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Literature Review Of Physical And Virtual Robotics In Educational Environments

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ABSTRACT

As the modern world progresses, applications for robotic environments become more prevalent. Increasing demand for robotics has encouraged schools to provide a wider variety of coding and systems classes. Many challenges can arise from teaching robotics, some consisting of a lack of availability, the cost of machinery, and sometimes even a lack of time to effectively teach the curriculum.

Virtual Robotics Programming Curriculums

New virtual programs are being developed, that can offer potential solutions to the main issues physical robotics faces. EVRS and VRP-Cs are slowly being introduced into classrooms to be tested against physical robots. The goal of these tests is not to determine which method is best however, it is to study the differences the curriculums have on a student's learning methods.

Methods

Objective

- Determine the differences in using physical and virtual robotics in educational environments

ABB Robot Studio

- ABB simulation does not autosave and is buggy (risk losing work)
- $1,500

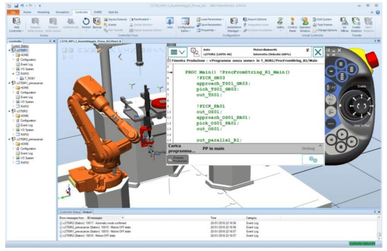

Figure 1

ABB IRB 1100.

Figure 3

Figure 2

- Non-portable and large, we used a table on wheels to move it around the room
- Requires pressured air and standard outlet, had to have an installed air compressor
- $15,000-$45,000

Virtual Vs. Physical Systems When Solving Problems

The physical students focused on testing their circuits against other physical robots (this was not required). This gave the students the opportunity to work with their robots outside of testing and get a better understanding of the machine's behaviors.

For the virtual class, the students were noted to have created their circuits at a consistent rate. Because the virtual students spent less time with each individual robot, they focused more on programming. This resulted in the students having less unique and less dense circuitry than the physical class.

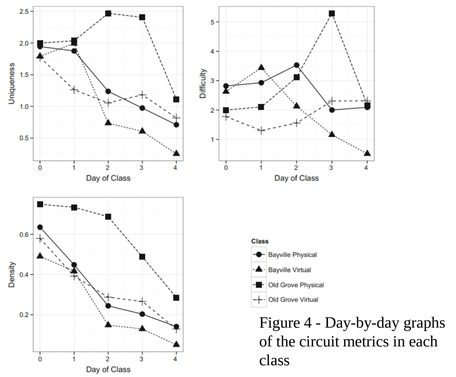

Figure 4 - Day-by-day graphs of the circuit metrics in each class

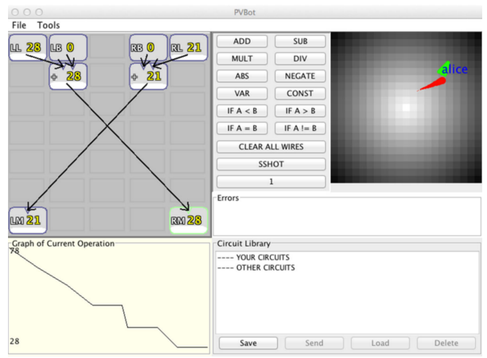

Figure 5 - VBOT client interface

VRP-Cs In Classrooms

VRP-Cs are being used to replace/make EVRs more efficient. The main fault of EVRs is that they waste time when being customized for students. It's been noticeable that since VRP-C has been introduced to classrooms, the students' and teachers' ability to understand computational systems has improved.

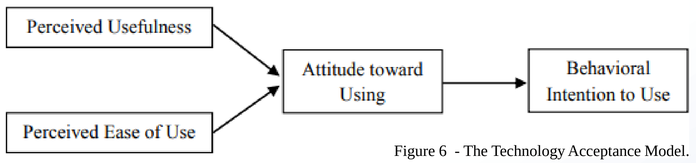

Figure 6 - The Technology Acceptance Model.

