Associations between Students' Perspectives of the Constructivist Learning, Self-efficacy, and Academic Achievement in Math and Science

Faculty Research Grant Recipients: Sharing Research Findings
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Agenda

- **Introduction:** purpose, research questions, context, theoretical framework

- Methodology: instruments, variables, sample, data analysis

- Findings

- Implications & Limitations

- Recommendations

- Discussion/Questions

Research Purpose & Questions

Investigate the associations between **students' self-efficacy (SE)** beliefs, perceptions of the **constructivist learning ecology (CLE)**, **demographic** data and **academic achievement** in **math and science**

1. What are the relationships between students' academic achievement in math, perceptions of the CLE, reported SE and demographic information?
2. What are the relationships between students' academic achievement in science, perceptions of the CLE, reported SE and demographic information?

Context-Cultural considerations in the UAE

Religion

Gulf

Arabic

Collectivism

Power distance

Emirati/Expatriate
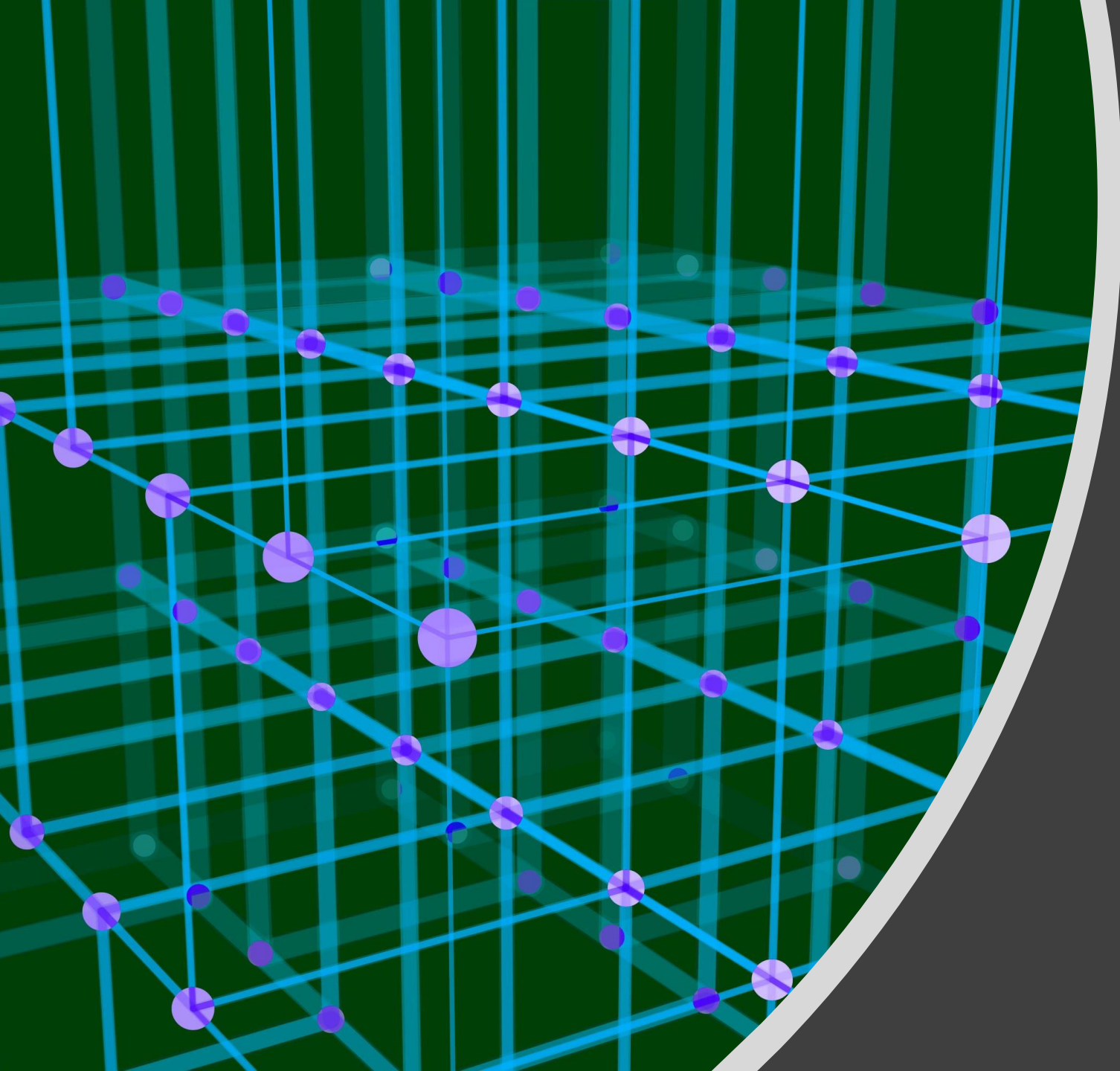
Context- K-12 Education in the UAE

