MATHEMATICAL ASSOCIATION OF AMERICA

RUTGERS
THE STATE UNIVERSITY
OF NEW JERSEY

MAA MATHFEST
TAMPA
FLORIDA
AUGUST 2-5, 2023

ST. JOHN'S
UNIVERSITY

INQUIRY-BASED LEARNING, AUGUST 3RD, 2023

Inquiry-based Counting Problems and the Mathematical Cryptography Cybersecurity Password Activity

Rasha Abadir: M.A., PTL, Ph.D. Student, Rutgers University

Suzanna Schmeelk: Ed.D., D.P.S., M.B.A., St. John University

Agenda

- Introduction

- The Longitudinal Study

- Video Mosaic Collection

- VMC Analytics

- Cyber Security Pilot Study and Password Activity

- Conclusion and Implications

MATHEMATICAL ASSOCIATION OF AMERICA

MAA MATHFEST
TAMPA
FLORIDA
AUGUST 2-5, 2023

INQUIRY-BASED LEARNING, AUGUST 3RD, 2023

"Tell me and I forget, teach me and I may remember, involve me and I learn." Benjamin Franklin

There is research evidence that when students from an early age are presented with well-designed mathematical problem tasks under certain conditions that support collaboration, emerging solutions can develop through student interaction and sharing of ideas (Maher & Martino, 1996).

MATHEMATICAL ASSOCIATION OF AMERICA

MAA MATHFEST
TAMPA
FLORIDA
AUGUST 2-5, 2023

INQUIRY-BASED LEARNING, AUGUST 3RD, 2023

The Longitudinal Study

In a long-term study, some problem tasks focused on the counting math strand, where students engaged in inquiry-based problems like building towers of a specific height with colored cubes or accounting for all possible pizzas with various toppings.

Students uncovered innovative solutions for these tasks, using representations and justifications to demonstrate their confidence in finding all possible towers or pizzas based on given conditions (Maher, 2005, 2010).

The Video Mosaic Collaborative

A distinctive collection of more than 5000 hours of digitized recordings from longitudinal and cross-sectional studies of students doing inquiry-based mathematical problem tasks.

These video resources are available to educators and researchers all over the world free of charge.

The Video Mosaic recordings demonstrate that students as young as elementary school age can effectively deal with complex mathematics problems.

https://videomosaic.org/

MATHEMATICAL ASSOCIATION OF AMERICA

MAA MATHFEST
TAMPA
FLORIDA
AUGUST 2-5, 2023

INQUIRY-BASED LEARNING, AUGUST 3RD, 2023

VMC Analytics

Third-graders, Stephanie and Dana, justify their solutions to a series of counting problems that inquire about finding the number of distinct outfits that could be created with a certain number of available colored shirts and pants.

https://rucore.libraries.rutgers.edu/rutgers-lib/70475/

Brandon, a fourth grader in a slow learning class, surprised his teacher by presenting a strong argument that accounted for all possible pizzas with 4 different toppings without any duplication or leaving out any possibilities. Brandon also made a clear connection to the number of all possible 4-tall towers using 2 different colored cubes.

https://rucore.libraries.rutgers.edu/rutgers-lib/65272/

MATHEMATICAL ASSOCIATION OF AMERICA

MAA MATHFEST
TAMPA
FLORIDA
AUGUST 2-5, 2023

INQUIRY-BASED LEARNING, AUGUST 3RD, 2023

Pilot Study and Password Activity

- The aim of the study was to investigate middle-school students' understanding of web browsing, cyber risks, and online safety during remote learning.

- The study involved eighth-grade students working in pairs over seven sessions, in addition to pre and post-interviews about their knowledge of cybersecurity.

- During one of the sessions, a password activity was used to prompt discussions on strong and weak passwords, incorporating counting and sample space.

MATHEMATICAL ASSOCIATION OF AMERICA

MAA MATHFEST
TAMPA
FLORIDA
AUGUST 2-5, 2023

INQUIRY-BASED LEARNING, AUGUST 3RD, 2023

Conclusion

Building an understanding of counting principles through the facilitation of inquiry-based tasks could potentially foster a foundation for insights into cybersecurity.

References

MATHEMATICAL ASSOCIATION OF AMERICA
MAA MATHFEST
TAMPA
FLORIDA
AUGUST 2-5, 2023
INQUIRY-BASED LEARNING, AUGUST 3RD, 2023

Agnew, G., Mills, C., & Maher, C. (2010). VMCAnalytic: Developing a collaborative video analysis tool for education faculty and practicing educators. In R. H. Sprague, Jr. (Ed.), Proceedings of the 43rd Annual Hawaii International Conference on System Sciences (HICCS-43): Abstracts and CD-ROM of full papers. IEEE Computer Society. Los Alamitos, CA: Conference Publishing Services.

Maher, C. (2005). How students structure their investigations and learn mathematics: Insights from a long-term study. The Journal of Mathematical Behavior, 24(1), 1–14.

Maher, C. (2010). The Longitudinal Study. In Combinatorics and Reasoning: Representing, justifying, and building isomorphisms. New York: Springer.

Maher, C. A., & Martino, A. M. (1996). The Development of the Idea of Mathematical Proof: A 5-Year Case Study. *Journal for Research in Mathematics Education JRME, 27*(2), 194-214.

Martino, A., & Maher, C. (1999). Teacher questioning to promote justification and generalization in mathematics. The Journal of Mathematical Behavior, 15(1), 53–78.

Schmeelk, S., Krumpnik, V., Wilkinson, L., & Maher, C. A., (2023), Understanding Interventions for Middle school Student's Online Cybersecurity Risks: A Multidisciplinary Analysis, 18th Annual Hawaii International Conference on Education, Honolulu, HI.

Schmeelk, S., Abadir, R., Krumpnik, V., Wilkinson, L., & Maher, C. A., (2024), Middle-School Students' Understanding of Key Cybersecurity Risks, 19th Annual Hawaii International Conference on Education, Waikola, HI. (Under Review)

INQUIRY-BASED LEARNING, AUGUST 3RD, 2023

Thank you!
Q&A
Emails:
rga24@math.rutgers.edu

schmeels@stjohns.edu