Journal of Engineering Education Transformations ,
Volume 37 , No. 1 , July 2023 , ISSN 2349-2473, eISSN 2394-1707

10.16920/jeet/2023/v37i1/23129

Summer Multicultural and Interdisciplinary Learning for Engineering (SMILE) in Transportation: Online Professional Development for Future Science Teachers of Culturally and Linguistically Diverse Students

Jiyoon Yoon[1], Kate Hyun[2], Farah Naz[3], Troyee Saha[4]
[1,2,3,4] University of Texas, Arlington, U.S.A
[1] jiyoon@uta.edu
[2] kate.hyun@uta.edu
[3] farah.naz@uta.edu
[4] troyee.saha@uta.edu

Abstract : This study was designed to offer an online professional development opportunity, "Summer Multicultural and Interdisciplinary Learning for Engineering (SMILE) in Transportation," for future elementary STEM teachers and measure its effects on their teaching. As the student population grows more diverse, schools face more significant challenges in delivering practical instructions on "transportation" to the diverse student population, including minority students who speak English as a second language. SMILE in Transportation provided future science teachers with an opportunity to interact with cultural professionals in Transportation who were experts in Transportation, had their cultural backgrounds, and presented transportation systems through their cultures. The cultural professionals in Transportation involved inter-disciplinarily professionals not only on the college campus but also from the communities. SMILE in Transportation was a novel approach to increase the knowledge of future science teachers in Transportation and to develop a unique teaching methodology that incorporates the backgrounds of culturally and linguistically diverse students into teaching engineering of Transportation. The data collected from the pre-and the post-surveys of the participants' science affinities & cultural competency (teaching efficacy, cultural competency, personal interest, & cultural IQ), science knowledge tests, and the qualitative survey at the end of the project were used to improve future teachers' understanding of Transportation and other cultures and their skills in developing culturally- responsive instructions to teach Transportation, as well as to update SMILE workshop for future sessions.

Keywords: interdisciplinary; minority students; multicultural; Transportation; professional development.

1. Introduction

As the student population has become increasingly diverse and ethnic minority students have demonstrated difficulties in meeting academic expectations in STEM science, schools are facing significant challenges in effectively delivering science instruction to close the achievement gap (Colby & Ortman, 2015; Franklin, et al., 2014; Wilson, 2014). School teachers pay attention to creating a learning environment that is engaging and accessible to a broader range of students. Minority students in the U.S. are continuously experiencing isolated and inequitable learning in schools (Darling-Hammond, 2001), resulting in failing schools. According to the studies of NAEP (NCES, 2011) and TIMSS (Gonzales et al., 2009), the achievement gap

Jiyoon Yoon
University of Texas, Arlington, U.S.A
jiyoon@uta.edu

in science that starts as early as elementary schools become increasingly more comprehensive in higher education (Chapin, 2006). The ethnic minority students' performance lags behind that of white students, and the gap has widened in math and science areas.

The persistence of unequal educational outcomes among ethnic minority groups can be removed by enhancing teachers' abilities. Research has continuously demonstrated that minority students need to be situated within their diverse, daily experiences (William, 2011; Quian, et. al., 2017; Theobald, E. J., et. al., 2020), which makes them feel more personally meaningful, increase their interest positively, and learn more easily and thoroughly (Hurtado, et al., 2009; Baurhoo & Asghar, 2014). The culturally-responsive instructions enable the teachers to resolve potential cultural differences among students in the classroom and create an equal learning environment for all the students, including the minority students. However, to see this change occur, a dramatic shift in the confidence in teaching diverse students, cultural competencies, and science affinities (personal interest and efficacy) is required from teachers in classrooms (Ladson-Billings, 2014).

