Preparing Preservice Early Childhood Teachers to Evaluate the Efficacy of Science Activities

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Purpose

To identify and analyze students' abilities to assess the effectiveness of self-selected on-line STEAM activities as well as their attitudes toward teaching science. The eventual goal is to see if a correlational relationship exists and, if so, how this can be used to increase preservice teachers' abilities and interests in teaching STEAM activities in early childhood settings.

Background

Students in an Early Childhood curriculum development class do an assignment of evaluating an online science activity against the criteria for such activities developed by Petersen et al (2019). The activity occurs in an integrated curriculum course the semester before the students begin student teaching.

Context and Participants

- Subjects – Spring/Fall 2021
  - Early Childhood/Childhood Education dual certification majors
  - In their 5th of 6 blocks of classes
  - Semester before Student Teaching
  - N = 70 total
    - 49 Spring 2021 (assignment only)
    - 21 Fall 2021 (assignment and survey)

Context and Participants: Prior relevant coursework

ECED 222: Teaching, Learning, and Inquiry

An introduction to the processes of teaching, learning, and assessment examining pedagogical approaches, including how to develop an **inquiry mindset**, models associated with various developmental domains; **teaching strategies** for use with diverse young children.

Selected Student Learning Outcomes:

- Demonstrate an understanding of learning as an ongoing, **inquiry-based process** that is both individual and collective
- Demonstrate an understanding of how to support growth across developmental domains … and discuss **implications for planning, implementation**, & assessment
- Demonstrate knowledge of and the ability to locate **appropriate curriculum resources**

Selected Assignments

- Two inquiry-focused lesson plans (taught to peers)
- Virtual field visit observations and reflections of an expeditionary learning school using inquiry learning through a project-based curriculum

Context and Participants: Prior relevant coursework

CURR 316: Teaching Science and Math to Children

Contemporary teaching/learning **strategies** for math and science in early childhood and elementary classrooms. Focus on the nature of children's science and math learning, teacher as learning facilitator, and New York State and National Learning Standards for STEM.

Selected Student Learning Outcomes:

- Demonstrate an understanding of developmentally appropriate teaching practices in **science and mathematics** for **preschool, primary**, and intermediate students
- Demonstrate an understanding of the place of **inquiry and problem-solving** objectives in science and mathematics teaching

Context and Participants: Current course

ECED 353: Curriculum Development for Young Children

Further understanding of the **organization and management** of functional learning environments for young children and the use of **curriculum development principles** and **strategies** to design **developmentally appropriate and educationally sound** learning experiences for young children.

Selected Student Learning Outcome (aligned with the assignment):

- Demonstrate, p**lan, implement and evaluate curriculum activities** for young children that are **developmentally appropriate** … and are **educationally worthwhile**.

Assignment Preparation

- Prior analysis of online creative/art activities for young children
- Discussions of Misconceptions
  - Sinking/Floating activity
- Discussion of responding to unanticipated student questions
- In-class exploration of STEM/STEAM activities for young children (e.g. creating ramps out of loose parts)

Instruments

Curriculum Analysis Template

Attitudes toward Science Teaching scale

Curriculum analysis template

Ten curriculum analysis constructs

1. Meaningful to Children
2. Activity engagement
3. Presence of problem-solving
4. Making claims from evidence
5. Engaging communication
6. Collect & record data
7. STEM concepts
8. Sharing findings
9. Integrating language & literacy
10. Student Collaboration

Each construct was prompted by a key question with 2-4 sub-questions for a total of 37 review questions in the template

Peterson, S., et al. (2019) "To Pin or not to Pin: Choosing, Using and Sharing High-Quality STEM Resources? *Young Children, 74*, 3. Retrieved from: To Pin or Not to Pin_ Choosing, Using, and Sharing High-Quality STEM Resources _ NAEYC.pdf

Curriculum analysis template

- Peterson et al. (2019) created this template for teachers to analyze STEM resources that they find online.
- Most students and teachers use online resources for their planning. Thus, they must critically evaluate these resources to ensure they are appropriate for both the children and the content they are teaching.
- We chose the template based on its accessibility and straightforward application for use by teachers with the hope that the students will continue to use this type of analysis when they officially become teachers.
- Furthermore, it aligns with key areas of consideration to evaluate STEM concepts which allowed us to focus on specific areas for our data analysis

