

# Mathematics worksheet using interactive visualizations

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## Overview

Visualization is important for learners of all ages. Drawing is found to improve communication skills, critical thinking skills, reading skills, and mathematics skills in children [1, 2, 3, 5]. For mathematics, visualization plays an important role in learning and understanding most of the basic and advanced concepts. Children starts learning numbers, addition, and subtraction using their fingers and the number line. A study showed that four 15-minute sessions of games with a number line closed the knowledge gap between children from low-income and high-income family [4]. Not only children that benefit from using visualization in learning mathematics, students in higher education also benefit from using visual mathematics in their learning as well [2].

In this project, I made changes to worksheets I used in Vector Calculus (MAC-200) course by adding interactive visualizations in them.

## Aims and objectives

- To develop worksheets with interactive visualizations.
- To improve students' understanding in Vector Calculus using the interactive worksheets.

## Activities

- In lecture session, students use printed worksheets along with interactive ones that they can access from their phones or laptops.
- Students do assignments or homework using provided interactive visualizations as aid tools.

## Project in progress

This project is in progress. The interactive worksheets are intended to be used in MAC-200 in the 1<sup>st</sup> trimester

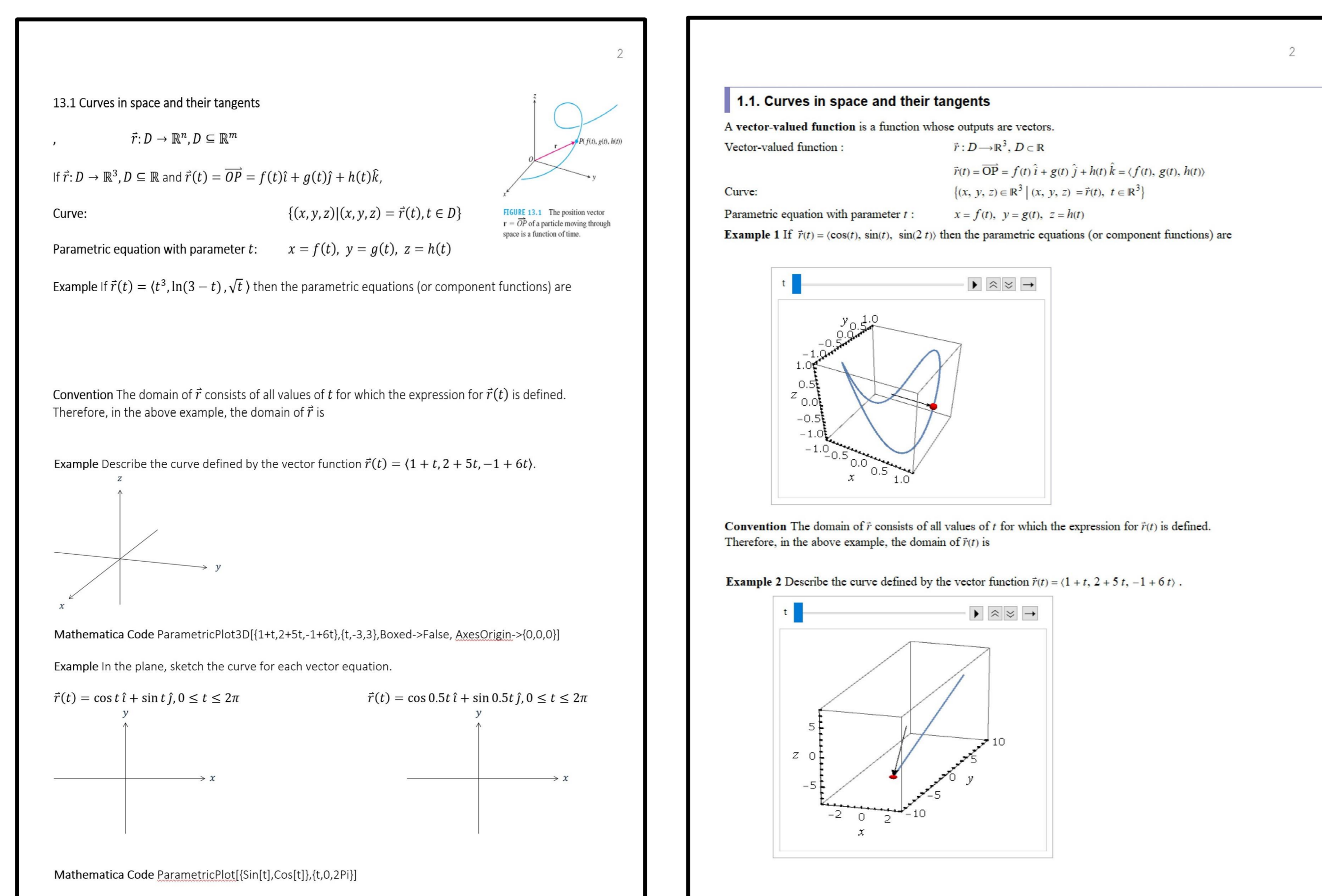


Figure 1 Comparing old worksheet (left) and the interactive worksheet (right)