2. Literature Review

To enhance the ethnic minority students' learning opportunities, teachers connect the minority students' cultural knowledge to academic knowledge, which helps the students extend their learning to academic concepts (Gay, 2000; Kozleski, 2010). School teachers in diverse classrooms must gain knowledge of the cultures represented in their classrooms and link this knowledge to their teaching, which helps them to transform their own cultural biases and preferences for communicating with ethnic minority students and their learning. Therefore, culturally responsive teaching engages and sustains student participation and achievement in science classrooms.

A. Culturally Responsive Instruction

Culturally responsive Instruction (CRI) gets students from non-dominant cultures engaged in demonstrating their proficiencies in their languages and culture from their everyday lives. CRI translates the logical structures of their culture and languages onto the school curriculum, which helps the students experience intellectual growth as a result of an interaction. The students successfully achieve when their strengths are nurtured and connected to new knowledge. It is essential to recognize the minority students' culture and their home languages for minority students' learning (Ladson-Billings, 2014).

B. Scientific Affinities

This study utilized scientific affinities, including identity formation theory, self-efficacy theory, and growth mindset theory, to measure the effects of CRI on future science teachers. Identity theory explains how future teachers develop long-lasting science identities and mix them with their self-concepts, increasing their possession of Transportation (Herman, 2011). Self-efficacy theory presents their confidence in their abilities through mastery, vicarious, modeling, and emotional and hands-on experiences (Chowdhury, 2016). Growth Mindset research supports that future teachers become mature and foster mental resilience when they face challenging tasks (Dweck, 2015). Teachers with strong science identities and self-efficacy were more likely to seek out positive experiences in science, which cultivates their mindsets. This SMILE study was designed to get future teachers involved in building their identities, improving self-efficacy, and thus growing their mindsets in Transportation by integrating cultures in teaching Transportation.

C. Integration of Culture for Scientific Affinities

Education research strongly indicates that combining culture and science motivates and engages students in learning complex concepts and closing their achievement gaps in science areas (Gay, 2000). The culture in this proposal means all the ways for living, including food, arts, music, traditional games, dance, housing, geography, politics, education, and so on. CRI is a pedagogy that allows teachers to close the cultural gap in classrooms and have their students from non-dominant cultures leverage their proficiencies in their languages and culture from their everyday lives and translate the logical structures of their personal identity into the school curriculum (Kozleski, 2010). This cultural interaction forms essential factors in their mental growth, including identity, self-efficacy, and mindset (Ladson-Billings, 2014). Therefore, teachers must have the ability to connect minority students' cultures to academic knowledge for minority students' learning opportunities. This enables the students to become successful when their strengths are nurtured and connected to new knowledge. Their culture and home

languages must be recognized as essential instructional elements.

D. Purpose of the Study

This study sought to explore the effects of the SMILE in Transportation using a CRI approach on future science teachers' knowledge of Transportation, science affinities, and cultural competency. The study was conducted based on the following research questions:

1) Does the SMILE in Transportation help future science teachers to increase their knowledge in Transportation?

2) Does the SMILE in Transportation improve their affinities in Transportation?

3) Does the SMILE in Transportation promote their cultural competency?

3. Methods

A. Participants

The Participants of the project are nine future science teachers with the age range of 18 to 24 years old (56%), 25 to 34 years old (33%), and 35 years and older (11%), mostly female (89%), and the ethnicity of White (44%), Asian (22%), and Black (11%). They are the juniors enrolled in a science method course in the teacher license program. Half of the participants had been enrolled in the current teacher license program for one year (44%), 2 years (22%), 3 years (22%), and more than 3 years (11%). Table 1 summarizes the demographic information of the participants.

B. Procedure of the Study

This study lasted for one academic year. The project team composed of two research scholars (one from science education and the other from the transportation engineering) proceeded the study following the five objectives:

1) “collaborate” by recruiting cultural professionals from the campus, city halls, local communities (cultural centers and international museums and schools) for three months, The cultural professionals were the experts in Transportation, had strong cultural knowledge, and presented transportation systems through their cultures. Korean teacher and Bangladeshi Engineers voluntarily joined this study as the cultural professionals.

