筑波大学
University of Tsukuba
ICDME-TSUKUBA INTERNATIONAL CONFERENCE 2022
INTERNATIONAL COOPERATION DEVELOPMENT IN MATHEMATICS EDUCATION

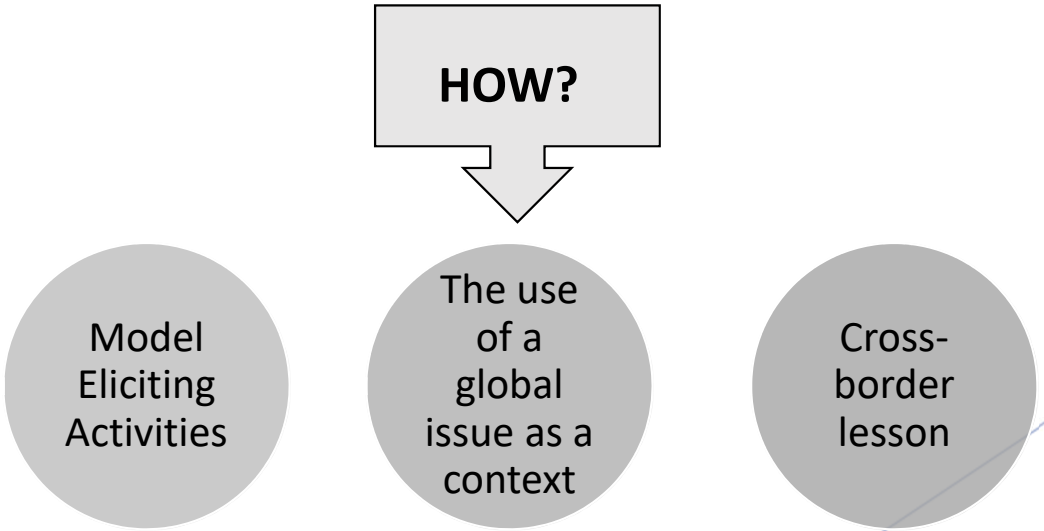
Fostering Global Citizenship In Mathematics Classrooms

Russasmita Sri Padmi
SEAMEO Regional Centre for QITEP in Mathematics

Gabriel Matney
Bowling Green State University

INTRODUCTION

- The importance of Global Citizenship Education (GCED) to educate students as future citizens of the world.
- The strong potential of mathematics as the gate to GCED.

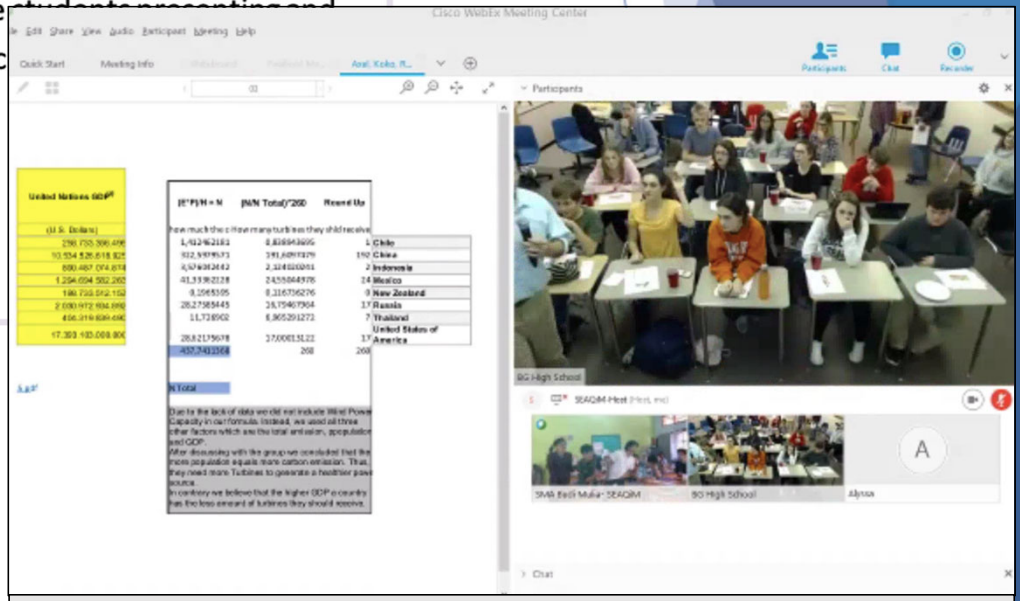


RESEARCH QUESTION

"When students engage in a cross-border model eliciting mathematics activity, what elements of global citizenship education are enacted?"