- Public (MOE) & Private (ADEK)

" A country's greatest investment lies in building generations of educated and knowledgeable youth "

The late Sheikh Zayed bin Sultan Al Nahyan

Methodology

Variables and Instruments

Dependent Variables
(MAP GROWTH TEST)
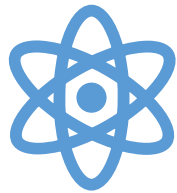
Independent Variables
(ONLINE RESEARCHER-CONSTRUCTED SURVEY)

- Demographic

- Attitude

- Perceptions of the constructivist learning environment

- Self-reported self-efficacy
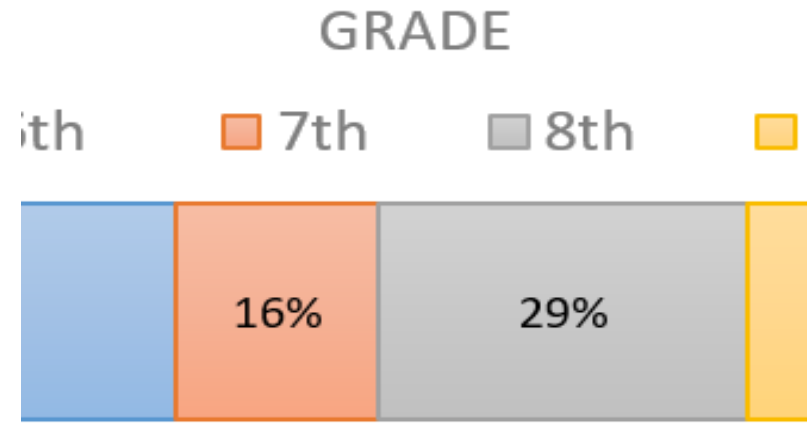
Math Achievement

Science Achievement

Demographics-School

- A private school (K-12) in Abu Dhabi following the American curriculum aligned to the Common Core standards

- ADEK Rating: Very Good

- Over 1000 students

- Over 100 teachers

- Founded over 10 years ago
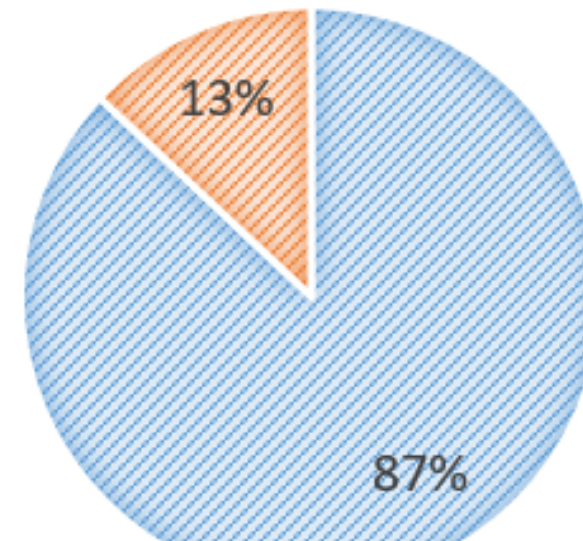
- Gender segregated

Demographics- Sample (N= 165)

