



Becoming a Globally Competent Educator: A Self-Study of My Theoretical and Practical Understandings of Global Competency

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Abstract: This self-study explored my theoretical and practical understandings of my role and responsibilities regarding preparing future science educators who are globally competent. Specifically, I focused on how I changed my approach to teaching and addressing global competencies during science instruction as a science teacher educator. Using grounded theory, open coding, and the constant comparison method allowed for a comprehensive and rigorous data analysis, including journal entries, critical friend meetings, concept maps, and student artifacts. The findings of the study underscore a transformative shift in my journey toward becoming a globally competent instructor as I strived to cultivate global competence in my students. The findings and subsequent implications inform the field of science education regarding teacher educators' role in preparing teachers to be critical change agents.

Keywords: global competence, self-study, teacher preparation, science education

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Introduction

Global competence is a multidimensional construct that requires a combination of knowledge, skills, attitudes, and values successfully applied to global issues or intercultural situations (PISA, 2018). Many of the pressing global issues of the 21st century are scientifically based. Such issues as climate change, pollution, and pandemics often traverse international boundaries regarding their cause and effect. Even though the discussion of global competence and the skills to survive in a globalized future is ever-increasing, the teaching and learning in the K-12 science classroom rarely reflect science's multidimensional and multinational aspects.

Scientific issues affecting multiple nations necessitate scientists forming international research teams to understand how they define research problems and their solutions differently. The number of scientific publications with international co-authors increased from 18.6% in 2011 to 23.5% in 2019 (*UNESCO Science Report*, 2021). These numbers reveal increased cooperation and collaboration between the scientific communities in different parts of the world.

It is not just the scientific community that is involved in such collaborations. Universities and large corporations are internationalizing their research, creating a demand for a globally competent STEM workforce. With the rapid growth of information technology, the time and cost of traveling are significantly reduced, creating more opportunities for collaborative work. Understanding the true nature of a globalized science impacts people's ability to engage in an increasingly scientific and interconnected world. Without such international connectedness, our efforts would be fragmented, isolated, and not so innovative.

This illustrates the need to increase the quantity and enhance the quality of science education efforts to prepare students to thrive in an interconnected, interdependent, and complex world. Unfortunately, the science teaching

approaches do not adequately prepare globally competent citizens, and change is necessary (Bencze, et al., 2013; DeBoer, 2011). By their very nature, such changes will require a different approach to teaching than many of our future educators have experienced. As teachers must play an essential role in enacting the curriculum while addressing the unique needs of students, high-quality professional preparation, which includes learning within such approaches, is necessary (Russell & Martin, 2023).

Given an understanding that teachers teach as they are taught, not as they are taught to teach (Blume, 1971), the science education program within my department has prioritized the practice of intentionally displaying an expected pedagogical behavior for the preservice teachers to experience and reflect on (Lunenberg et al., 2007). This is the grounding for the two science content courses taught within the department. Considering this and our increasingly globalized world, I sought to intentionally display global competence in my instruction for future teachers. However, I quickly found myself pulled up short. This occurred in an early conversation with the course coordinator, where I failed to answer the question, “How would I need to change to become a globally competent instructor.” I am an ardent believer in internationalizing science education, but this question made me realize my inadequacy in translating my theoretical knowledge into action. This research was propelled by the understanding that there are “shortcomings in [our] work and the gaps between [our] rhetoric and the reality of [our] practice” (Zeichner, 1999, p.12).

The purpose of this self-study was to deepen my understanding of how I, as a science teacher educator, could intentionally display global competence in my science instruction. My research effort was guided by the question: What does it mean to be a globally competent teacher of science in the context of a science content course for undergraduate preservice teachers?

Initial Theoretical Understandings

The Importance of Addressing Global Competencies in Science Education

Recent developments in Artificial Intelligence, DNA sequencing, renewable energy, and biotechnology have led to the understanding that scientific advancements and breakthroughs are not confined to a single country but shared across borders. The United Nations report (2020) titled 'The Next Frontier: Human Development and the Anthropocene' explores the concept of the Anthropocene era and its impact on human development. It discusses the challenges posed by environmental degradation, climate change, and biodiversity loss within the context of human well-being. The report emphasizes the need for a holistic and sustainable approach to development, highlighting the interconnectedness of environmental and social issues. To face the challenges posed by a novel and scientifically interrelated world, our children must attain a high level of science literacy. Science literacy inculcates awareness of socio-scientific issues and nature to critically evaluate future scientific developments (Bencze & Carter, 2011).

The purpose of science education in the 21st century is not to create knowledge consumers but to make informed decisions on science. Students should be equipped to take an active role in societal issues concerning science (Hodson, 2010). Rather than mere knowledge acquisition, they should use their scientific knowledge to

address societal changes and embark on positive changes. Rather than a transmissive vision, scientific literacy should hold a transformative vision characterized by participation and socio-scientific activism (Bencze, 2017). The vision-III of scientific literacy leads to a scientific commitment and participation aligned with equity and social justice (Valladares, 2021). Science education for the 21st century should aim towards social activism.

At the heart of this concept lies the need to utilize a global competence approach in science education. Boix-Mansilla and Jackson (2023) defines global competence as “the capacity to examine local, global and intercultural issues; understand and appreciate the perspectives and worldviews of others; engage in open, appropriate and effective interactions with people from different cultures; and act for collective wellbeing and sustainable development” (p. 5). Global competence in science is the capacity of students to engage with complex global challenges and opportunities through the lens of science. It entails interdisciplinary and global perspectives, problem-based learning, and scientific investigation founded on existing research (Asia Society, n.d.). It empowers students to investigate intricate biological, chemical, physical, environmental, and human systems, fostering the ability to consider diverse viewpoints, communicate effectively on scientific matters with global audiences, and translate their scientific insights into actions that impact local communities and the world. Global Competence equips students to think like scientists, encouraging them to question established scientific understanding, engage with scientists worldwide, and collaborate on solutions to global issues while evaluating the consequences and ethical, legal, and social implications of scientific progress

Implementing Global Competence Approach in Science Instruction

The efforts in cultivating a global competence approach to education are primarily explored in social studies and foreign language concepts (Byram et al., 2013; Crawford et al., 2020; Majewska, 2023; Merryfield, 2012). The studies that inculcate a global perspective in content areas like math and science are much less explored (Tichnor Wagner et al., 2019; Rahman, Liu & Buck, 2023). Science education is characterized as a recall-based education (Osborne, 2013), and that poses the primary challenge of incorporating global perspectives into instruction. From the literature I found, I have elucidated different approaches teachers in these studies used to integrate global competence into science instruction.

