FINAL REPORT ON COLLABORATIVE TECHNOLOGY PROJECT

“MATHEMATICAL AND COMPUTERIZED TRAINING MODELS TO PROMOTE EXECUTIVE FUNCTIONS IN LATE ELEMENTARY SCHOOL AGE CHILDREN”

FALL SEMESTER 2018

INSTRUCTIONAL DESIGN, DEVELOPMENT, AND EVALUATION

IDE 611: TECHNOLOGIES FOR INSTRUCTIONAL SETTINGS

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Proposal for Collaborative Technology Project

Project Title: Mathematical and Computerized Training Modules to Promote Executive Functions in Late Elementary School Age Children

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Brief Introduction:
the OECD’s Program for International Students Assessment (PISA) data show that Brazil is stuck, in the last ten years, among the ten countries with worst results in the educational field and even lowered its position in the global ranking, which is resulted from the poor promotion of Executive Functions (EFs) at school and the disarticulation of the transition between elementary and middle school. Therefore, a research will be done to develop and investigate the efficacy of a cognitive intervention program to promote EFs in a sample of late elementary school age children.

Purpose of the Project:
This project is to form mathematics and computerized training part of the intervention program to promote executive functions in late elementary school age children. Thus, it will contribute to the expansion of the repertoire of EFs in children in the transition period between elementary and middle school in Brazil as well as scaffolding teaching strategies that promote EFs into the daily curriculum of mathematics.

Target Audience: 5th grade students at public schools in the city of Sao Paulo

Technology or technologies to be used:
• National Library of Virtual Manipulatives (NLVM)  
http://nlvm.usu.edu/en/nav/vlibrary.html

The National Library of Virtual Manipulatives (NLVM) at Utah State University has transported powerful teaching tools on mathematics into the virtual dimension of the computer, which help illustrate mathematical relationships and applications in K-12 education. The NLVM is an effective means for accelerating and deepening students' understanding of math.

NLVM has also developed its Computer App which can be used offline and can support K-12 teachers to better embedded it into their courses.

Overall project review:

• EF for school students background knowledge
• Set up learning goals (EF, math, computer skill checklist)
• Gather relative websites and activities to develop content from #30-#35
• Revise the courses with storyboard for teacher and the assessment of the course

Tentative timetable:

Oct 1-8 Initial proposal
Oct 9-23 Proposal Revision
Oct 24-Nov 12 computer skills checklist/ what math knowledges they should achieve /activities in the following sections /progress report
Nov 13-30 storyboard for teacher, assessment
Dec 1-7 Final Report

Challenges to be faced:

• How to integrate math content with EFs? - Solution: Relate math learning goals with qualities of EFs.
• How to guarantee students could learn with the technology? - Solution: Develop a Students’ Computer Skills Checklist.
• How to guarantee teachers could make the most of the technology? - Solution: Develop a story board.
Expected results:

- To contribute to the expansion of the repertoire of EFs in children in the transition period between elementary and middle school in Brazil. Session plans #30-#35.
- To develop students’ computer skills. Students’ Computer Skills Checklist.
- To offer teachers training about how to promote EFs in the classroom with story board. Teachers story board.

Demonstration of the Project:

- Session plans #30-#35
- Assessments (included in each plan)
- Computer Skills Checklist

What we have done:

Our first meeting was set up on Oct 5th, during which Cristiane introduced briefly her dissertation and we made consensus on what’s our goals were. Based on her introductions, we shared our opinions, did the brainstorming and clarified misunderstandings. We completed our proposal according to our first meeting.

Our second meeting was made after having received the feedback from Prof. Lei. On the first meeting we modified the proposal according to the feedback and made our goals clearer that we should not only provide session plans through this project, but also a students’ computer skills checklist to guarantee students could learn with technologies, a teachers’ story board to guarantee that teachers could make the most of the technologies and an assessment rubric to support the evaluation of these courses. Through this meeting we narrowed down our goals and made it clear what was the assignment of each of us. We all had a more practical understanding of our project after the discussion.

The third meeting on Nov 9th was made to follow up each other’s progress. We shared our unfinished session plans and checklist and discussed with each other to make agreement. Cristina was also invited to make sure our plans were appropriate and feasible for practicing. We made it clear that our session plans should include teachers’ instructions word by word. Doubts and misunderstandings were put forward and discussed to make agreements.

Besides the three meetings, we kept following up with each other as well as making small discussions through WhatsApp and emails. We submitted our session plans as
well as other works on Google Drive so that others could download them and gave some suggestions or modifications. With mobile applications and devices, we tried to make discussions in time and efficient.

What challenges we have met and how we overcome that.

