

# Spreadsheet-based math-CT activities: Solving statistics problems

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## Introduction

CT has gained great attention as many countries and bodies have tried to realize it in schools' curricula (Bocconi et al., 2016) There has been a positive relationship between pre-service teachers' CT preparation and their future instruction (Yadav et al., 2011). Pre-service teachers have been prepared with programming courses such as in Singapore (Ho & Ang, 2015). This study will investigate spreadsheet-based Math-CT lessons implemented in pre-service teachers.

Papert (1980) first introduced CT as a way to construct knowledge through interactions with computer programs. Another definition of CT refers to computational thinking as a thought process involved in formulating problems and their solutions so that the solutions are represented in a form that can be effectively carried out by an information-processing agent (Wing, 2010). In this study, we define CT as problem-solving and thought processes to solve problems by human or processing agents or both and to construct knowledge.

## Computational thinking framework

Ye et al. (2023) have summarized the frameworks used for CT integration. One of the frameworks is by Shute et al. (2017). This framework adapted and improved the previous frameworks. The framework has six facets namely; decomposition, abstraction, algorithm, debugging, iteration, and generalization (Shute et al., 2017). This framework provides detailed indicators of the facets, and it helps us to incorporate them into learning activities, and these are more operational. Therefore, the authors decided to use this framework to develop Math-CT activities using a spreadsheet. Moreover, Papert (1980) developed constructionism theory where the individual artefacts construction is fostered. This study was also based on that theory to let our participants construct artefacts.

This study explored the plugged CT activities used by a computer or processing agent. A literature study by Ye et al. (2023) summarized the software used such as general programming like Scratch, Arduino, and Python, and mathematics software like GeoGebra, Geometer Sketchpad, MATLAB, and Spreadsheet. A spreadsheet is more available and affordable for teachers and schools (Ho & Ang, 2015). Therefore, using the spreadsheet for this study is convenient for the respondents to access.

## Method

This study used an online survey through Google Forms distributed to pre-service mathematics teachers (PSMT). An online survey was used as in 2021 the Covid-19 pandemic was still prevalent

and physical distancing was recommended. A spreadsheet document was attached to the Google Forms and contains a statistics problem related to average score and then respondents should solve it and upload it. This poster will present only the statistics problem. The questions included Likert-scale ratings such as for their perception. Content analysis was used for this study.

## Report and analysis

This poster will highlight three main findings of the study. They are (1) CT's facets visible from activities with the spreadsheet document, (2) types of formulas to solve the problem, and (3) the perception of the usefulness of the spreadsheet. First, some CT's facets by Shute et al. (2017) incorporated in the activities are visible. The respondents worked on data of mathematics scores (numbers) and had to find out who passed the mathematics exam or who did not. To do so, they must decide on the passing grade. To determine the passing grade, it has some formulas and steps to determine the cut-off score. These steps are like the decomposition facet, which breaks down the problem into smaller ones and is easier to solve. Working with formulas depicts the algorithm facet. The other facets will be presented on the poster. Second, some mistakes students make in using formulas are still prevalent due to different Ms. Excel versions. Third, respondents stated that a spreadsheet was helpful to solve the problem and could make them understand the concepts.

## Proposal

The digital poster will highlight the spreadsheet document and its incorporated CT's facets. Formulas inputted to solve the Math-CT problem and perceptions by pre-service teachers will be presented.

## References

- Bocconi, S., Chiocciariello, A., Dettori, G., Ferrari, A., Engelhardt, K., Kamyliis, P., & Punie, Y. (2016). Developing computational thinking in compulsory education. *Proceedings EdMedia 2016*. <https://doi.org/10.2791/792158>
- Ho, W. K., & Ang, K. C. (2015). Developing computational thinking through coding. *Proceedings of the 20th Asian Technology Conference in Mathematics*, 73–87. <http://atcm.mathandtech.org/>
- Papert, S. (1980). *Mindstorms: Children, computers, and powerful ideas* (1st ed.). Basic Books.
- Shute, V. J., Sun, C., & Asbell-Clarke, J. (2017). Demystifying computational thinking. *Educational Research Review*, 22, 142–158. <https://doi.org/10.1016/j.edurev.2017.09.003>
- Wing, J. M. (2010). Computational thinking-What and why? *The Link Magazine*. <https://www.cs.cmu.edu/link/research-notebook-computationalthinking-%0Dwhat-and-why>
- Yadav, A., Zhou, N., Mayfield, C., Hambrusch, S., & Korb, J. T. (2011). Introducing computational thinking in education courses. *SIGCSE '11: Proceedings of the 42nd ACM Technical Symposium on Computer Science Education*, 465–470. <https://doi.org/10.1145/1953163.1953297>
- Ye, H., Liang, B., Ng, O.-L., & Chai, C. S. (2023). Integration of computational thinking in K-12 mathematics education: A systematic review on CT-based mathematics instruction and student learning. *International Journal of STEM Education*, 10(3), 1–26. <https://doi.org/10.1186/s40594-023-00396-w>