One prominent way utilized is to incorporate global topics within classroom boundaries to encourage students to collaborate on global issues (Kerckhoff & Cloud, 2020; Nugent et al., 2015; Smith, 2021; Tichnor-Wagner et al., 2016). This involved exposing students to diverse global perspectives in order to instill globally competent skills. One such way to expand students’ definition of cultural relevance is by incorporating the intersection of national, racial, and ethnic identities into science education. This involved exposing students to scientists from diverse backgrounds, fostering a global consciousness. To better cater to the diverse backgrounds of their students, science teachers moved away from Western-centric education models and emphasized inclusivity and global perspectives (Kerckhoff & Cloud, 2020).

The two prevalent methodologies teachers utilize to incorporate global competency into science instruction are integrating global content into existing curricular activity and aligning global teaching with desired pedagogical

approaches (Kherkhoff & Cloud, 2020; Reiss, 2016; Tichnor-Wagner et al., 2016). A specific example is how teachers incorporated global learning by integrating global perspectives into studying energy-related environmental issues and how teachers utilized web quests and provided students with articles and videos about natural disasters worldwide (Kherkhoff & Cloud, 2020; Tichnor-Wagner et al., 2016). Teachers connected the curriculum to real-world experiences by addressing global issues like pollution. Through an interdisciplinary approach, students reflected on their own lunch habits, creating trash-free lunch boxes showcasing a genuine understanding of the global impact of individual actions (Tichnor-Wagner et al., 2016). Reis (2014), with his students from secondary science methods course in a teacher preparation program, created a list of a list of global issues drawing on ideas presented in Agenda 21 and the United Nations Millenium Development Goals to instill a global perspective on the science curriculum. These lessons extended beyond science standards, fostering a sense of global citizenship and an understanding of the interconnectedness of scientific principles with global issues.

Boix-Mansilla and Chua (2017) suggest signature pedagogies in global competence, which are teaching practices that nurture students' capacities and dispositions to act on issues of global significance. They illustrate an example where they have utilized the signature pedagogy of purposeful comparison, which aims to nurture global competence among students by guiding them to investigate the comparative effect of climate-induced sea level rise in coastal communities of New York and Cape Town. By analyzing the similarities and differences in the effect of sea level rising in two distant lands, students learn how a single phenomenon can have varied consequences across different regions.

Online platforms like scistarter.org empower teachers to engage students in collaborative projects worldwide (Nugent et al., 2015). The Global Learning and Observations to Benefit the Environment (GLOBE) project further exemplifies the potential for international collaboration involving K-12 students from over 120 countries in studying environmental parameters (Smith, 2021). The World MOON Project, as described by Smith (2021), exemplifies cooperation on a global scale. Students observe the Moon, share their findings internationally, and collectively identify and explain patterns. This collaborative process, though independent, signifies a shared global endeavor in understanding natural phenomena.

Even though such Collaboration-based global classrooms (CBGC) are helpful for incorporating global competence in science instruction, pre-service teachers in a study by York & Hite (2021) demonstrated low intentions to implement this pedagogy in their future teaching practices. A significant challenge identified was the struggle to connect CBGC with the specific math and science content they are required to teach. None of the participants in the study felt entirely confident in their ability to design and implement global collaborations, indicating a lack of self-efficacy and the need to provide additional support and resources for teacher preparations.

In conclusion, science teachers are adopting innovative approaches to infuse global perspectives into their instruction. Challenges such as the need for relevance and perceived self-efficacy highlight areas for improvement. To envision a globally competent future science teacher population, teacher preparation programs

need to evolve and integrate these changes into both their science content and method courses. According to the report published by Longview Foundation, a globally competent teacher should have the knowledge of the international dimensions of their subject matter and a range of global issues, pedagogical skills to teach their students to analyze primary sources from around the world, appreciate multiple points of view and recognize stereotyping, a commitment to assisting students to become responsible citizens both of the world and their communities (Longview foundation, 2008). A globally competent teacher should possess a different orientation toward science teaching. This study represents my journey towards becoming a globally competent instructor by employing instructional approaches that instill global competence in the pre-service teachers taught in the science content course.

Global competence is a difficult concept to incorporate without explicit guidance for integration, and pre-service teachers need to be trained to effectively showcase global competence (Fergusson Patrick et al., 2014; Parkhouse et al., 2015). Taking this as motivation, this study incorporates a global competence approach into mainstream physical science instruction that pre-service teachers are expected to teach in K-12 classrooms. Most of the studies that have been conducted on incorporating global perspectives in teacher preparation programs have been conducted in the social sciences (Reidel & Draper, 2013; Zong, 2022). This study addresses the research gap by conducting a study where the author examines the self while incorporating global competence approaches in science instruction.

Methods

Self-Study Approach

Grounded on social constructivist theory (Vygotsky, 1978), the perception of self is derived from thoughtful reflection on interactions through communication between oneself and others from the culturally formed social setting. The central goal of reflective thinking in teacher education is to develop teachers' reasoning about why they employ specific instructional strategies and how they can improve their teaching to affect students positively (Dewey, 1929). Through this study, I aimed to understand what constitutes globally competent skills by reflecting on my instructional strategies to create a globally competent classroom. It was a process of transforming myself into a globally competent teacher while attempting to transform my students into one.

Self-study enables us to explore our theories and practice systematically. According to the Self Study of Teaching and Teacher Education Practices Research (S-STTEP), the "self in the self-study is the one who is enacting the practice with others, and it is the same self who is doing the study and is in practice" (Pinnegar & Hamilton, 2009, pg.12). Through this self-study, I aimed to reflect on the actions I employed and challenged my previously held assumptions to create a globally competent instructional strategy (Schon, 1983). In this process, I assumed two roles - one that of a researcher and the one that of being researched. Challenging those assumptions results in a deeper understanding of my ideas and connects me more to my central mission as a teacher (Korthagen, 2001). At each stage of the self-study, I consistently reflect on whether my practice is consistent with my ever-evolving ideals and theoretical standpoint. After all, "Practicing what I preach" is this self-study research's inherent guide and motive (LaBoskey, 2004, p.819).