2) “design” by holding a meeting with the cultural professionals and creating culturally responsive science activities based on the cultural professionals’ transportation literacy and cultures for two months,

3) “perform” by communicating between the future science teachers and the cultural professionals at the SMILE in Transportation (online workshop) for a week,

4) "produce" a representative transportation curriculum for the ethnic minority students that is integrated into the participants' school curriculums for one months, and

5) "contribute" to the advancement of knowledge in multicultural education and the subject areas of Transportation by disseminating the research and curriculum products generated through SMILE in Transportation to a broad audience of educators for six months.

Table 1: Demographic Information of the Participants

Demographic Components	Sub-categories	Percentages
Age	18-24 Years Old	56% (5)
	25-34 Years Old	33% (3)
	35 Years and Older	11% (1)
Gender	Male	11% (1)
	Female	89% (8)
Ethnicity	Hispanic or Latino	22% (2)
	Asian	22% (2)
	Black or African American	11% (1)
	Caucasian or White	44% (4)
Race	Hispanic or Latino	22% (2)
	Not Hispanic or Latino	78% (7)
Numbers of years enrolled in the current program	1 year	44% (4)
	2 years	22% (2)
	3 years	22% (2)
	3 years and more	11% (1)

*Number of participants % (N=9).

D. Data Collection

Data collected for this project included both quantitative (a) science affinities: science teaching

Table 2 : Evaluation Tools For Data Collection

Quantitative Data	Qualitative Data
Pre- and post-survey of science affinities & cultural competency (science teaching efficacy, cultural competency, personal interest, & cultural intelligence)	Interview at the end
Pre- and post-modified Texas standardized test in Transportation (STAAR test: State of Texas Assessment of Academic Readiness)	

efficacy, cultural competency, personal interest, & cultural intelligence and b) modified standardized tests in Transportation) and qualitative measures (the online interview at the end of the project). Before and after the participants experienced the SMILE in Transportation with the cultural professionals, they were asked to take the pre-and the post-survey tests (quantitative measures) and an online interview at the end (qualitative measure). Table 2 shows the evaluation tools.

After developing a preliminary transportation education curriculum by cultural professionals in Transportation, the online SMILE in Transportation workshop was held with future elementary science teachers. The workshop curriculum included three main components:

1) Learning about transportation literacy and immigrant culture

2) Developing and sharing a culturally-responsive curriculum for Transportation

3) Creating the culturally-responsive instructions for a Cultural Science Night.

During the workshop online sessions, the future teachers participated in multicultural and interdisciplinary discussions and activities to learn about general knowledge of transportation systems in two different countries (Korea and Bangladesh) and to experience the immigrant histories and culture, including topics in language, politics, housing, geography, and education. In the online workshop, the participants experienced mostly transportation systems and other cultures with the cultural professionals and then explored interactive and outdoor activities beyond in-class learning. The two cultural professionals who willingly collaborated for this study were 1) an elementary teacher in social studies & science from a local school and 2) a civil engineer from a university engineering lab. After the

Table 3 : Workshop Schedule & Learning Outcomes

	Mon	Tue	Wed	Thu	Fri
AM 9-12	Hispanic Culture/ History	Korean Culture/History	Presentation of Video Documentation	Developing CRI	Presenting CRI to the class
PM 1-4	Online Excursion of Local Hispanic communities	Online Excursion of Local Korean communities	Lecture of How to develop CRI	Developing CRI and materials	Presenting Culturally responsive instructions to the class
PM 6-9	Online Communication for Cultural Science Night	Online Communication for Cultural Science Night	Online Communication for Cultural Science Night	Online Communication for Cultural Science Night	Cultural Science Night (Online)
Learning Outcomes	Understand Hispanic culture/history	Know Korean culture/history	Learn how to develop CRI	Develop CRI	Perform CRI to students

workshop, the participants reserved their times for online reading, research, or personal consultation with the project team and the cultural/transportation professionals to develop culturally- responsive instructions. At the end of the workshop, the participants created their own culturally responsive instructions and presented them at the Cultural Science Night. The learning outcomes of the workshop are: Students are able to: 1) understand Hispanic culture/history, 2) know Korean culture/history, 3) learn how to develop CRI, 4) develop CRI, and 5) perform CRI to students. Table 3 includes the workshop schedule and learning outcomes.