Peterson, S., et al. (2019) "To Pin or not to Pin: Choosing, Using and Sharing High-Quality STEM Resources? *Young Children, 74*, 3. Retrieved from: To Pin or Not to Pin_Choosing, Using, and Sharing High-Quality STEM Resources_NAEYC.pdf

Teacher Attitude Scale

Early Childhood Teacher's Attitudes toward Science Teaching

Four subscales

1. Comfort/Discomfort
2. Classroom preparation requirements
3. Managing Hands-on science
4. Child development appropriateness

Each subscale had 5-6 items for a total of 22 items in the instrument
Five-item Likert Scale; scored 1-5

Cho, H.-s., Kim, J., & Choi, D. H. (2003, December). Early Childhood Teacher's Attitudes toward Science Teaching: A Scale Validation Study. *Educational Research Quarterly, 27*(2), pp. 33-42.

Method

STEAM activity analysis assignment

Student:

1. Chooses an online preschool STEM/STEAM activity
2. Analyzes the activity with a template based on Peterson et al. (2019)
3. Decides whether the activity is developmentally appropriate
4. Justifies their decision and either
    a. (if appropriate) Connect to 2 readings and explain the justification of why it is appropriate
    b. (if not appropriate) Either:
    - modify the activity to be suitable for young children's STEM/STEAM learning
    - or explain why they cannot change the activity with a justification aligned to what they have learned in the course

Results

Statistics:
STEAM Activity Analysis

	Number	Avg. Lngth	Highest	Lowest
Yes	36	268	491	126
No	34	363	716	81

Note: Disregarding the 81 Lowest word count for “No” answers, the lowest word count response was 188.

Curriculum analysis construct recommendations

[34 of 70 students made a total of 77 recommendations]

Construct	Cited	% cited	Rank
Meaningful to Children	7	9.1%	
Engaging to children	10	13.0%	T2
Presence of problem-solving	17	22.1%	1
Making claims from evidence	3	3.9%	T8
Engaging children in communication	2	2.6%	10
Collect & record data	8	10.4%	4
STEM concepts	10	13.0%	T2
Students sharing findings	6	7.8%	T 6
Integrating language & literacy	3	3.9%	T8
Student Collaboration	6	7.8%	T6
Other	5	6.5%	

Curriculum analysis construct recommendations - key observations

- Higher focus on problem-solving, STEM concepts, and engaging children

- Lower focus on integrating language and literacy and engaging children in communication
  - The lack of focus on integrating literacy is surprising due to students taking multiple literacy courses before this course.
  - The lower areas of focus may be related to a lack of direct experience in classrooms.
    - Due to COVID-19, the students have only had virtual placements, not in-person placements, at this point.
      1. The lower areas, such as engaging children in communication, might be connected to this lack of experience directly communicating with children.
      2. The students' higher focused areas, such as engaging/meaningful and STEM concepts, can be considered in general lesson planning without direct engagement with children.

- Findings reveal the need to review the Peterson checklist questions and sub-questions to determine if some areas (e.g., language/literacy) are questioned more precisely than others.

Results

Top four recommendations

1. Increase problem-solving element
2. More engaging to the children
3. [tie 2] More (or *more appropriate*) STEAM concepts
4. Add collecting and recording data

Lowest four recommendations

7. [tie 6] Student collaboration/Sharing findings
8. Making claims from evidence
9. [tie 8] Integrating Language and Literacy
10. Engaging children in communication

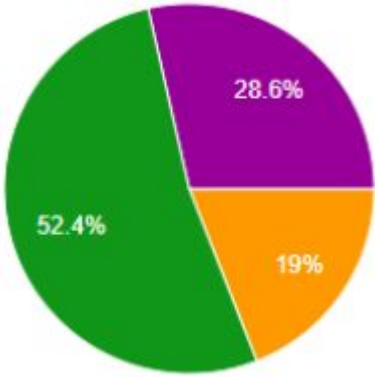
Statistics:
ECE Attitude Scale

SUBSCALE	AVG SCORE (1-5)
Comfort/Discomfort	3.88
Classroom Preparation	4.03
Managing Hands-on Science	4.40
Developmental Appropriateness	4.28

Some items were worded so that 1 (Strongly Disagree) indicated the more positive attitude toward teaching science. The point values of these items was reversed for the purposes of the statistics.