This self-study utilized the S-STTEP methodology that used components like provocation, exploration, refinement, focus identification, study design, reconsideration process, ethical action, and presentation to guide this research study (Pinnegar & Hamilton, 2009). As mentioned earlier, this study was provoked by my inadequacy in translating my theoretical knowledge about global competence into practical steps while teaching science. Later, I explored the literature in the area to find studies that have utilized the global competence approach in science instruction. As I proceeded, my ideas got refined, and the focus of the study was to understand how I transformed myself to be a globally competent teacher of science. Once we had identified the focus of the study, we carefully selected the data collection and analysis methods that could help us better understand the research question. This is further explained in the following sections. We went back and forth with our collected data to ensure the evidence provided in the study represented the research we had undertaken. Throughout this study, we have made it a priority to demonstrate and integrate principles of integrity and trustworthiness, ensuring that our methods and findings are transparent and reliable.

Context and Participants

Exercising critical reflectivity is crucial for qualitative researchers aiming to decolonize their research methodologies (Thambinathan & Kinsella, 2021). This involves thoroughly examining the researcher's role and a heightened awareness of power dynamics within the research process. In addressing my positionality throughout this study (Reagan, 2000), I aim to make explicit the specific perspectives from which I conducted this work, allowing readers to recognize potential biases. Having been born and raised in India, a country often classified as part of the Global South or the developing world, and having refined my research skills in the United States, typically considered part of the Global North or the developed world, my perspective is shaped by these complex dynamics. My stance against colonial power reflects a vision for a more just world where both the Global South and Global North coexist peacefully. Rather than aligning myself with any nationalistic ideology, I identify as a researcher for humanity without borders. For me, global competence is not a domination of one part of the globe over another; rather, it signifies a collaborative effort by humanity to fight the global issues we face. As a self-study, I am the primary participant in this study. My educational background includes an undergraduate and master's degree in chemistry. While attaining my doctoral degree in science education, I teach undergraduate science courses to pre-service teachers. I adhere to a constructivist ontological stance, believing that reality is constructed through social processes and interaction (Vygotsky, 1978)

The secondary participants in this study included a professor of science education who served as my critical friend (CF) in this journey. Since self-study researchers are the study's actors and spectators, they require good judges to help them question their ideas. Schuck (2002) emphasized the necessity of having checkpoints in self-study research to assist with the interpretation of data. A critical friend is vital to this study, providing continuous feedback and suggestions. The reflective meeting with a critical friend aided me in uncovering my assumptions, challenging those assumptions, questioning their significance, and suggesting alternative explanations that led me to dig deeper into my thought process (Loughran, 2007; LaBoskey, 2004). This resulted in the revelation of study elements that would not have been possible without the help of a critical friend. The other secondary participants, the preservice teachers, were from my two sections (N=23 and N=22)

of the course. Most pre-service teachers in this course were freshmen and sophomores. Among the 45 students, the majority were female, with only six males. The predominant ethnicity was White, with the cohort also including one Latino and two Black American students. They contributed to my evolving understanding through their responses during classroom activities and homework submissions.

The context for this study included two sections of a science content course for preservice science teachers offered at a public university in the midwestern part of the United States. The course was titled “STEM For Educators,” and its objective was to develop students understanding of science, technology, and engineering with related coverage of mathematics in an integrated fashion that adheres to the National Science Education Standards. This 1.75 hour/two times a week course is heavily activity-based and includes hands-on science activities.

Data Collection

This study employed the framework of self-study developed by Allender and Manke (2004), which emphasized the importance of having multiple checkpoints in self-study research. It is essential to have numerous checkpoints for establishing claims, appraising evidence, and reconstructing claims based on emerging evidence. A self-study researcher must be challenged with their ideas and theories, which requires continuous monitoring and improvement. Critical friend meetings (CFM) were the platform where my progress was continuously monitored, and naïve notions were uncovered.

Multiple data sources were used to understand the complexities of the process. The primary data sources included the transcriptions of the critical friend meetings, personal journal entries, and concept maps. Critical friend meetings happened regularly during six months of study (Shuck and Russell, 2005). Thirteen 35-60 minutes of critical friend meetings occurred throughout the study. During these meetings, I discussed my plan for the next week, shared my newfound understanding, and my reflection on the activities. Data was also collected from course documents to analyze student responses based on my instructional strategies.

During this study, a research journal was maintained to capture the reflection-in-action (while doing the task) as well as the reflection-on-action (after the task) (Schon, 1983). These journal entries reflected my expectations of the outcomes, the resultant outcome of my actions, and my reflection on the entire process. In addition to the journal entry, six concept maps on global competency were created during this study. These concept maps reflected my thoughts on global competency and how it changed during this process.

Data Analysis

This study utilized a grounded theory approach to data analysis. Grounded theory emphasizes the development of theory from data, allowing for the emergence of new insights and perspectives (Charmaz, 2014). Specifically, an open coding technique was used to break down my critical friend conversations and journal entries to identify similarities and differences in the words used and thoughts/ideas expressed. Through this process, various themes and categories were identified. The constant comparison method by Corbin and Strauss (1990)

was employed to explore these themes and categories further. This method systematically compares data within and across categories to uncover patterns and variations. As new ideas emerged throughout the study, new categories and themes were created. Using grounded theory, open coding, and constant comparison allowed for a comprehensive and rigorous data analysis.

Findings

The outcomes of this self-study were categorized into four overarching themes. The findings are presented in a narrative format that unfolds the epiphanies and realizations experienced in this journey. Epiphany is understood as a sudden moment of clarity/ enlightenment, whereas realization refers to a gradual moment of awareness.

Global Competency is not synonymous with multicultural or inclusive education.

During this study, the disorienting dilemma (Mezirow, 2000) I experienced was the multitude of definitions of global competence found in existing literature and which one to choose from (Engel et al., 2019). In my first critical friend meeting (CFM), when my CF asked me my ideas on global competence and why science needs to be global, I articulated my thoughts as follows.