- Problem of Java. The technology website we use should be based on Java and it’s time consuming for us to figure out how to download it and install it because we all use different browser and PC systems. We discussed and exchanged some ideals and figured it out finally.

- It’s very challenging to narrow down our goal from the whole project into a more specific one. And we discussed what has already down and what is need to be down to make the scope clearer.

What we reflect about our project

Reflection of Wenjie Shen:

This project provided us with an authentic learning environment. Since this project was also one part of a dissertation, our session plans would be put into use in a real school in Brazil. We have a group of authentic target audiences and our product will be utilized to train authentic teachers, which made us excited and gave us pressure at the same time. With the authentic context, products and evaluation criteria, we could not "pretend" to do something, but consider and discuss everything as detailed as possible, which made tasks more challenging but also more meaningful.

This project is self-directed, which means that we decided our theme and goals, designed our project and arranged what we should do and when should we discuss all by ourselves. When it is self-directed, we took the most of the responsibility. We value the task that we chose by ourselves and kept working towards our goals, which made us more motivated to complete it. However, we still have assistance from our instructor. The scaffolds given by instructor were hidden behind. When we submitted our proposals for the first time, Prof. Lei comment that our goals were too big and we should narrow down. With her feedback we discussed and modified our goal, our product as well as our time schedule. We were glad that the feedback of our progress report was much better.

Last but not least, we found communication is really important in cooperation. Each time we met difficulties or misunderstandings, we tried to either make a face-to-face meeting or communicate through email or WhatsApp. Timely and effective communication really reduced the waste of time and enforced the progress of our project. Each of us have our own academic backgrounds and previous learning
experiences, so discussions always gave me new ideas or perspectives for this project. I would like to give my true appreciation to my partners. Without their effort we cannot make it.

Reflection of David Pax Buatshia Kokesha

Our project was based on the Executive functions (EFs). I was the tech guy of the project. My task was to figure out how to link the cognitive process with the technology in order to enable students of 5th grade to develop math skills and logical thinking. I never did that before. It was a huge challenge for me. I was supposed to understand basics math first and to choose the right technologies that match with the concept.

However, I really learned a lot on psychology and how the EF in our brain works for us. While I was working on the project, I understood that all students can engage successfully with executive function strategies if they are taught explicitly and given opportunities to reflect on their learning process.

I learned also how to develop software that enhance the EF. Generally, when I was coding education software. I did not pay attention to the EF part of the user. But now, I changed my way to see the coding program for the education field. I know now what to add in the software in order to boost the EF of the user or learner.

Furthermore, it was a great pleasure and honor to work with 3 superwomen, they were effective and productive, working with them challenged me to give the best of mine. From different kind of background and culture (Brazil, China, and Cambodia), and different major (Psychology, the Cultural foundation of education, and educational leadership), together, we bring on the table our culture and knowledge to design a great software and curriculum that matches our target audience. It was a pleasure to apply some skills I’ve learned in instructional design course in that project and using some reading materials from the technology settings course such as:

- Gamification.
- Web-based teaching and learning
- Assistive technology, accessibility, and universal design

I really think that this project could change the way we see games and the effectiveness of gamification in the education field. More than that I dedicate myself to keep on with this project for my further research.

Reflection of Srey Pech

The final technology project is really very much interesting and rewarding. After completing this project, I think my group members feel like an achievement to contribute to a comprehensive plan for developing and investigating the efficacy of a cognitive intervention program to promote EFs in a sample of late elementary school age children in Brazil.
This work would be very challenging without the guidance and support from Ms. Cristiane Marx Flor. From the beginning, Cristiane provided clear orientation on her study plan and invested her time and effort to join our meetings and regular communication exchange about the process and progress of the project, sharing experiences and discussion with group members throughout the process.

Despite the good collaboration, we also faced few issues and hurdles regarding understand of topic, the mathematics contents and relevant material like National Library of Virtual Manipulatives website was complicated with Java. But with effective communication between all members via meetings, email, phone all the risks and issues were overcomes with the time beings. We had arranged the meetings until all the members were cleared and much satisfied with the understanding of process. My team was very much generous with the commitment and time punctuality.