4. Results

The findings are discussed in three sections: knowledge of Transportation (pre-and post-test), scientific affinities & cultural competency (pre-and post-test), and a qualitative survey at the end of the study. Nine participants completed the tests for knowledge of Transportation, scientific affinities, and cultural competency.

A. Knowledge of Transportation

The results from the modified Texas standardized test in Transportation (pre-test: M= 6.00, SD =1.32 & post-test: M =9.33, SD =0.71) indicated that the online interactions with the cultural professionals resulted in an extremely significant improvement in

Table 4 : Results Of The Knowledge In Transportation

	N	Mean	SD	Std. Error of D	t	df	P
Pre-test	9	6.00	1.32	0.373	8.94	8	0.0001[a]
Post-test	9	9.33	0.71				

[a]P<0.0001

participants' knowledge in transportation (t=8.9443, p< 0.0001). Only nine participants took this pre-and post-knowledge test. Most of the participants increased their knowledge of Transportation after they participated in the program. Table 4 shows the results of knowledge in Transportation.

B. Scientific Affinities & Cultural Competency

1) Teaching Efficacy

The results from the pre-test (M= 3.87, SD =0.43) and post-test (M =4.09, SD =0.47) of teaching efficacy indicated that the online interactions with the cultural professionals were not statistically significant

Table 5 : Results Of Teaching Efficacy

	N	Mean	SD	Std. Error of D	t	df	P
Pre-test	9	3.87	0.43	0.243	0.917	8	0.3858[a]
Post-test	9	4.09	0.47				

[a]P>0.01

in improving participants' teaching efficacy (t=0.917, p>0.01). Most of the participants did not show a significant increase in their confidence in teaching Transportation after they participated in the program. Table 5 shows the results of teaching efficacy.

2) Cultural Competency

The results from the pre-test (M= 4.00, SD =0.403) and post-test (M =4.24, SD =0.49) of cultural competency indicated that the online interactions with

Table 6 : Results of Cultural Competency

	N	Mean	SD	Std. Error of D	t	df	P
Pre-test	9	4.00	0.43	0.241	1.0142	8	0.3402[a]
Post-test	9	4.24	0.49				

[a]P>0.01

the cultural professionals were not statistically significant in improving participants' cultural competency (t=1.014, p>0.01). Most participants did not show a significant increase in their cultural competency after participating in the program. Table 6 shows the results of cultural competency.

3) Personal interest

The results from the pre-test (M= 3.41, SD =0.72) and post-test (M =3.76, SD =0.96) of personal interest indicated that the online interactions with the cultural professionals were not statistically significant in

Table 7 : Results Of Personal Interest

	N	Mean	SD	Std. Error of D	t	df	P
Pre-test	9	3.41	0.72	0.340	1.0446	8	0.3268[a]
Post-test	9	3.76	0.96				

[a]P>0.01

improving participants' personal interest (t=1.0446, p>0.01). Most participants did not show a significant increase in their Personal Interest in Transportation after participating in the program. Table 7 shows the results of personal interest.

4) Cultural Intelligence

The results from the pre-test (M= 3.90, SD =0.36) and post-test (M =4.05, SD =0.63) of cultural intelligence indicated that the online interactions with the cultural professionals were not statistically significant in improving participants' cultural

Table 8 : Results Of Personal Interest

	N	Mean	SD	Std. Error of D	t	df	P
Pre-test	9	3.90	0.36	0.224	0.6591	8	0.5283[a]
Post-test	9	4.05	0.63				

[a]P>0.01

intelligence (t=0.5283, p>0.01). Most participants did not show a significant increase in their cultural intelligence after participating in the program. Table 8 shows the results of cultural intelligence.