“And I don't think science is something very local. And it is a very real phenomenon happening, which is taught in multicultural ways in different places. But still, I think they, and I do not expect all the students here to stay in the United States for their entire life, they would be moving to many countries, and many can because it is very connected at this point and going somewhere else. And so, in that case, global competence in teaching science becomes important.”

(26 October, 2022)

This conversation illustrates how I experienced confusion while stating global competence in science education. I struggled to situate the need for global competence in science education. I was confusing it with multicultural and inclusive education. After the critical friend meeting, I journaled.

“I thought I talked about global competency, but after the meeting with CF, I realize it is not. Then what is this, which people refer to as global competency”?

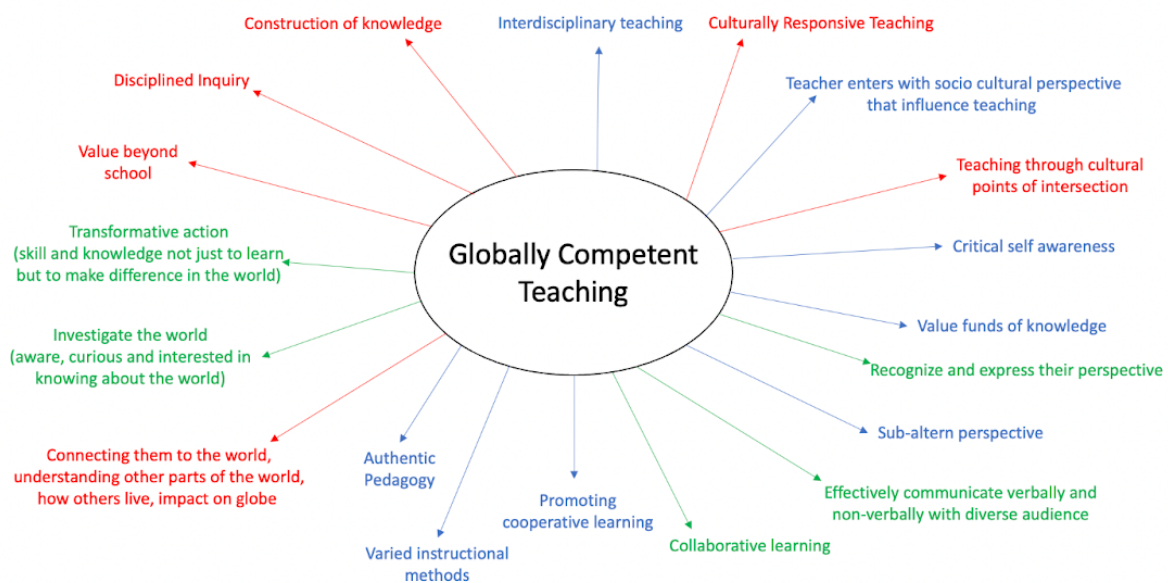
(27 October 2022)

The journal entry during this time suggests a feeling of “confusion” and a “perplexed” state. It was when my CF pointed out the skills I wrote (blue coloured in Figure 1) and told me it referred to inclusive and multicultural education that I acknowledged the confusion. Even though I talked about nations and the globe, the skills I wrote down did not reflect the connection to global science. This led to the first realization of my self-study that global competence is not synonymous with multicultural or inclusive education. This cognitive conflict left me unsettled and triggered me to explore it further. My entire focus during this time shifted to finding the skills that constitute global competence and moving ahead from the concept of multicultural and inclusive education. By conducting a literature study, I realized confusion on defining global competence exists among teachers, and they often relate it to similar constructs like intercultural competence, internationalization, and multicultural education (Hall & Hite, 2022; Parmigiani et al., 2023; Tamerat, 2020). A unanimous definition of global competence is still not agreed upon (Salzar & Roczen, 2018), which places educators in a definitional ambiguity. The lack of a standardized definition becomes apparent in professional development settings, where

varied interpretations hinder a cohesive understanding among educators, leading to challenges in incorporating global competence into classroom instruction (Hall & Hite, 2022). Teachers express confusion about what constitutes global education, some associating it solely with international travel, while others emphasize its broader implications (Siczek & Engel, 2019). They also used global competence interchangeably with cultural competence, suggesting a lack of understanding (Tamerat, 2020). The absence of a clear understanding and concrete examples of global competence hinders teachers from effectively implementing it in their teaching practices. According to Banks (2004), multiculturalism falls in stage 5 of the “stages of cultural development typology,” and global competency falls in stage 6. Multiculturalism lies more closely with the issues of race and class dealing with equitable education opportunities. In contrast, global competency mainly deals with an international perspective and how individuals function effectively in the global community. Thus, global competency and multicultural education are not synonymous, but multicultural education leads to the path of global competency. Throughout this study, I decided to stick with the definition of global competence provided by Boix-Mansilla & Jackson (2013), which states, “Global competence is the capacity and dispositions to understand and act on issues of global significance” (p. 2).

Figure 1

Globally Competent Skills



Global competence constitutes a set of skills that must be meaningfully integrated to establish a globally competent classroom.

I started this self-study in early October by reading through the literature and identifying the skills that constitute global competence. Reading relevant literature before starting a research study is crucial for situating your area of interest within the existing knowledge and enhancing your understanding of the topic (Webster & Watson, 2002). Structural representation tools like concept maps were utilized during this self-study to represent

the knowledge and understanding gained. Concept maps help to capture the interconnectedness and visually represent the relationship between various concepts, thus facilitating a better understanding (Novak & Cañas, 2007).

The first concept map I created had skills that primarily reflect multicultural education (colored blue in Figure 1). After realizing the confusion, I possess between multicultural education and global competence, my focus shifted to identifying skills that define global competency and moving away from multicultural and inclusive education. These skills are colored in red. Later, I pondered this thought even more and added additional skills, colored in green (Figure 1).

At this point, I was confident about the skills I listed and started to make little track changes to the activities conducted in the Q205 classroom to internationalize teaching science. I took one skill at a time and designed activities based on that skill. Little Post-it notes noting the specific activities were attached to the various skills (Figure 2).

