Evaluating 21st Century Skills Development through Makerspace Workshops in Computer Science Education.

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Petros Papagiannis received the master's degree in Data Science and Engineering from the Cyprus University of Technology , in 2023. He is currently a Phd Candidate majoring in Using Graph Neural Networks to Analyze Team Interactions and Improve Football Coaching Strategies at the Cyprus University of Technology. In addition he is the coordinator of the Computer Science BSc in the Cyprus College in Limassol

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Introduction

Objective:

- The study aims to evaluate the development of 21st-century skills—specifically critical thinking, collaboration, communication, and creativity—through makerspace workshops integrated into computer science education.
- Makerspaces provide a collaborative environment where students can engage in hands-on, project-based learning, aligning with educational goals for skill development.

Methodology

- Workshop Overview: The workshops were conducted in 'Introduction to Programming' and 'Computer Architecture' courses, involving activities like building digital circuits and programming microcontrollers.

- Assessment Method: Skills were assessed using pre- and post-workshop surveys based on the 21st Century Skills Survey Instrument methodology, with data analyzed using Python for statistical significance.

Results

- Key Findings: Significant improvements were observed across all skill areas. Critical thinking scores increased from a mean of 3.8 to 4.2, while creativity saw the most substantial gain, with a mean increase from 4.0 to 4.5.

- Paired t-tests confirmed the significance of these improvements (all p-values < 0.05).

- Pre-Assessment Descriptive Statistics:

Skill	Mean	Median	Std Dev	Min	Max
Critical Thinking	3.8	4.0	0.9	2	5
Collaboration	4.1	4.0	0.8	3	5
Communication	3.9	4.0	0.7	2	5
Creativity	4.0	4.0	0.8	3	5

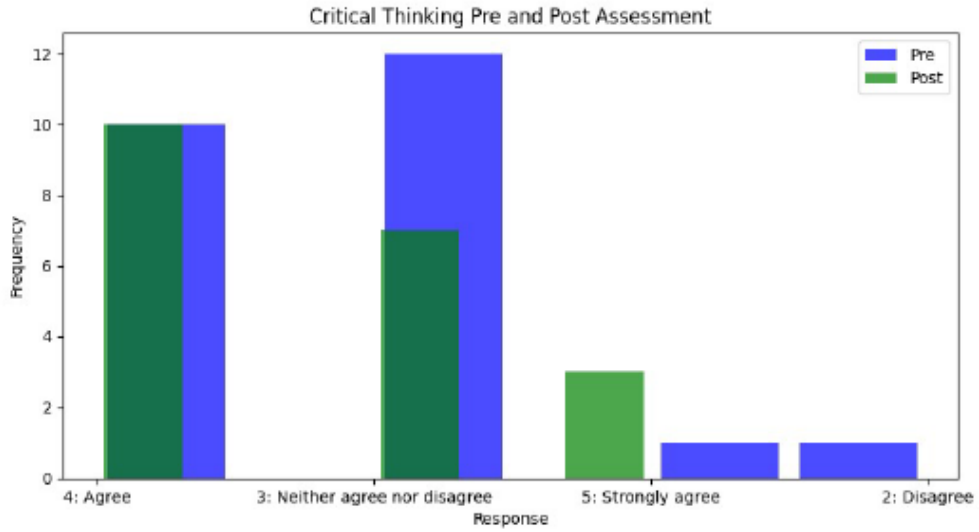
- Post-Assessment Descriptive Statistics:

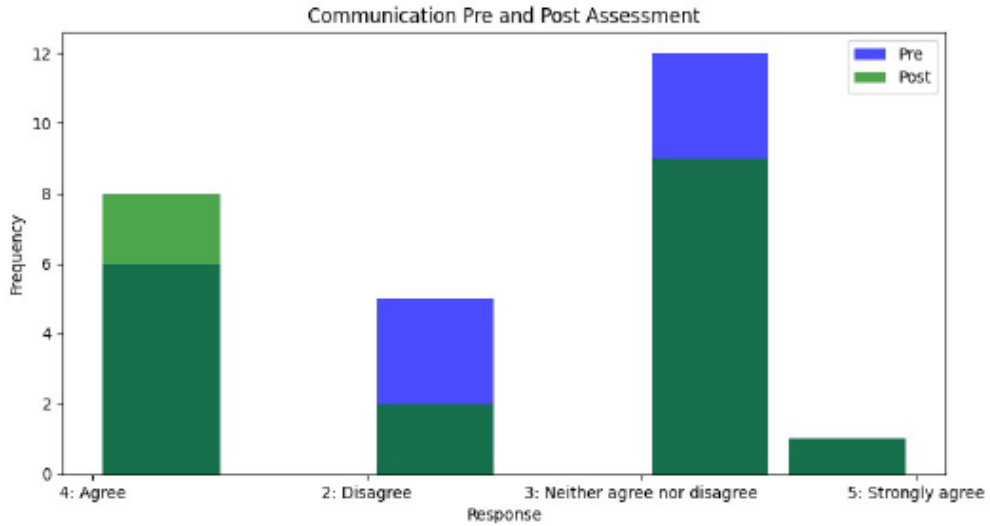
Skill	Mean	Median	Std Dev	Min	Max
Critical Thinking	4.2	4.0	0.7	3	5
Collaboration	4.4	4.0	0.6	3	5
Communication	4.3	4.0	0.7	3	5
Creativity	4.5	4.5	0.6	4	5