C. Qualitative Survey at the end

Eight participants in the survey shared various viewpoints on culturally responsive teaching in STEM education and transportation curriculum. Here's an analysis of their responses:

Participant 1: This participant believes that current

STEM education lacks diversity and inclusivity. They highlight the need for culturally responsive science teaching and express concern that many teachers are unaware of how to include minorities, women, and people with special needs. They emphasize the importance of integrating students' cultures into science education: "In my opinion, current STEM education is not diverse and inclusive. According to some research studies, many STEM education still focuses on boys and girls didn't like to do STEM areas, so that's why we're still encouraging culturally responsive science teaching. Many teachers, they don't know how to include, especially minorities, women, and people with special needs. They don't know their culture… So how to integrate their culture in teaching science? ... (I have) a feeling they're failing."

Participant 2: This participant acknowledges the importance of incorporating different cultures into the curriculum, considering the growing diversity of the nation. They emphasize the role of educators in this process: "I think it's important because, the diversity of our nation is growing. So, we as educators need to know how to incorporate different cultures into our curriculum."

Participant 3: This participant emphasizes the importance of creating a welcoming environment for students and eliminating bias. They highlight the need for students to feel included and comfortable in the learning environment: "I was just saying that it's important to help make sure students feel welcome and don't have any feel like they have any bias going on."

Participant 4: This participant suggests that teachers could include lessons on the contributions of women of color and other cultures in STEM fields, such as NASA. They believe that highlighting diverse role models can help attract more students to STEM subjects: "I think teachers could do more lessons on the different cultures and how Women of color or other cultures have played a big part like in NASA. For instance, they can teach lessons on that kind of diversity to draw more people towards it."

Participant 5: This participant agrees with a previous comment and suggests making lessons more realistic to help students relate and see themselves in the subject matter. They believe this would contribute to inclusivity in STEM education: "I definitely agreed with the other participant, make the lesson more realistic so all the students in the class can relate and visibly see themselves in that position."

Participant 6: This participant discusses the issue of girls feeling intimidated by STEM subjects and suggests promoting a growth mindset among students. They propose encouraging students to believe in their ability to tackle STEM activities and reinforcing the idea that they can succeed: "So, we were talking about how women are kind of women and girls, some girls in school they are kind of intimidated by STEM and you know, science engineering. And they think that they're not able to do the activities or the lessons that are provided to them. So maybe as educators we could push for, like a growth mindset, you know, tell them that they can do these things that are being presented to them."

Participant 7: This participant suggests an alternative approach in the transportation curriculum by allowing students to share their preferred modes of transportation rather than their actual experiences. This way, students can engage in a more imaginative and inclusive activity, reducing the chance of embarrassment or discomfort related to personal circumstances: "Maybe say how they would like to get to school instead of how they get to school. Because they can make something up like they could say, 'oh I would like to go in rocket ship, or I would like to go to school and a limo or an hour monster truck'. So, they don't have to share their actual personal experience and feel like if they're put on the spot or embarrassed by their current situation. It makes it more fun, and I guess more inclusive because it's more like an imaginary thing and it's a literal form of it."

Participant 8: This participant suggests asking simple questions about different modes of transportation to engage students in the discussion. By focusing on shared experiences, they believe this approach can contribute to inclusivity in the transportation curriculum: "I think you could also just ask you know who's been on a bus before, who's been in a car, who's ridden a bike? Stuff like that."

Overall, the participants express concerns about the lack of diversity and inclusivity in STEM education, particularly in relation to gender, ethnicity, and students with special needs. They highlight the importance of incorporating different cultures, diverse role models, and realistic examples to make STEM subjects more relatable and inclusive. They

also emphasize the need to create a supportive and welcoming environment for all students, addressing biases and promoting growth mindsets.