Figure 2

Representation of Activities Corresponding to Each Skill



While assigning each activity to a skill, I had an epiphany: many concept map terms looked similar. This made me realize that the board's global competent skills could be grouped into broader categories. My CF acknowledged my thoughts on grouping the terms during Critical Friends Meeting 5. Together, we grouped the skills into more general categories (Figure 3). The rationale behind the grouping is provided in Table 1.

Figure 3

Grouping the Skills into Broader Categories

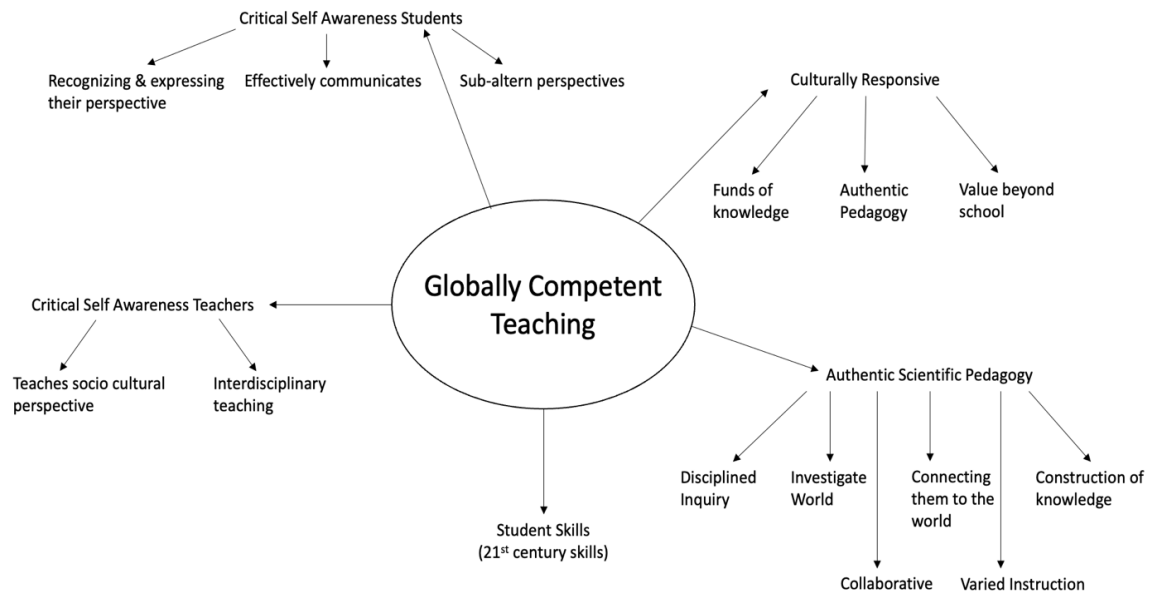


Table 1

Grouping Skills to Broader Terms

Broader Category	Explanation
Authentic Scientific Pedagogy	To have an authentic scientific pedagogy, there should be disciplined inquiry, collaborative learning, connection to the world, and investigating of the world. This is implemented through varied instruction and knowledge construction
Cultural Responsive Teaching	Valuing students’ funds of knowledge. Authentic pedagogy emphasizes activating and leveraging students’ prior knowledge for meaningful learning, which leads to a culturally responsive approach to learning that validates students’ cultural perspectives.
Critical Self-awareness of Teachers	Teachers’ critical self-awareness would include their socio-cultural perspective. It plays a crucial role in facilitating interdisciplinary teaching.
Critical Self-Awareness of Students	Providing opportunities for students to communicate, recognize, and explore their perspectives effectively and possess subaltern perspectives, which involves reflecting on one’s identity, beliefs, and experiences and acknowledging the existence of multiple narratives and perspectives.
21st-century skills	Developing student’s 21st-century skills.

After grouping the skills into broader categories, I connected each activity to the broader skillset. This marked the exploration phase of my transformation (Mezirow, 2000). I was engaged in research to expand my understanding of each skill category by developing activities and delivering them in my classroom. Each skill on the concept map had an action associated with it to enhance a student's ability in that skill. Several activities

were designed to build various skills in students. The Marshmallow Challenge was utilized to develop collaborative skills, while sharing the science behind their winter break activities connected science content to their funds of knowledge. To enhance creativity, students worked in groups to define terms like distance, velocity, acceleration, and deceleration based on their activities without using standard definitions. Additionally, they analyzed food labels to associate everyday foods with elements in the periodic table. Hands-on activities/experiential nature of education increases students' understanding of science concepts by providing concrete experiences (Meichtry, 1992)

During this phase, I sought out how each activity delivered a specific skill set to the students and its effects on them. However, during CFM 7, 8, and 9, my CF noted that I was using a checklist to measure global competence, and the curriculum was not yet globalized. She challenged my thoughts by pointing out that I focused on specific skills, not global competence. This conversation prompted me to design activities that meaningfully integrated the skills.

The next activity I designed for Newton's Laws of Motion unit was to create a comic strip based on real-world contexts addressing the laws of motion (Table 2). While planning this activity, I provided an opportunity for students to use 21st-century skills to connect science and global issues (e.g., volcanic eruption, glacial movement, rocket launching, nuclear eruption) and a venue for them to share their funds of knowledge. I integrated multiple skills in global competence by providing students an opportunity to be collaboratively involved in a project where they investigated global phenomena. Moreover, while designing this activity, I realized there needs to be more integration among the skills to make it globally competent teaching.

Table 2

Comic Strip on Newton's Laws of Motion

You and your partner are required to create a comic based on Newton's laws of motion. Choose any one of the contexts to create your comic strip.

1. Volcanic eruption.
 - a. Eruption of Hunga - Tonga - Hunga - Ha'apai
 - b. Eruption of Sakurajima volcano
2. Motion of glaciers
 - a. Muldrow Glacier
 - b. Antarctic Glaciers
3. Launching of the rocket
 - a. SSLV – D2
 - b. Soyuz MS-23
4. Explosion of the nuclear bomb.
 - a. Tsar Bomba Nuclear Bomb
 - b. Atomic bombings of Hiroshima and Nagasaki

Figure 4 depicts my new understanding of global competence with connections among the skills. To illustrate the interdependency of each skill, I used dotted lines. All the arrows in the new image go into the central circle, representing globally competent teaching. It is to clarify that all these skills constitute global competency, not independently. The focus shifted from the skills to the central circle, unlike Figure 1. This whole circle is what globally competent teaching means and depicts that skills must be meaningfully integrated.

