects illustrate how constructionist learning environments can foster cultural awareness by providing students with opportunities to explore and celebrate diverse cultural practices, thereby promoting inclusivity and respect.

6. Conclusion

Overall, this study contributes to the growing body of research at the intersection of constructionism and GCE. The findings affirm that constructionist learning environments provide a powerful platform for students to develop critical thinking, collaboration, empathy, and environmental responsibility. By including constructionist teaching methods in K-12 curricula, educators and policymakers can create powerful learning experiences that help students become informed and caring global citizens.

Despite the promising results, this study also highlights areas for further exploration. While the findings demonstrate the potential of constructionist environments to foster global citizenship competencies, the lack of standardized methods for assessing these skills presents a challenge. Future research should focus on developing robust frameworks for evaluating the impact of constructionist learning on GCE (Yanniris, 2021). Additionally, while this study provides insights into K-12 settings, further studies are needed to explore how constructionist approaches can be scaled and adapted for diverse educational contexts (Schutte et al., 2017).

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