5. Discussion & Conclusions

The aim of this study was to investigate the impact of online professional development called SMILE in Transportation, which utilized a culturally responsive teaching approach, on the knowledge of future science teachers in Transportation, their science affinities, and their cultural competency. Pre- and post-surveys were conducted with nine participants, revealing that the study effectively enhanced the participants' knowledge of Transportation. However, statistically significant effects on their science affinities and cultural competency were not observed. Nevertheless, qualitative survey responses indicated that the study successfully raised participants' awareness of cultural diversity and facilitated the creation of high-quality educational materials through the use of a culturally responsive teaching approach. The participants also highlighted potential challenges in implementing culturally responsive instruction, including the difficulty of incorporating multiple cultural components, privacy concerns, and potential legal issues.

Based on the statistical analyses conducted with the participants, it was found that SMILE in Transportation was valuable in providing a condensed knowledge of Transportation within a short period of time. However, it could have had a positive impact on supporting participants' interests and confidence in teaching Transportation to culturally diverse students. Although the future science teachers acquired new teaching strategies and materials through SMILE in Transportation, they expressed a need for more confidence and comfort in delivering the newfound information to students (Rollison, Ludlow, & Wallingford, 2012). Given the relatively brief duration of the project (five days), teacher candidates were required to simultaneously learn and implement culturally responsive instruction, resulting in limited opportunities to practice and present it effectively to diverse students.

However, the qualitative survey findings indicated that the implementation of SMILE in Transportation with a culturally responsive teaching approach had a positive impact on the participants' understanding and preparation for culturally responsive instruction in classrooms. The online interaction with cultural professionals through SMILE in Transportation stimulated cognitive engagement among the participants (McLoughlin & Lee, 2010), inspiring them to delve deeper into transportation concepts by leveraging visual and audio multimedia in cultural presentations. This culturally responsive approach facilitated broader participation in transportation learning, including underrepresented student groups, thereby fostering their interest in transportation literacy and enhancing their appreciation and understanding of our living environments through the lens of transportation and cultural adaptation.

By employing the culturally responsive teaching approach, future teachers were able to better recognize the needs of ethnic minority students in classrooms and felt empowered to provide informed and responsible instruction (Aronson & Laughter, 2016; Hammond, 2014; Paris & Alim, 2014). The implementation of SMILE in Transportation also played a role in enhancing the participants' confidence in teaching, contributing to their positive outlook on teaching science (Maypole & Davies, 2001; Yager & Akcay, 2008; Yager et al., 2008; Yager et al., 2009). Overall, the culturally responsive teaching approach adopted in SMILE in Transportation resulted in improvements in teachers' scientific knowledge, confidence in teaching science to culturally diverse students, and cultural competency within the classroom setting.

SMILE in Transportation is an innovative approach that aims to foster future science teachers' interest and literacy in Transportation by integrating transportation concepts with diverse cultures. The project focuses on meeting the needs of ethnically diverse students, thereby enhancing future science teachers' knowledge and understanding of multicultural education in the context of transportation. Throughout the study, cultural professionals in Transportation provided valuable assistance to the participating future science teachers, helping them broaden their understanding of different cultures and improve their instructional knowledge and skills in Transportation. The project also aimed to ensure equal learning opportunities for all learners by actively involving future science teachers in interactive and hands-on activities through the SMILE in Transportation initiative.

The culturally responsive transportation curriculum was developed collaboratively by the participating future science teachers and cultural

professionals during the SMILE in Transportation workshop. Through deep online conversations, each future science teacher was able to construct their own transportation curriculum, tailored to their specific teaching context and incorporating cultural perspectives. This study also holds significant insights for educators and administrators in the field of Transportation, offering guidance on how to effectively support the achievement of ethnic minority students in Transportation education.

By facilitating interactions between future teachers and cultural professionals with expertise in transportation and diverse cultural backgrounds, this study sought to bridge scientific affinities and transportation literacy. The project recognized the value of allowing future teachers to engage with experts who possess both transportation knowledge and cultural insights, creating a rich learning experience that connects the two domains.