I started creating more activities that integrate global competence skills and connect them to global issues (Table 3). Eventually, I became more confident about the way I teach, and my enthusiasm for designing new activities that incorporate global competence skills increased.

Figure 4

Final Concept Map

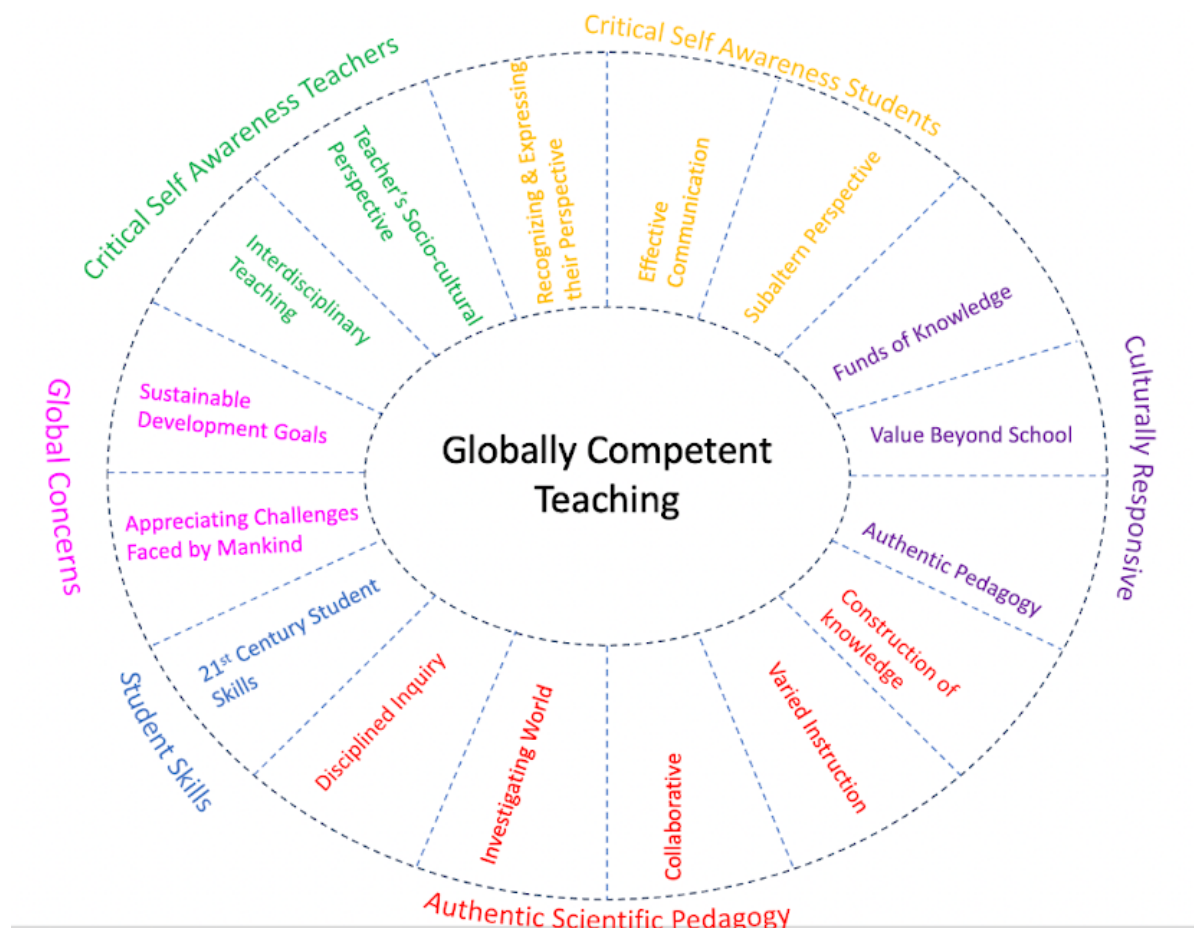


Table 3*Presentation on Renewable Sources of Energy*

The most popular renewable energy sources are solar energy, wind energy, hydro energy, tidal energy, geothermal energy, and biomass energy. Choose any one of the following –

- Solar energy – Bhadla Solar Park India, Benban Solar Park Egypt
- Wind energy – Jiuquan Wind Base China, Hornsea Wind Farm UK
- Tidal energy – Sihwa Tidal power Station South Korea, La Rance France
- Geothermal Energy - Larderello Geothermal Complex, Italy,
- Makban Geothermal Complex, Philippines

Also choose a source of renewable energy that you have seen in your home country or when you have travelled abroad. Make a presentation to educate your friends about energy conversions and how it relates to what we have studied in our class.

Your presentation should address the following: Why is it Important to use renewable sources of energy, explain Sustainable Development Goal 7, explain the renewable energy source you selected, explains what we have studied in class based on the context you selected, concluding thoughts/ slide

Using one global competency skill at a time in activities does not qualify me as a globally competent teacher.

To achieve my goal of demonstrating global competency in my science instruction, the first thing I did was to make changes in the activities conducted in the classroom to reflect the global competency. Table 4 represents a few activities I designed initially.

Table 4*Activities to Modify Unit 1*

1. Identify:
 - 5 metals and the countries that export those metals
 - 5 minerals that are required for our body and which natural products provide those minerals to our body.
 - Few elements from the periodic table that influence the recent effects of global warming. Find out which countries contribute to the majority of their production.
2. What is the reaction that happens when the CO₂ reacts with the ozone layer? And the impact of that.

After learning about my activities during CFM 3 (16 November 2022), my CF challenged my intentions and questioned my thinking on executing these activities in the classroom.

CF: "But I think, do you have your goals? Like what Global competencies are you connecting it? What are you hoping to effect it with your students?... you came up with cool activities. And so what are you hoping to affect with the students?.....You know what you want to do before you know what is leading you. "

16 November 2022

A qualified individual as a critical friend is helpful in a self-study process where they question your assumptions and help you reframe your perspective (LaBoskey, 2004). This conversation with my CF made me realize I lacked the connection to globally competent skills while designing the activity. Even though I created the activities, I could not articulate which global competent skills I connected these activities to. I knew what I wanted to do (the activities I designed) before I knew what was leading me (which skills I focused on while designing the activity).