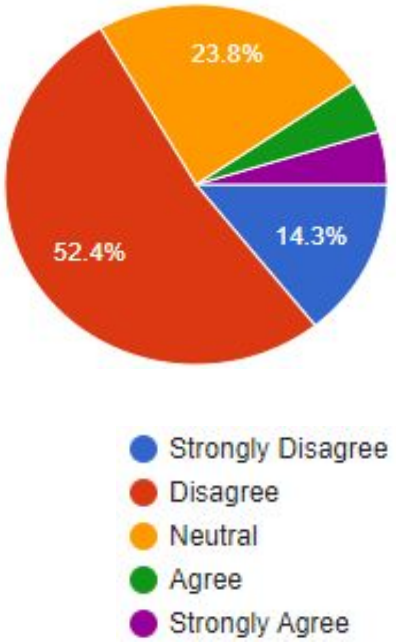
I feel comfortable doing science activities in my early childhood classroom

81.0% Positive Response



I fear that I am unable to teach science to young children adequately

66.7% Positive Response



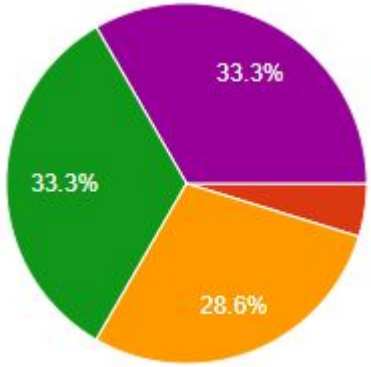
Although initially, these results may seem to contradict each other:

The comfort level students indicated regarding doing science activities is an expected response based on prior coursework.

The lower positive response regarding fear about teaching science is most likely a reflection of the level of experience candidates have in the classroom.

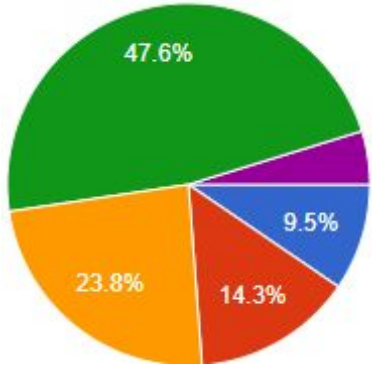
I feel comfortable with the level of scientific knowledge necessary for teaching young children

66.6% Positive response



I am afraid children may ask me a question about science principles or phenomena I cannot answer