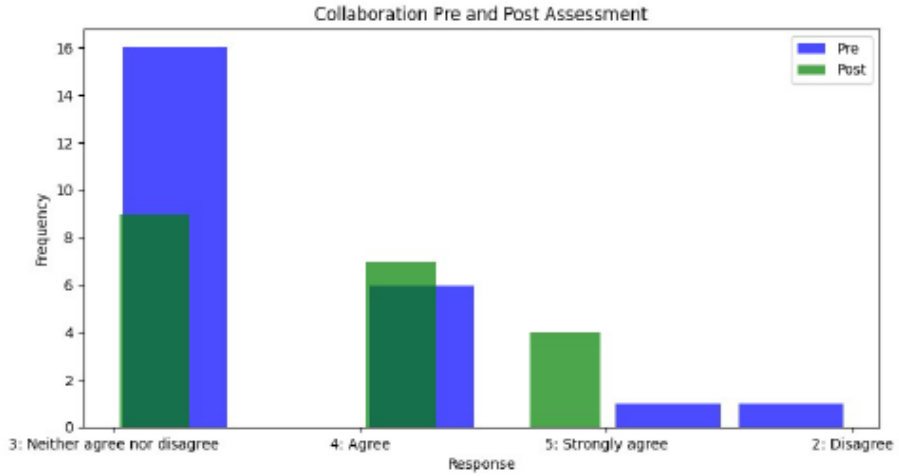
- Paired t-test Results:

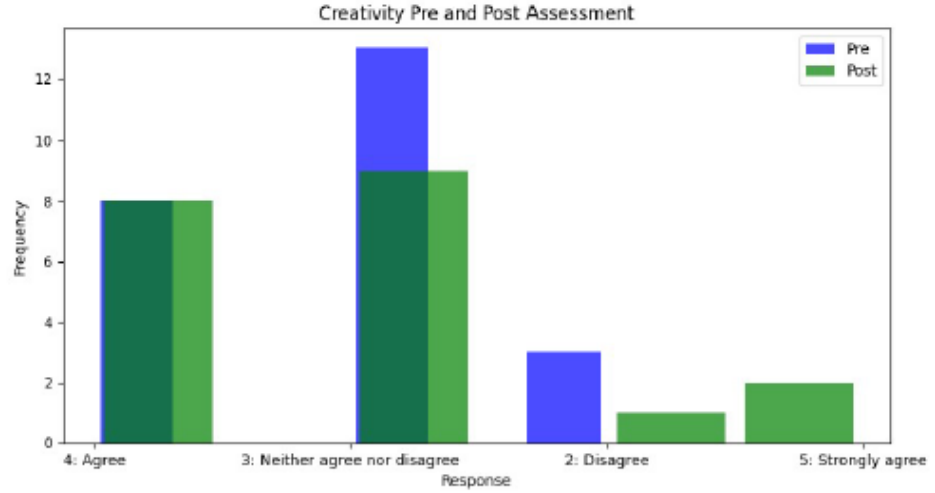
Skill	t-value	p-value
Critical Thinking	3.5	0.001
Collaboration	4.2	0.0005
Communication	3.8	0.0008
Creativity	4.5	0.0002

Results









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Discussion

- Implications: The results suggest that makerspace workshops can significantly enhance essential 21st-century skills in computer science students, potentially leading to better preparedness for professional and academic challenges.

- Limitations: While positive, the study's results are based on a small sample size, and further research with larger groups is recommended.

Conclusion

- Makerspaces offer a valuable platform for experiential learning, driving skill development beyond traditional lecture-based approaches. Future work will explore scalability and long-term impacts.

- Plans include expanding the workshops to more courses and exploring virtual makerspaces as an alternative for remote learners.

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Acknowledgements / Contact Information

- Acknowledgements:
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