This revelation prompted me to design activities that address each skill outlined on the concept map and necessitate the targeted application of these distinct skills. I started reading literature on each skill and how that skill helps in achieving global competency. Reading the literature, I tried to discover why these skills are crucial aspects of teaching global competence (Gutierrez, 2008, as cited in Tamerat, 2020, p.4). With the help of existing literature, I ascertained the goal of my activities. However, I unintentionally disregarded the primary essence of being a globally competent teacher, instead centering my attention solely on individual skills. At this point, I felt the most stalled in my growth. After CFM 8, I noted.

“I am the one who got connected with the funds of knowledge of these students, but they didn't have a connection.....Collaboration is a lot more complex than putting them in a group, and funds of knowledge are a lot more complex than asking them to write their experience.....When I was just exploring funds of knowledge, it didn't mean I was doing global competency; it meant I was doing funds of knowledge. Is it just using one of the skills from this lot of skills that make me a globally competent teacher? Just focusing on funds of knowledge does not make me a globally competent teacher.”

1st February 2023

The emotions I went through during this time were mostly frustration. I could not implement global competence even though I was exploring each of the skills. This led to the realization that using one skill at a time in activities does not qualify me as a globally competent teacher.

During CFM 9, I validated my thought process by conveying that I was trying to teach all the skills in the classroom so the students would perform in a way that is for the global good. However, one comment during the CFM 9 swiftly altered my perspective. My CF told me I was trying to prepare my students to be globally competent without doing any global competencies in my classroom. It was as if I was only giving them pieces and letting them figure out how to connect them to the bigger picture. My initial thought process was to provide students with all the skills associated with global competence with the expectation that they would practice globally competent teaching in the future. Later, I realized that If I only provided the skills that constitute globally competent teaching, they would never practice such teaching in their classroom. In a journal entry, I wrote,

“...I can feel I am thinking, and I am thinking deeply and reading.... Still, I felt everyone said global competency is essential, but no one discussed implementing it in a science classroom. No one told how to train teachers to deliver globally competent teaching. How can I make science globally competent? I am covering all the skills but still not doing globally competent teaching....”

I was devastated, frustrated, and irritated by myself for being unable to think through this.

I started designing activities that meaningfully integrated the skills. Instead of focusing on the traditional scientist-oriented curriculum, my focus was to sequence the presentation of the science content from the student's perspective (Aikenhead, 1992). To design such activities, I Googled the challenges faced by human beings in today's world. I perused essential news headlines and current affairs worldwide and searched for scientific advancement in the 21st century. The activities in Table 2 and Table 3 are the result of this attempt. This process expanded my knowledge base on global scientific issues. I thought through each and how to connect them to the science I was teaching in the classroom. I was trying to logically connect the context to the content I was teaching so that students understood the content better (Aikenhead, 1992). While connecting global concerns to classroom science, I thought about the skills teachers should utilize to translate it into the classroom. While brainstorming on relating activities to global issues, I realized that integrating and connecting these skills to implement global competence is a whole new skill. Moreover, that skill would make me a globally competent teacher.

The purpose of teaching science in a globally competent way is to improve students' understanding of science.

During a conversation with my CF, I was prompted to contemplate why science needs to be globalized, leading me to articulate the purpose of teaching science in a globally competent way for the very first time. This led to the first epiphany of my transformation process when I talked aloud about the purpose of globally competent teaching. For me, the purpose of teaching science in a globally competent way is to improve students' understanding of science.

During CFM 10 (22 March 2023), my CF suggested making my goal explicit to my students. A study by Akerson et al. (2000) revealed how an explicit reflective activity-based approach enhanced pre-service elementary teachers' views on science. An explicit reflective approach to instruction often facilitates an improvement in learning science content. So far, I have never shared with them; my goal is to teach science in a globalized manner and equip them to see how scientific content could be taught in a globalized way.

I was curious to know my student's responses to my study and whether they felt my approach was helpful. The happiness I possessed after sharing my goals with my students was evident from the journal entry on 28th March. This marked one of the happiest moments during this self-study. I noted.

“When one of the students said she did not like science because it was always about facts and did not connect to anything she knew. But now, she can connect with the things she has heard of, making learning science enjoyable. Even though she did not use the word global, I felt my efforts in globalizing the classroom piqued her interest in learning science.”

28 March 2023

Student responses piqued my interest, and I wanted to explore whether they started connecting the classroom's science content to global concerns without my prompt. While discussing a unit on heat energy, I gave them an activity where they had 10 minutes to discuss as a group and develop a presentation on global warming. Surprisingly, they connected global warming issues to different countries' socio-economic backgrounds without

any prompts. They observed that countries with lower socio-economic backgrounds lack adequate resources to combat its effects, while wealthier nations are the primary contributors to global warming. This led to the realization that through practice, students will naturally develop global competence in their thinking without needing external prompts.

Motivated by the positive response from my students, I designed a final project where I pushed students to integrate STEM using a globally competent approach. This activity integrated various disciplines we covered throughout the semester, including chemistry, physics, energy, technology, and engineering. In this activity, students were prompted to draw from their funds of knowledge, allowing them to perceive the significance of what they learn in school within real-life situations. They were encouraged to link the learned concepts to the pressing concerns of humanity, utilizing the framework of sustainable development goals. This collaborative project required effective communication during the final presentation, where students showcased their findings. Students needed to skillfully combine diverse skills, as depicted in image 4, to accomplish the activity successfully.

“This was the happiest class I had. I did not expect my students would create models. I am so pleased to see the models they created. Aluminum foils as solar panels on roofs of cars. They used bottle caps as wheels and told me the tires are made from recycled materials. They told me they are recycling waste collected from oceans to make the materials for car seats....”.

Journal entry

27 April 2023

While sitting in the class, listening to my students, and seeing their final presentation, where they created a sustainable car model, I felt I achieved the goal of teaching science in a globally competent way, which was to improve students’ understanding of science. This marked the final stage of my transformation, where I worked towards influencing a change in my student’s lives based on my transformed perspective on how to execute globally competent teaching in the context of this course (Mezirow, 2000).