Finally, this technology project should be helpful and very much supportive for my future work. I learnt very much from group work experience as it will help me out for such type of technology project which serve as a good reflection for my future prospects regarding to technology project like this level or above. After all, integrating technology into instruction is very appealing to me after finishing this course. It encourages me to integrate technology as much as possible and in a meaningful way into my teaching plan. I can’t wait to make the most of technology to help students to learn better.
Title: Understanding the concept of the positional value of numbers and the addition algorithm in the decimal number system

a. Objectives:
   1. To deepen the understanding of the positional value of numbers and the addition algorithm concept in the decimal number system. Develop cognitive flexibility and prioritizing by decomposing digits into blocks and vice-versa.
   2. Promote the organization of ideas in the shifting value places operations with units, tenths, hundredths and thousandths blocks.
   3. Develop mental images of numbers, positional value of numbers and addition operations. cognitive flexibility

b. Curriculum field: Mathematics (Positional value of numbers concept / Addition concept).


d. Executive Functions Targeted: Organization (categorizing) /Planning, prioritizing /Cognitive flexibility.


f. Session design: This session will be mediated in the school’s computer lab, utilizing the Addition with Base Bocks activity from the National Library of Virtual Manipulatives http://nlvm.usu.edu/en/nav/vlibrary.html. The operations in this activity will be developed in 4 different columns: units, tenths, hundredths and thousandths. Students will work in pairs.

g. Instructions:

   Warming up:
   - In the last sessions, we have learned the concept of decimal numbers which can be extended infinitely to the left side of the point or the right side of the point. And the position of decimal numbers has its value. Can you give an advantage of using decimal numbers to your partner? (Let students discuss, and write some of the answer on the blackboard)
**Activity 1** Understanding the position value of numbers in units and tenths-organization

- (Teacher opens Base Blocks in the computer and broadcast the screen to students’ computers) Now I want to create 3 blocks, what should I do? (Give one second for students to answer) Yes, I can click 3 times. (Teacher click 3 times the unit block and in the right column it appears 3 blocks randomly)
- (Teacher clicks unit block another 2 times) Now how many blocks do I have? (students answer together 5)
- (Teacher clear the column and then clicks unit block 12 times (when over 10 the number at the right side will disappear) as quick as possible) Now how many blocks do I have? (Students may take more times to count before giving the answer of 12)
- Look, it takes more time to count. So how can I count quickly? Yes, I can put them in order. (Teacher put 10 blocks in a line) Now each line has 5 blocks, and how many lines do we have? (students: 1) Yes, we have one line of 10 blocks and another 2 single blocks, so how many blocks do we have? (students: 12)
- Exactly. Now the second column is a bar, which means each bar of blocks contains 10 blocks. So, I don’t have to waste my time put single blocks in order, but with 3 clicks to create 12 blocks. (Teacher show how to do it on the screen) So think about a lot of blocks, if we count one by one, we will waste a lot of time.
- And the third column is a flat. One flat contains 100 blocks. The left column is a cube. One cube contains 1000 blocks. If we count one by one, we need to count 100 times. If we put them in a flat, (Teacher click one cube and one-unit block) now how many blocks did I create? (students: 101.) Yes, it’s easier and quicker.
- Now open base block in your computer and work with your partner. One gives a number from 0 to 9999, the other try to create blocks of that number as quickly as possible. (10 minutes)

**Activity 2** Shifting value places operations with units, tenths, hundredths and thousandths blocks and simple addition algorithm.

- Ok very well. Now everyone looks at the computer screen (broadcast teachers’ screen). The decimal number is created in the same way. The right column represents the unit position, and the bar Column represent the tenth position, the falt column represent the hundredth position and the cube Column represent the thousandth position. When I want to show 9 blocks, I just click 9 times the right column, right? When I want to add one more, what should I do? Should I do another click at the right column? Why not?
So, what’s rule of using this base block? (teacher guides students to speak out the following rule)

“You can only have 9 things in a column. When you add the tenth thing, you need to make a fair trade up”.

- Exactly. So, each time the unit column has more than 9 blocks, we should clear them and add one bar in the tenth column. For example, how to represent 17+5? First, I have a bar (click a bar in the tenth column) and 7 blocks (click 7 times in the unit column), and then I add 5-unit blocks (click twice in the unit column), now I already have 9 in the unit column, right? How many blocks did I add? Yes 2, I still have to add 3, but there are already 9 blocks. What should I do now? (Let students give the answer of “make a trade”) Yes you are right. I will made a trade (clear the unit blocks and add 1 bar), then I continue to add the other 3 blocks. How many bars do I have? 2, so I write 2 in the tenth position. How many unit blocks do I have? 3, so I write 2 in the unit position. That makes 23.

- Now work with your partner on the computer, try to figure out the answer of 35+8, 214+21, 458+50, 1999+1

- Is there any volunteer who wants to show how they do their job? (Teacher broadcast volunteer’s computer screen and let them show how to do the addition algorithm with the base blocks, correcting them if needed)

**Activity3** Develop mental images of numbers and assessments for addition operations.

- We have already learned how to use cubes, flats, bars and single blocks to do addition operation. But we cannot draw them every time if we don’t have the computer, right? How about using different colors to represent them? Now please open the chip abacus in your computer, explore it with you partner. (2 minutes)

- Can you tell me what does the blue point represent? (a flat), and the green point? (a bar) And the yellow? (unit block) Very good. Now try to create 12 yellow points, and what do you find? (students: we can trade!) Yes, you can click the arrow and trade 10 yellow points with 1 green point. Similarly, we can use 10 green points to trade 1 blue point. When we write numbers, the tenth position is just like the green point. So, when we write 10, the “1” means 1 green point and “0” means no yellow point. And 1 green points equal to how many yellow points? (students: 10). Exactly, so 10 means ten yellow points.