GRADE

6th   ■ 7th   ■ 8th   ■ 9th

16%   29%

NATIONALITY

■ Emirati   ■ Other

8.5

91.5

1ST LANGUAGE

■ Arabic   ■ Other

13%

87%
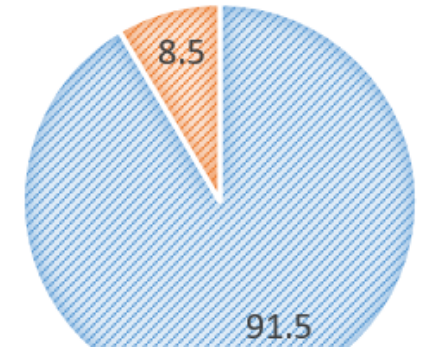
GENDER

■ Male   ■ Female

47%

53%
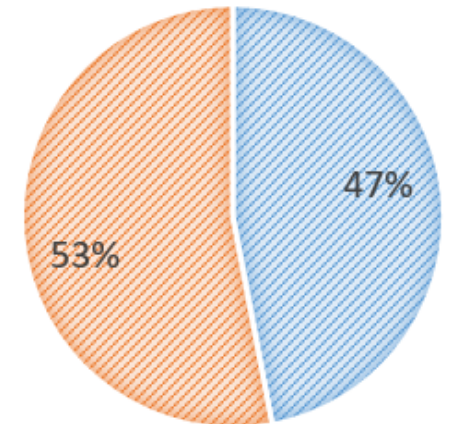
MAP Growth Assessment (DepV)

- Common measure- all schools in Abu Dhabi following the American curriculum must take it
- Computer adaptive and typically administered 2-3 times per academic year
- Tracks academic growth and achievement of students in grades K-12
- Developed and managed by NWEA (Northwest Evaluation Association) with test and re-test studies showing strong reliability indices (NWEA, 2020)

Constructivist Learning Environment (IndV)

Learner-centered where knowledge is constructed rather than transmitted

Variable	Description	Sample Item
Personal Relevance	Meaningful and relevant experiences	What I learn in my math class is useful to my daily life.
Uncertainty	Knowledge evolves	I learn that mathematics has changed over time.
Critical Voice	Question teachers' pedagogical plans	It is OK for me to ask my math teacher 'why do I have to learn this?'
Shared Control	Collective control of the management of learning	I help my math teacher to decide which activities are best for me.
Student Negotiation	Opportunities to explain and justify ideas	In my math class, I can ask other students to explain their ideas.

Student Self-efficacy –General Discipline (IndV)

Belief in the capability of organizing and executing the actions necessary to succeed at a given task (Bandura, 1997)

Variable	Description	Sample Item
Mastery experience	Experiences with sustained effort and perseverance to achieve goals	I do well in math class when I study very hard.
Social Persuasion	Being informed by a trusted someone that one has the ability to achieve	My math teacher has said that I am good at learning math.
Physiological	One's emotions, moods, and physical states	Just being in math class makes me feel nervous.

Student Self-efficacy-Content Specific (IndV)

Content learning self-efficacy focusing on cognition and application of content skills (Wang & Tsai, 2019)

Variable	Description	Sample Item
Conceptual understanding	Being able to understand concepts within the discipline	I can choose an appropriate formula to solve a math problem.
Higher order cognitive skills	Being able to utilize higher order cognitive skills within the discipline	When I come across a math problem, I can devise a plan to solve it.
Application of knowledge and skills	Being able to apply discipline-specific knowledge and skills during general life experiences	I can use math to solve problems in everyday life.
Academic Communication	Being able to communicate appropriately during discipline-specific activities	I can discuss math content with my classmates comfortably.