Project Setting and Timeline

September 21 – November 30	December 8	December 14
Preparation	**First Day of Lesson**	**Second Day of Lesson**
• Sharing the draft of task and lesson plan. • Establishing date, platform of students' discussion, and technical issues. • Discussing task, lesson plan, and possible solutions	• Introducing the students to each other. • Testing the technical matter, especially the internet connection. • Introducing the students to the task.	The disc



The students presenting their solution through WebEx.

The Lesson

Situation:

A wind power company has developed a new type of wind turbine that theoretically generates 20% more energy than the previous wind turbines. The company would like to test these new wind turbines in at least five different countries around the world. For this test, they will donate 260 turbines across the selected countries. Several countries interested in receiving these wind turbines include: Chile, China, Indonesia, Mexico, New Zealand, Russia, Thailand, and the United States.

Each of these countries want to reduce their CO2 emissions and receiving these new wind turbines will help them do that.

Your team is given the task to develop a method for ***fairly*** distributing the 260 wind turbines to at least five of these countries.

Wiemken, R., Padmi, R. S., & Matney, G. (2021). Global connections through mathematical problem solving. *Mathematics Teacher: Learning and Teaching Pre-K – 12*, *114*(3), 219-226.

- The lesson was not planned to adhere to specific curriculum standard, but as an enrichment task whereby students would apply prior knowledge to real-life data and give justification for the viability of their mathematical model to solve a global problem. Furthermore, the task was not aimed at a specific grade or age, but designed in such a way that it can be solved by grade 9-12 students.
- The lesson was to be conducted in English.
- The students use real-life data from credible and reputable global organizations.

DATA SHEET

CO2 Emission Table – 2014	Total CO2 Emission[1] (kt-c)	Coal & Coal Products[1] (kt-c)	Crude Oil & Petroleum Products[1] (kt-c)	Gas[1] (kt-c)	Wind Power Capacity[2] (MW)	United Nations Population Estimate[3] (People)	United Nations GDP[4] (U.S. Dollars)
Chile	20748	6641	11949	2158	331	17,613,798	258,733,356,496
China	2444710	2011525	325220	107964	91,412	1,390,110,388	10,534,526,618,925
Indonesia	124815	48632	56491	19692	Unknown	25,513,116	890,487,074,874
Mexico	430798	47404	241382	142012	1,859	124,221,600	1,294,694,582,263
New Zealand	8553	1536	4946	2070	623	4,566,700	198,733,512,153
Russia	399464	87933	93508	218023	Unknown	143,761,378	2,030,972,934,892
Thailand	69302	18653	26286	24363	223	68,416,772	404,319,839,490
USA	1566861	465144	613400	391951	61,110	317,718,779	17,393,103,000,000

Conversion: 0.557918615 kt-c/gwh

Wiemken, R., Padmi, R. S., & Matney, G. (2021). Global connections through mathematical problem solving. *Mathematics Teacher: Learning and Teaching Pre-K – 12*, *114*(3), 219-226.