23.3% Positive response

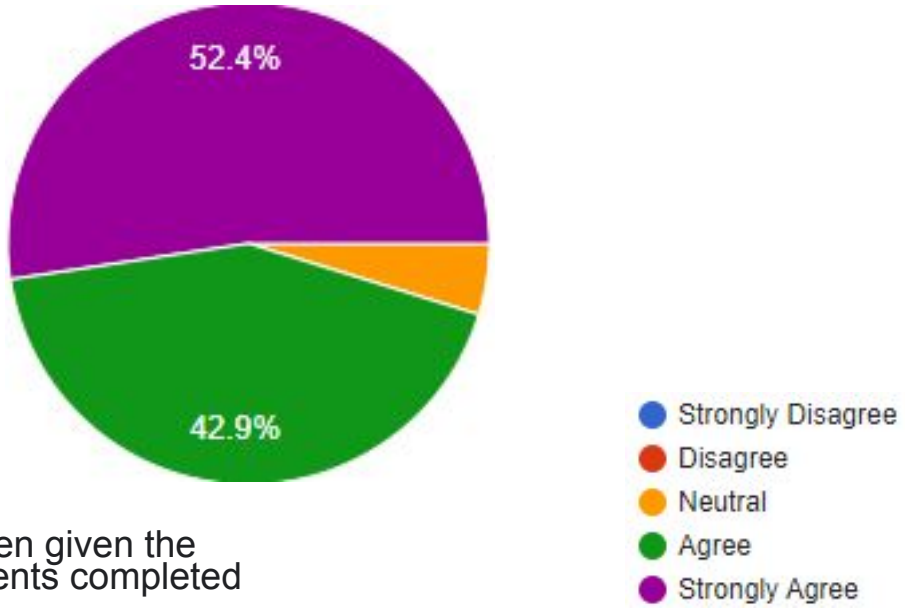


Again, the substantially lower positive response about answering children's questions seems to contradict the higher positive response about necessary knowledge for teaching science.

It would be good to use focus groups or individual interviews of students to further explore these anomalous results.

I am familiar with raising open-ended questions to encourage children's scientific thinking

94.3% Positive response

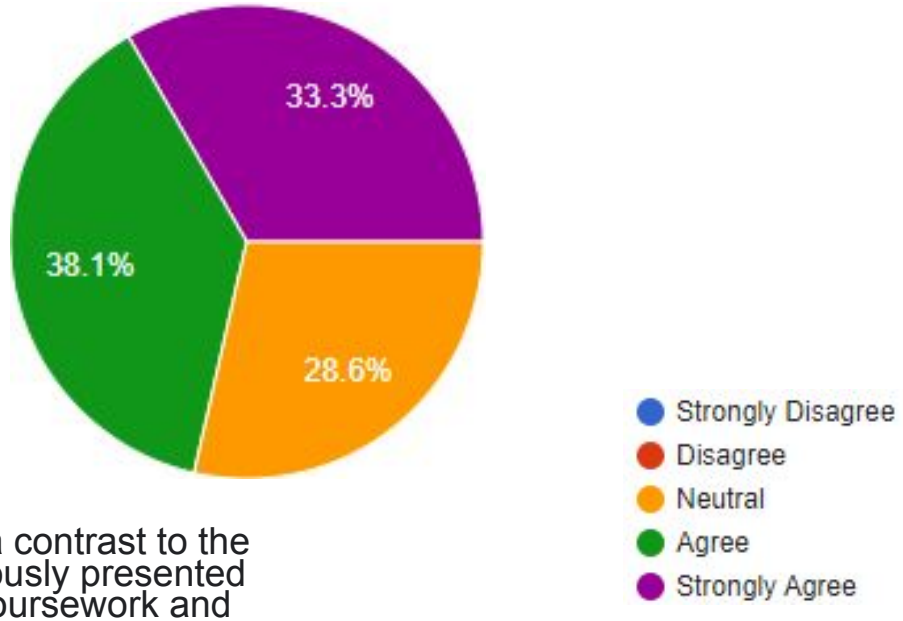


This was a surprising result even given the prior coursework and assignments completed by these students.

However, on further reflection, as the 5th semester of a 6-semester program, students who are not familiar with this type of questioning have probably not continued in the program (as this is an important basis of inquiry-based teaching and is emphasized in the program).

I am comfortable with determining the science curriculum that is developmentally appropriate for young children

71.4% Positive response



This result was surprising (as a contrast to the student response for the previously presented item). Candidates have prior coursework and assignments that should have made them comfortable with determining developmentally appropriate science curriculum.

This result merits further investigation through focus groups or individual interviews.

Further research

- Modify Peterson et al. (2019) checklist
  - Based on results to clarify activity implementation
  - Possibly add sub-questions or modify questions (e.g., language/literacy and student communication)
- Assessment at different stages of the program
  - One cohort
  - Implement ECE Attitude Scale multiple times in the program
    - ECED 222 course (pre)
    - CURR 316 course (pre)
    - ECED 353 (pre and post)
  - Students complete in-person field experiences (hopefully!)
- Follow up interviews
  - Interviews or discussion groups may be used to discern anomalous results from the attitude scale.
- Other scales
  - Consider using the Maier (2013) scale over the Cho & Choi (2003) scale

Selected References

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