6. Limitations And Recommendations

While this study yielded valuable insights into future science teachers' science affinities, cultural competency, and transportation literacy, it is important to acknowledge its limitations. First and foremost, the generalizability of the findings is constrained due to the small sample size of only nine voluntarily participating future science teachers. The limited representation of five population groups (Black, Caucasian, Latino, Asian, and Multiethnic) within the future science teacher participants should also be considered, given the diverse teacher population in the United States. Therefore, it is recommended that future investigations include larger sample sizes and more ethnically and racially diverse groups of participants to enhance the generalizability of the findings and ensure a more comprehensive understanding of the experiences with culturally responsive instruction (CRI).

Additionally, this study solely focused on a one-time point assessment during a single semester, which limits the understanding of how future teachers' experiences with online professional development evolve over time. Future research could employ longitudinal studies to examine changes in future teachers' experiences with online professional development, both during and after the semester, including their adjustment to online learning environments and the transition to face-to-face instruction.

Lastly, it is worth noting that this study did not include a comparative perspective by capturing future teachers' experiences without the SMILE in Transportation program. Incorporating a comparison group would provide valuable insights into the differential effects of online professional development with the CRI approach compared to traditional methods. Further analysis examining the experiences of future science teachers with online professional development, both with and without the SMILE in Transportation, would shed light on the similarities and differences in their experiences.

Acknowledging these limitations, future research should address these gaps to deepen our understanding of the effectiveness and potential benefits of online professional development and the CRI approach in enhancing future science teachers' knowledge and skills in transportation education.

Acknowledgment

We want to express our deep and sincere gratitude to the Center for Transportation Equity, Decisions, & Dollars and the staff related to the project for their financial supports and invaluable guidance throughout the research.

References

[1] Aronson, B., & Laughter, J. (2016). The Theory and Practice of Culturally Relevant Education: A Synthesis of Research Across Content Areas. Review of Educational Research, 86(1).

[2] Baurhoo, N & Asghar, A (2014) Using universal design for learning to construct inclusive science classrooms for diverse learners, Learning Landscapes, 7(2), 59-81.

[3] Cloby, S., & Ortman, J. (2015). Projections of the Size and Composition of the U.S. Population: 2014 to 2060, U.S. Census Bureau: Department of Commerce, 25-1143.

[4] Chapin, J. R. (2006). The achievement gap in social studies and science starts early: Evidence from the early childhood longitudinal study, The Social Studies, 97(6), 231–238.

[5] Chowdhury, M. A. (2016). The integration of science-technology-society/science-technology-society-environment and socio-

scientific-issues for effective science education and science teaching. Electronic Journal of Science Education, 20(5), 19-38.

[6] Dweck, C. (2015). Carol Dweck revisits the growth mindset. Education Week. Retrieved from: https://www.edweek.org/leadership/opinion-carol-dweck-revisits-the-growth-mindset/2015/09

[7] Flanklin, S. L., Slate, J. R., & Sheila, A. (2014). Ethnic Disparities in Graduate Education: A Selective Review of Quantitative Research, Social Theory, and Quality Initiatives, Journal of Faculty Development, 28(3), 63-79.

[8] Gay, G. (2000). Culturally responsive teaching: theory, research, and practice. New York: Teachers College Press.

[9] Gonzales, P., Williams, T., Jocelyn, L., Roey, S., Kastberg, D., & Brenwald, S. (2009). Highlights from TIMSS 2007: Mathematics and science achievement of U.S. fourth- and eighth-grade students in an international context. Retrieved from http://nces.ed.gov/pubs2009/2009001.pdf

[10] Hammond, Z. (2014). Culturally Responsive Teaching and the Brain: Promoting Authentic Engagement and Rigor Among Culturally and Linguistically Diverse Students, Corwin Press.