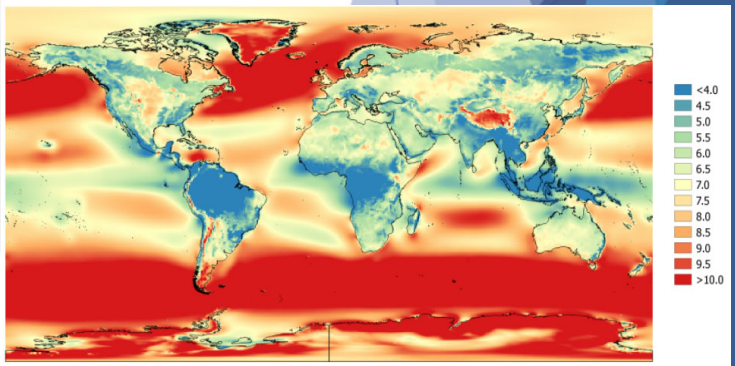


Figure 1
Mean wind speed at 100m from MERRA reanalysis. Period 1979-2013

METHOD
Data Analysis

COGNITIVE	SOCIO-EMOTIONAL	BEHAVIORAL
(4) Students learn about governance structures and systems, including politics, history, and economics.	(9) Students learn about their identities and how they are situated to understand global citizenship.	(12) Students explore their own beliefs and values as well as those of others, and discover challenges for governance of contrasting and conflicting beliefs and values.
(5) Students learn about rights and responsibilities of individuals and groups.	(10) Students learn about difference and diversity (family, language, gender, sexuality, and religion)	(13) Students learn about social justice and ethical issues.
(6) Interconnection among local, national, and global issues are illuminated.	(11) Students learn about common factors that transcend difference and develop ability to respect differences.	(14) Students have the opportunity to develop attitudes of compassion and empathy for others and environment.
(7) Students use critical inquiry skills.		(15) Students learn about opportunities to take individual and collective action at local, national, and global level.
(8) Students learn about the dominance of English language and how this affects non-English speakers.		

Modified from Global Citizenship in Mathematic Task Protocol (Evans, 2018)

FINDINGS AND DISCUSSION

The Cognitive Domain

An example of mathematical model by Indonesian students

Step 1	Step 2
$N = \frac{E \times P}{H}$	$X = \frac{N}{N_{total}} \times 260$
E = CO_2 emission P = population count H = GDP X = number of turbines received for each country	

$$\frac{9(A_1)+6.5(B_1)+5(C_1)}{\sum_1^8(9(A_n)+6.5(B_n)+5(C_n))}(260) = W_n$$

A = CO_2 emission

B = wind capacity

C = GDP per person

W_n = number of windmills for each country

An example of mathematical model by US students

Wiemken, R., Padmi, R. S., & **Matney, G.** (2021). Global connections through mathematical problem solving. *Mathematics Teacher: Learning and Teaching Pre-K – 12*, *114*(3), 219-226.

FINDINGS AND DISCUSSION

The Cognitive Domain

- When defending their model, the students have to justify the choice of the mathematics operation.

Example of transcript

Indonesian student 1: If we just add them together, it won't do any significant …
Indonesian student 2: It's the same if we add or multiply.
Indonesian student 1: Multiplying is the best choice.
Indonesian student 3: Because these two are different factors, so if we add them together, it just doesn't seem right.
US Teacher: Is China's number boosted because of multiplication? Wouldn't another country, say Indonesia, benefit more from addition?
US student 1: Well, they are dividing by GDP which is also really big, so it evens out the multiplication, I think.

- Indonesian students learned about the dominance of English language and how it affects the way they convey information, while US students learned how to speak with other people with different cultural and national background.

FINDINGS AND DISCUSSION

The Socio-emotional Domain

- The task exposed the difference in culture, where US students are more used to expressing personal opinions and perspectives, while Indonesian students are generally stricter on staying within the line of mathematics facts and procedures.

- The difference was also evident in justifying the importance of some variables, in particular GDP. The model of Indonesian students considers high GDP as a predictor of fewer turbines, because it means the country can afford clean energy themselves. The model of US students considers GDP as predictor of more turbines, because it means the company can count on that country as a future market.

Example of transcript

Indonesian student 3: Essentially, we have the same idea in how we have to divide by the importance, or how much they need it. So, how much they need it, over the total of how much all country need it – do you get what I mean?

US student 2: Well, I saw fair as relative. Aside from moral question in a sense of do we distribute to those in needs, there is also business question of do we distribute it for profit. We tried to consider both ethical and business side.

CONCLUSION

COGNITIVE DOMAIN

- Students used critical inquiry skills.
- Students learned about the dominance of the English language and how this affects non-English speakers.

SOCIO-EMOTIONAL DOMAIN

- Students learned about difference and diversity.
- Students learned about common factors that transcend difference and developed an ability to respect differences.

Lesson learned

The worth-exploring potential of **MEA with global context** as a way to:

- foster the students' problem solving ability, and
- helping the students recognizing themselves as a world citizen and member of an interconnected community, by providing a platform where they can brainstorm different opinions and thoughts in solving a particular problem with students from different countries.

Thank you!