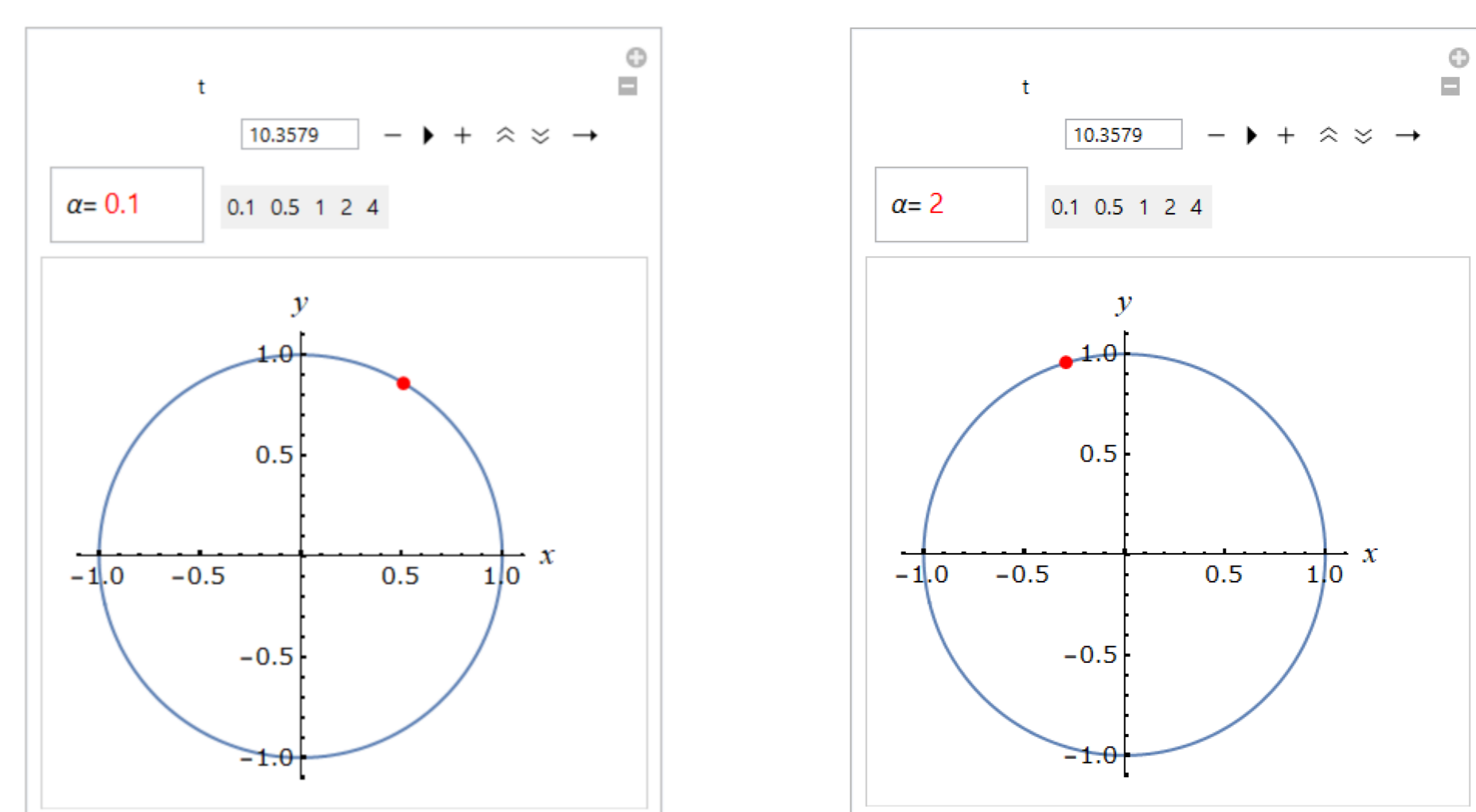


Figure 2 Students can interact with the content. In the example here students can change the value of  $\alpha$  in the vector equation  $\vec{r}(t) = \cos(\alpha t)\hat{i} + \sin(\alpha t)\hat{j}$  and relate it to the change of angular speed of the particle.