Discussions

The findings of the study underscore a transformative shift in my journey toward becoming a globally competent instructor as I endeavored to instill global competency in my students. While transforming myself into a globally competent teacher, the disorienting dilemma I faced was the definitional ambiguity that exists in global competence. The lack of a clear and universally agreed-upon definition of global competence poses a significant challenge for educators, as there exist multitudes of definitions of the construct (Hall & Hite, 2022; Parkhouse et al., 2016; Siczek & Engel, 2019). There is no single standard definition, and therefore, it leads to varied interpretations. Teachers express confusion about what constitutes globally competent education, with some associating it solely with international travel, while others use the term interchangeably with intercultural competence, internationalization, and multicultural education (Hall & Hite, 2022; Siczek & Engel, 2019; Tamerat, 2020). In this study, as we discussed incorporating a global competence approach in science education, it would be helpful if global competence were associated with established education standards, similar to how 21st-century skills are incorporated into the Next Generation Science Standards. This would provide educators

with clear guidelines and frameworks that help them to incorporate global competence into their teaching practice effectively. This would also ensure that the instructional material aligns with a recognized standard that enhances the quality and consistency of education.

Based on the findings, of this study, global competence in science refers to competencies that connect to international perspectives and global issues. Here, the emphasis should be on “global issues” as that creates a criticality to even delve into contentious topics, which is much needed for the development of citizens of the 21st century where neo-liberal policies and market-oriented education make students consumers of boundless knowledge (Hodson, 2010). Teachers are shown to possess such attitudinal challenges, exhibiting hesitancy with politically contentious topics or issues that might trigger varying reactions within the community. Teachers navigate this challenge by avoiding politically charged topics like global poverty or climate change and opting for less controversial subjects to avoid conflicts (Tamerat, 2020). They often superficially incorporate global content, focusing on elements such as foods, flags, fashion, and festivals (Hall & Hite, 2022). This mindset not only deprives global competence but inculcates a wrong notion.

During this journey, I consistently kept myself updated with global scientific issues and linked the unit of heat energy to the broader context of global warming. I was surprised to witness my students independently associating the global warming issue with the socio-economic backgrounds of various countries, even without any explicit prompts. This activity gave my students the confidence to discuss such contentious topics in their future classrooms. Unlike other studies I reviewed (Reis, 2014; Smith, 2021; Tichnor-Wanger et al., 2016), which utilized a global competence approach in a specific unit of science, this study employed the global competence approach throughout an entire semester of teaching. The global competence approach should be considered as a way of teaching science rather than a one-time activity. Future studies should investigate how students attain global competence in science when they are consistently taught using this approach. Such research could find out the long-term benefits and improvement in student understanding, critical thinking, and ability to engage with global issues. By demonstrating the effectiveness of continuous integration of such an approach in science education, these studies could provide valuable insights into enhancing student’s overall academic performance and preparedness for addressing complex global challenges. After all the foundation of the global competence approach is an egalitarian model where our students uphold the values of human dignity, equity, and sustainability (Boix-Mansilla & Jackson, 2023).

The study’s results highlight a prevalent misconception among teachers, viewing global competency as a checklist rather than a “lifelong journey” (Hall & Hite, 2022, p.675). During my self-study, I, too, initially held the misconception of associating global competency with a specific skill set. However, I later realized that focusing on a single skill does not necessarily express global competence in my instruction. Global competence entails the meaningful integration of skills that are purposefully connected to a global concern, issue, or perspective. This holds particular significance in the current scenario, where science and technology are intricately linked to various aspects of society (Flink & Ruffin, 2019). Their benefits and concerns have widespread implications for humanity, contributing to an uncertain and ambiguous situation.

To actively demonstrate global competence, I transitioned away from traditional passive-receiver instructional strategies. Instead, I engaged students in making informed decisions about science. One such activity was tasking them to create a design for a sustainable car model. This activity prompted them to bridge theoretical knowledge from the classroom with real-life scenarios, encouraging a thoughtful consideration of the practical aspects of car usage and fostering creative thinking toward building a sustainable model. In doing so, we moved beyond the transmissive vision characterized by the unilateral transmission of scientific knowledge. We embraced a transformative vision committed to active participation, emancipation, and engagement with socio-scientific activism. Integrating globally competent science instruction aligns with the Vision III of scientific literacy (Valladares, 2021).

Furthermore, a common cause of student disinterest in science is often attributed to a decontextualized image of the subject. Integrating global competence into science instruction provides a contextualized perspective, thereby enhancing student interest in the field of science. I observed a positive response to the science content when I linked it to real-life situations for the students. I am committed to exploring more ways of integrating global competence approach in science instruction. More than being carried away with the global competent skills, I would focus on incorporating global perspectives and issues related to the content I am teaching. While incorporating, I intend to identify the skills my students need to effectively engage with and participate in the content being taught. To achieve this, I plan to compile a comprehensive list of these skills, focusing on those frequently emerging when providing students with global perspectives and addressing global issues in a science classroom. Subsequently, pre-service teachers need to be explicitly instructed on methods to enhance these skills in their students. It is also significant to provide professional development programs for in-service teachers about the way they could utilize to incorporate global competence approach in science instruction.

Globalization holds positive or negative connotations based on the point-of-view of the person wielding the word. It is important for schools to function as a way to open students' eyes to different injustices around the world and to show them what it means to inspect and unpack various perspectives. If teachers are confused with what they have to foster through globally competent education, then this function of schools is never going to be a reality. There should be a clear guidelines of what global competence means in the science classroom so that teachers can adequately prepare for it. Further research is necessary to investigate how global competence can be integrated into science instruction, aiming to uncover challenges faced by educators and understand the diverse instructional methodologies used in this context. More theoretical as well as empirical studies are required to understand the meaning of global competence with respect to science, identify the skills required for teachers to become globally competent, and explore how teachers can incorporate these skills into K-12 science classrooms. This study could be considered as one of the foundational steps towards better understanding global competence in science instruction.

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Ethics Statement: This self-study adheres to ethical standards by ensuring transparency, reflexivity, and confidentiality throughout the research process. As the primary participant and researcher, I have taken care to anonymize any references to other individuals involved indirectly in this study.

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