Assessing the impact of using Python to teach Computational Thinking for remote schools in a Blended Learning Environment.

Lakshmi Preethi Kamak[1], Lisa Harris[2], Denise Baxter[2], Vijay Mago[1]
[1]DaTALab, Department of Computer Science, Lakehead University ,[2]Niijii Indigenous Mentorship, Indigenous Initiatives, Lakehead University

PROJECT OVERVIEW

The research is a collaborative project by Lakehead University and the Armstrong Public School, with funding from the NSERC Promoscience. The research aims to encourage the development of computational abilities to increase interest in coding using Python and visual blocks as a teaching aid in text-based programming.

Research Components

- **Computational thinking** (CT) allows us to understand a complex problem and work on solutions that humans and computers can understand. The methods involve breaking down problems into step-by-step solutions while identifying patterns and focusing on the important information.

- **Blended learning is a** method of combining online learning and classroom learning while providing access to all learning activities.

A customized blended learning environment with online and in-person classroom teaching materials is provided for the students of Grade 7,8 hosted on the D2L platform by Lakehead University.

Environment:
The structure of the teaching materials is based on the Ontario curriculum for coding concepts for grades 7 and 8. The code exercises were executed on the python console and Jupyterlab.

jupyter python

DEVELOPMENT PROCESS

Development phase

- Designing Curriculum content like lecture slides for Python Programming, lab manuals, exercises for middle school with widely used CT learning methodologies by integrating the Block-based coding by using visual aid in Python.

- Developing a customized blended learning environment with online and in-person classroom teaching materials is provided on the D2L platform.

Evaluation phase

- The proposed research will evaluate and compare the grade 7 and 8 student performance and receive feedback for the programming course that is taught using computational thinking methods.

- Following the ethical procedures recommended by the Research Ethics Board (REB) application has been submitted at Lakehead University. We have also received a letter of support from the Armstrong Public school.

- Developing the research survey, conducting the survey and data analyses of the results.

Since the project is yet to get through REB approval, we are currently at the development phase and have not started any analysis.

Challenges

- First Nation Schools are located remotely and with limited access to internet resources. Both online and offline materials are provided to students to enable a smooth transition.

- Since the dataset is small, the data will not be normally distributed, and hence non-parametric tests will be performed[3]. We plan to perform analytical methods like exploratory factor analysis and qualitative comparative analysis on the collected data.

RESEARCH INSTRUMENTS

Survey

The surveys are adapted from the following two questionnaires;
- Blended Learning Questionnaire (BLQ)
- Computational Thinking questionnaire (CTQ).

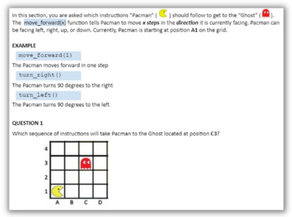
The CTQ questionnaire will question participants regarding CT skills. Scratch code was replaced with Python-based block code from the original CT test. Scratch is a block-based language that is easy for beginners to start coding. However, it may be cause frustration for students when transitioning from block to text-based programming with syntax errors as the most common reason[4].

The BLQ questionnaire will examine the structure of the course and feedback on our course.

The survey is based on the adaptation of the Callysto CTt assessment tool [1] and the Blended Learning Questionnaire [2]. Survey questions were carefully tailored to the student's grade.

Elements measured in Computational Thinking
- Digital Literacy
- Attitude towards Computational Thinking
- Previous Coding Experience
- Data Literacy
- Spatial CT Skills
- Problem Solving Skills

Elements measured in Blended Learning
- Experience with Using Blended Learning
- Comparison of Blended Learning to Face-to-Face Learning
- Overall Satisfaction with Blended Learning
- Comments on Blended Learning



Shifting from Block- to Text-based Programming

```
turn_right()
turn_right()
turn_left()
move_forward(1)
move_forward(1)
```

```
for x in range(3):
    move_forward(3)

turn_right()
move_forward(1)
```

```
while(car_destination != 'home'):
    if(front_side == 'clear'):
        move_forward(1)
    else:
        if(left_side == 'clear'):
            turn_left()
        else:
            turn_right()
        turn_left()
```

Teaching Python using blocks as visual aid

COMMUNITY PARTICIPATION

- The program is organized as a part of the Indigenous Outreach program by Niijii Indigenous Mentorship at Lakehead University.
- Students in grades 7-8 of Armstrong Public School, Gull Bay

DELIVERABLES

- The file label was designed to be interactive and encourage students to be familiar with the concepts of variables. The **file label** stores the student's name as a variable.

- Study materials incorporated with the **mascot**, which was named "Beavis" by the students enthusiastically.

- **Lab Manual**, Cue cards and D2L course in sync with the Ontario curriculum.

ACKNOWLEDGEMENTS

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NSERC CRSNG

We also acknowledge that our survey was adapted from the following established works:

[1] Callysto Computational Thinking Test (CCTT) (Student Version).
[2]Poon, Joanna 2013, Blended learning: an institutional approach for enhancing students'
learning experiences, Journal of online learning and teaching, vol. 9, no. 2, pp. 271-288.
[3] Diana Pérez-Marín, Raquel Hijón-Neira, Adrián Bacelo, Celeste Pizarro, Can computational thinking be improved by using a methodology based on metaphors and scratch to teach computer programming to children?, Computers in Human Behavior, Volume 105, 2020, 105849, ISSN 0747-5632
[4] Block-based coding. Block-Based Coding - Scratch Wiki. (n.d.). Retrieved February 24, 2022