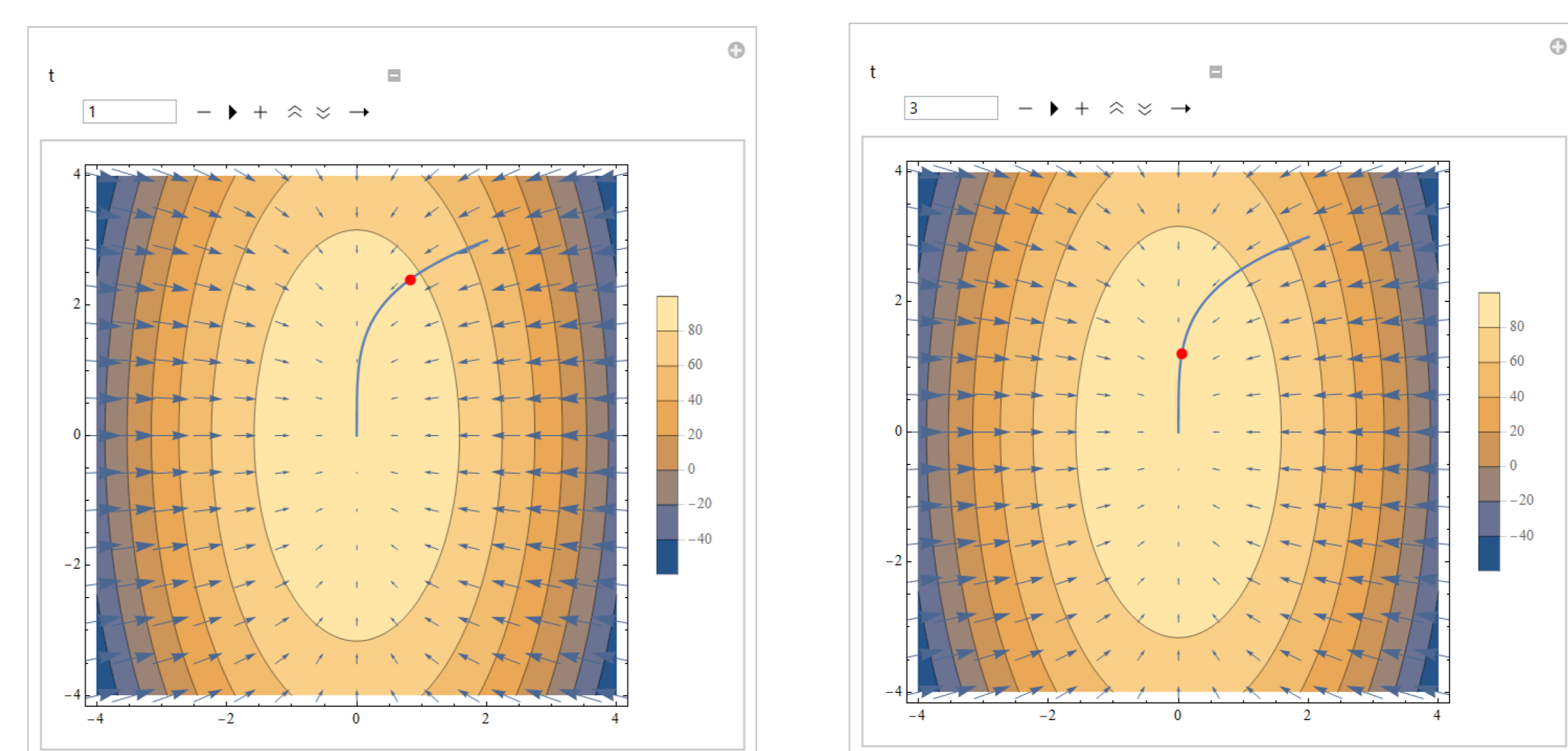


Figure 3 Students can see the visualization of an advanced problem such as the movement of heat seeking particle in their worksheet. The visualization can help them understand and be able to solve the problem faster.

## References

- 1) Anim, J. O. (2012). The role of drawing in promoting the children's communication in Early Childhood Education. *Early Childhood Education and Care*.
- 2) Boaler, J., Chen, L., Williams, C., & Cordero, M. (2016). Seeing as understanding: The importance of visual mathematics for our brain and learning. *Journal of Applied and Computational Mathematics*, 5.
- 3) Brooks, M. (2005). Drawing as a unique mental development tool for young children: Interpersonal and intrapersonal dialogues. *Contemporary Issues in Early Childhood*, 6(1), 80-91.
- 4) Siegler, R. S., & Ramani, G. B. (2008). Playing linear numerical board games promotes low-income children's numerical development. *Developmental science*, 11(5), 655-661.
- 5) Steffani, S., & Selvester, P. M. (2009). The relationship of drawing, writing, literacy and math in kindergarten children. *Reading Horizons*, 49(2), 4.