Data Analysis

$$\alpha = \left(\frac{k}{k-1}\right)\left(1 - \frac{\sum_{i=1}^{k}\sigma_{y_i}^2}{\sigma_x^2}\right)$$

- Item Analysis and Internal Reliability (Cronbach Alpha)
  - Math

    CLE α = 0.82　　　　SSE-G　α = 0.88

    　　　　SSE-C　α = 0.91
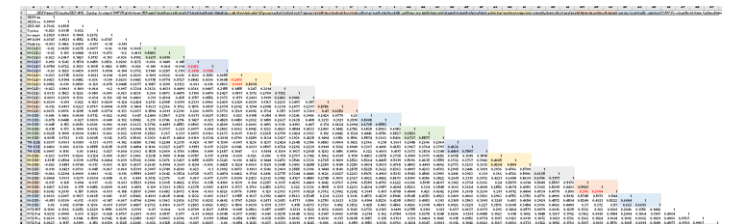
  - Science

    CLE α = 0.83　　　　SSE-G　α = 0.83

    　　　　SSE-C　α = 0.93

- Multiple Regression-……

$$a = \frac{[(\sum y)(\sum x^2) - (\sum x)(\sum xy)]}{[n(\sum x^2) - (\sum x)^2]}$$

$$b = \frac{[n(\sum xy) - (\sum x)(\sum y)]}{[n(\sum x^2) - (\sum x^2)]}$$

Results

Demographic data, "Constructivist Learning Environment" & Achievement on Math MAP

A:
- The overall regression was statistically significant ($R^2 = 0.17$, $F (9, 155)$ = F-3.72, p = Sig. 0.0003
- The following significantly predicted math MAP test:
1. SES (β=4.33, p = .005).
2. Typing (β=5.087, p = 0.013).
3. Math.At (β= 1.84, p = .0035).
4. CLE.PR (β=-3.36, p = .0034).

Demographic data, "Student Self-efficacy" Achievement on Math MAP

B:
- The overall regression was statistically significant (R^2 =0.19, $F_{(11, 153)}$ = F-3.36, p =0.003.
- The following significantly predicted math MAP test:
1. SES (β=4.53, p = 0.00)
2. Typing (β=4.7, p = 0.05)
3. SSE.ML (β=3.93, p = 0.05)
4. SSE.CHOTS (β= -3.347, p = 0.044).
   - ~~Gender (β=2.88 , p <0.16).~~

Demographic data, "Constructivist Learning Environment" and Achievement on Science MAP

C:
- The overall regression was statistically significant ($R^2 = 0.26$, $F_{(9, 155)}$ = F: 5.94, p =0.000
- The following significantly predicted science MAP test:
1. Gender (β=-5.4 , p = 0.005)
2. SES (β=2.8, p = 0.038).
3. Typing (β=3.58, p = 0.04).
4. CLE.Un (β=5.45, p = 0.000).

Demographic Data, "Student Self-efficacy" & Achievement on Science MAP Test

D:
- The overall regression was statistically significant (R^2 =.27, $F_{(11, 153)}$ = F-Ratio 5.02, p = 0.000.
- The following significantly predicted science MAP test:
1. Gender (β= -5.6, p = 0.003)
- ~~SES (β=2.33 , p = 0.11)~~
- ~~Typing (β= , p = 0.16)~~
1. SSE.ML (β=3.7, p = 0.07)
2. SSE.CAP (β=4.34, p = 0.02)