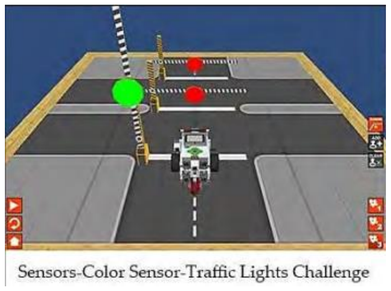

Figure 7 - challenges in VRP-C

Instructor Reviews

- Preservice CP teachers said after using VRP-C that they would incorporate it into their courses
- Many of the teachers said that the VRP-C systems were able to create environments that are too difficult to create in actual life.
- They appreciated that the codes written in VRP-C can be viewed step by step, this helps to detect errors and be more efficient in understanding what is wrong.
- The teachers supported that VRP-Cs prove cost-efficient and are more available to financially insufficient places. Not every school will have access to high-tech robotics because they are expensive. Thus, VRP-Cs, which are run remotely on PCs, are the best option.

Conclusion

When trialed against the same tests, virtually and physically taught students displayed different approaches to problems. This was likely due to the environment in which they worked the problems out.

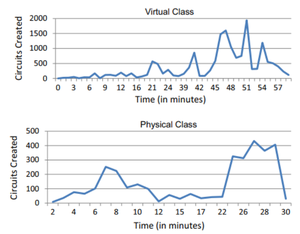

Figure 8 - Number of circuit changes per minute at Bayville in both the virtual (top) and physical (bottom) classes on Day 5

For virtual students, the ability to view their machines outside of the tests was limited. This led to the machines lacking uniqueness and complexity. The code for these machines, however, was more complex and displayed fewer errors than the physical students.

Using VRP-Cs can be useful teach robotics. Though they prove to be effective in teaching students how to program the machines, they do limit the students in creativity. Physical methods, while they encourage creativity and help students to understand the machines they work with. However, physical classes would still face the original barriers discussed. Using both physical and virtual methods to teach robotics would be the most beneficial to students.

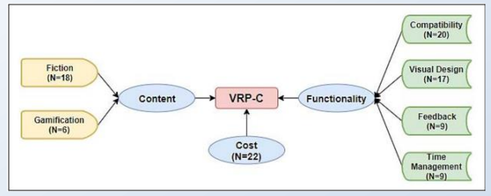

Figure 9 - The contributions of VRP-C to robotics programming teaching

REFRENCES

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Kılıç, S., & Gökoğlu, S. (2022). Exploring the Usability of Virtual Robotics Programming Curriculum for Robotics Programming Teaching. Informatics in Education, 21(3), 523-540.

Figure 1 - Gadaleta, M., Pellicciari, M., Berselli, G., & Tartarini, P. (2018). *Engineering Methods and Tools for Energy-Efficient Industrial Robotics* (Doctoral dissertation, Università degli Studi di Modena e Reggio Emilia).

Figure 2 - *Abb IRC5 Teach Pendant Industrial Robot Controller Touch Screen Protector*. (2023). Posr.us. Retrieved March 29, 2023, from https://www.posr.us/store/pc/viewPrd.asp?idproduct=1875.

Figure 3 - *Articulated robot IRB 1100*. ABB Robotics WebShop. (n.d.). Retrieved March 30, 2023, from https://webshop.robotics.abb.com/us/catalog/product/view/id/159/s/articulated-robot-irb-1100-assembly-r-0-475/category/3/

Figure 4 -*Articulated Robot Irb 1100*. (2018). ABB. Retrieved March 29, 2023, from https://webshop.robotics.abb.com/us/catalog/product/view/id/159/s/articulated-robot-irb-1100-assembly-r-0-475/category/3/?gclid=CjwKCAjwrJ-hBhB7EiwAuyBVXZKG2kXjmkHzB8N-_zuojzl_pSeIEBQdFWUwx2jS_PNx00fgvunGxoC-J0QAvD_BwE.

Figure 5 - Berland, M., & Wilensky, U. (2015). Comparing Virtual and Physical Robotics Environments for Supporting Complex Systems and Computational Thinking. Journal of Science Education and Technology, 24(5), 628-647.

Figure 6 - Kılıç, S., & Gökoğlu, S. (2022). Exploring the Usability of Virtual Robotics Programming Curriculum for Robotics Programming Teaching. Informatics in Education, 21(3), 523-540.

Figure 7 - Kılıç, S., & Gökoğlu, S. (2022). Exploring the Usability of Virtual Robotics Programming Curriculum for Robotics Programming Teaching. Informatics in Education, 21(3), 523-540.

Figure 8 – - Berland, M., & Wilensky, U. (2015). Comparing Virtual and Physical Robotics Environments for Supporting Complex Systems and Computational Thinking. Journal of Science Education and Technology, 24(5), 628-647.

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