[11] Herman, W. E. (2011). Identity formation. In S. Goldstein & J. A. Naglieri (eds.), Encyclopedia of child behavior and development. Springer. https://doi.org/10.1007/978-0-387-79061-9_1443

[12] Kozleski, E. B. (2010). Culturally Responsive Teaching Matters!, Equity Alliance, Retrieved from https://files.eric.ed.gov/fulltext/ED520957.pdf Ladson-Billings, G. (2014). Culturally Relevant Pedagogy 2.0: a.k.a. the Remix , Harvard Educational Review, 84(1), 74-85.

[13] Ladson-Billings, G. (2014). Culturally Relevant Pedagogy 2.0: a.k.a. the Remix, Harvard Educational Review, 84(1), 74-85.

[14] National Center for Educational Statistics. (2020). Racial/Ethnic Enrollment in Public Schools, The Condition of Education, Retrieved from https://nces.ed.gov/programs/coe/indicator_cge.asp

[15] Maypole, J., & Davies, T. G. (2001). Students' perceptions of constructivist learning in a community college American History II. Community College Review, 29(2), 54-80. https://doi.org/10.1177/009155210102900205

[16] McLoughlin, C. E., & Lee, M. J. W. (2010). Developing an online community to promote engagement and professional learning for pre-service teachers using social software tools, Journal of Cases on Information Technology, 12(1), 17-30. DOI:10.4018/jcit.2010010102.

[17] Paris, D. (2012). Culturally Sustaining Pedagogy: A Needed Change in Stance, Terminology, and Practice, Educational Researcher, 41(3).

[18] Paris, D., & Alim, S. H. (2014). What Are We Seeking to Sustain Through Culturally Sustaining Pedagogy? A Loving Critique Forward, Harvard Educational Review, 84(1).

[19] Rollison, J. M., Ludlow, L. H., & Wallingford, T. W. (2012). Assessing content knowledge and changes in confidence and anxiety related to economic literacy in a Professional development program for history teachers, Journal of Education al Research and Practice, 2(1), 15-30.

[20] Theobald, E. J., Hill, M. J., Tan, E., Agrawal, S. E., Arroyo, N., Behling, S., Chambwe, N., Cintrón, L., Cooper, J. D., Dunster, G., Grummer, J. A., Hennessey, K., Hsiao, J., Iranon, N., Jones II, L., Jordt, H., Keller, M., Lacey, M. E., Littlefield, C. E., Lowe, A., Newman, S., Okolo, V., Olroyd, S., Peecook, S., Pickett, S. B., Slager, D. L., Caviedes-Solis, I. W., Stanchak, K. E., Sundaravardan, V., Valdebenito, C., Williams, C. R., Zinsli, K., & Freeman, S. (2020). Active learning narrows achievement gaps for underrepresented students in undergraduate science, technology, engineering, and math, Proceedings of the National Academy of Sciences of the United States of America (PNAS), 117(12),

https://DOI.org/10.1073/pnas.1916903117

[21] Qian, X, Nandakumar, R., Glutting, J., Ford, D., & Fifield, S. (2017). Gender and Minority Achievement Gaps in Science in Eighth Grade: Item Analyses of Nationally Representative Data, ETS Research Report,2017(1), 1-19. https://DOI.org/10.1002/ets2.12164

[22] Williams, A. (2011). A call for change: Narrowing the Achievement gap between white and monitory students, the Clearing House, 84(2), 65-71. https://www.jstor.org/stable/41149869

[23] Yager, R. E., & Akcay, H. (2008). Comparison of learning outcomes in middle school science with an STS approach and a typical textbook dominated approach. Research in Middle Level Education, 31(7), 1-16. https://doi.org/10.1080/19404476.2008.11462050

[24] Yager, R. E., Choi, A, Yager, S. O. & Akcay, H. (2009). Comparing science learning among 4th, 5th, and 6thgrade students: STS versus textbook-based instruction. Journal of Elementary Science Education, 21(2), 15-24. https://doi.org/10.1007/BF03173681