Implications of the Research

Developing Research culture that improves practice in the schools

The perception of the participation of research

Gaining a better understanding of the contextual relevance

Understanding the intended curriculum vs the learned curriculum

MAP may not be culturally responsive and not consistent

Limitations of the Study

Social desirability bias in association with self-report

Students scores are linear with no outliers

A gap might exist between the intended curriculum and the learned curriculum

Lack of participation in research

References

- Arens, A. K., & Möller, J. (2016). Dimensional comparisons in students' perceptions of the learning environment. Learning and Instruction, 42, 22-30. doi:10.1016/j.learninstruc.2015.11.001
- Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. Educational Psychologist, 28(2), 117–148.
- Bandura, A. (1997). Self-efficacy: The exercise of control. New York: Freeman.
- Zubeyde Demet Kirbulut & Esen Uzuntiryaki-Kondakci (2019) Examining the mediating effect of science self-efficacy on the relationship between metavariables and science achievement, International Journal of Science Education, 41:8, 995-1014, DOI: 10.1080/09500693.2019.1585594
- Department Of Education And Knowledge. (n.d). Private Schools Overview. Retrieved from https://psp.adek.gov.ae/en/investors
- Fast, L. A., Lewis, J. L., Bryant, M. J., Bocian, K. A., Cardullo, R. A., Rettig, M., & Hammond, K. A. (2010). Does math self-efficacy mediate the effect of the perceived classroom environment on standardized math test performance? Journal of Educational Psychology, 102(3), 729-740. doi:10.1037/a0018863
- Huang, C. S. J., Yang, S. J. H., Chiang, T. H. C., & Su, A. Y. S. (2016). Effects of situated mobile learning approach on learning motivation and performance of EFL students. Journal of Educational Technology & Society, 19(1), 263-276. Retrieved from https://search-proquest-com.zulib.idm.oclc.org/docview/1768612513?accountid=15192
- Käfer, J., Kuger, S., Klieme, E., & Kunter, M. (2018). The significance of dealing with mistakes for student achievement and motivation: Results of doubly latent multilevel analyses. European Journal of Psychology of Education, 1-23. doi:http://dx.doi.org.zulib.idm.oclc.org/10.1007/s10212-018-0408-7
- Kerzic, Damijana, et al. "Exploring critical factors of the perceived usefulness of blended learning for higher education students." PLoS ONE, vol. 14, no. 11, 2019, p. e0223767. Gale In Context: Opposing Viewpoints, https://link-gale-com.zulib.idm.oclc.org/apps/doc/A606436408/OVIC?u=zayed&sid=OVIC&xid=8c68c366. Accessed 30 July 2020.
- Pamuk, S., Sungur, S., & Oztekin, C. (2017). A Multilevel Analysis of Students' Science Achievements in Relation to their Self-Regulation, Epistemological Beliefs, Learning Environment Perceptions, and Teachers' Personal Characteristics. International Journal of Science & Mathematics Education, 15(8), 1423–1440. https://doi-org.zulib.idm.oclc.org/10.1007/s10763-016-9761-7
- students' individual and shared perception of dealing with mistakes affect students' motivational and cognitive learning outcomes in different ways. Furthermore, our findings underline the relevance of teachers' attitudes as well as students' perceptions concerning mistakes for student learning and motivation in English as a foreign language class.
- Balentyne, P., & Varga, M. (2017). Attitudes and achievement in a self-paced blended mathematics course. Journal of Online Learning Research, 3(1), 55-72. Retrieved from https://eric.ed.gov/contentdelivery/servlet/ERICServlet?accno=EJ1148593
- Fazal, M. & Minaz, B. (2019). Blended learning in middle school math: The question of effectiveness. Journal of Online Learning Research, 5(1), 49-64. Retrieved from https://eric.ed.gov/contentdelivery/servlet/ERICServlet?accno=EJ1208816
- Hager, J. (2017). The Relationship of Reading Self-Efficacy and Reading Achievement in Second Grade Students (Unpublished master's paper). University of Montana, Montana. Retrieved from https://scholarworks.umt.edu/cgi/viewcontent.cgi?article=12111&context=etd
- Koenig, B. (2018). Effects of Blended Learning on At-Risk Youth: A Quantitative Study. Retrieved from URL: http://gateway.proquest.com.libconnect.ku.ac.ae/openurl?url_ver=Z39.88-2004&rft_val_fmt=info:ofi/fmt:kev:mtx:dissertation&res_dat=xri:pqm&rft_dat=xri:pqdiss:10981950
- NWEA. (2020). Map Growth-Map Reports Reference. Retrieved from https://teach.mapnwea.org/impl/PGM2_MAP_Reports_Reference.pdf
- NWEA. (2017). NWEA Guidance on the Interpretation and Use of New Engagement Metrics in MAP Growth Reports. Retrieved from https://www.nwea.org/content/uploads/2018/01/NWEA-Guidance-on-the-Interpretation-and-Use-of-New-Engagement-Metrics-in-MAP-Growth-Reports-1.pdf
- NWEA, (2011). Technical Manual For Measures of Academic Progress® (MAP®) and Measures of Academic Progress for Primary Grades (MPG). Retrieved from https://www.richland2.org/RichlandDistrict/media/Richland-District/AdvancED/Standard%205/5.1/5-1-NWEA-Technical-Manual-for-MAP-and-MPG.pdf