- Now work with your partner. One tells a number from 0 to 999 randomly, another creates points to represent that number. Then exchange your roles. The one who created points will give another number, the other add points of that number onto the previous number. (10 minutes)
- We can use cubes, flats and bars to count things. We can use different colors. If you want, you can also use different shapes. But the most used are numbers. They are just a representation of the position value.

**Activity 4** Understanding Roman numbers with different positional value and try to list more similar situations about different values in our daily life? - cognitive flexibility

- Nowadays we use Arabic number, which is widely used and very simple. In ancient times, people once used Roman numbers. We still use Roman numbers now. When will we use Roman numbers? (Teacher writes students' answers on the blackboard: Clocks, Centuries, Rooms...)

- Do you know how to write Roman numbers? (Teacher writes I II III IV V on the blackboard) It's a little bit more complicated. We make a trade when we meet 5, we use V to represent 5. An exception is that we don't use four I to represent 4, however we put an I on the left of V to show four, which is 1 less than 5. And when we want to write 6, we add an I on the right of V. Is it similar to how we write 11 in Arabic number? We put 1 in the tenth position and add 1. Can you guess how to write 7? Yes, add another I. (write VII on the blackboard)

  (Teacher call a students' name, for example Paola), Paola, what's your height? (Paola: 152 cm). Thank you, Paola. So, Paola is 152 centimeters tall, or we can say that she is 1.52 meters tall, right? When we talk about the length, we don't trade when we meet 10, however we trade when we meet 100. Can you give me other examples?

  • (possible answers): time (60 seconds = 1 hour); weight (1000 grams = 1 kilogram)

- In different situations, we may trade with different numbers. The computer in front of you are made of only two numbers: 1 and 0, how could it be possible? Because they are not trading at 10, but at 2. Thinking about your lives, can you imagine any analogy of this trading game with our lives? (Let students discuss in pairs first, and then discuss with all other students in the class).

  • In our lives, as in this game, we can grow and move from a lower life level to a higher one, as in the game, the units move to tenths, the tenths to the hundredths, etc. To be able to do this, we must nurture a number a positive habit, like studying and working hard, obeying to social norms, nurturing positive relationships, having a good friends net, etc.

  • On the other hand, the opposite can happen as well. People can lower their life levels when they break laws, don’t work, don’t respect others, live in isolation, etc.
Appendix 2 Sessions #32 #33

Title: Comprehending the subtraction operation’s concept with 2 or more numbers in the decimal number system

a) Objectives:

1. To deepen the comprehension of the operation of subtraction operation’s concept in the decimal number system.
2. Promote cognitive flexibility by training to represent numbers in base 10 blocks and vice-versa.
3. Stimulate the executive functions of organization and cognitive flexibility in the subtraction operations with “borrowing” proceedings, through the shift of positional value numbers.
4. Develop mental images of numbers, positional value numbers and subtraction operations.

b) Curriculum field: Mathematics (Positional value number / Subtraction operation concept).

c) Modality: Graphic, digital.

d) Executive Functions target: Organization, planning and cognitive flexibility.


a) Session design: This session will be mediated in the school’s computer lab, utilizing the Subtraction with Base 10 Blocks activity, comprised in the software Pare e Pense! The procedures in this activity will be developed in 4 different columns: units, tenths, hundredths and thousandths. Students will work in pairs.

f) Instructions:

1. Before beginning the mediation with subtraction operations, the teacher needs to be sure that students can represent numbers using base 10 blocks. Model this activity with your students: First, present different graphic representations using the blocks and ask them to write the correspondent number in their notebooks. Next, write a number in the blackboard and ask the students to represent it with the base 10 blocks.
2. In this session, we will deepen our understanding of what “borrowing” means in a subtraction operation: transferring numbers from a higher positional value to a lower one.

3. In the upper part of the screen, we find the number of blocks in the blue color. In the lower part, we find the number of blocks that will be subtracted from the blue ones, in the red color. We start our work always from the right to the left. If in a column, the number of blue blocks is smaller than the red ones, we will have to “borrow” blocks from next column to the left, where the positional value number is 10 times bigger.

4. Be aware that when you shift the blocks from their original columns, its digits that are represented in the first column to the right also shift.

5. Encourage your students to think out loud.

**g) Assessments and practice**

Can we make analogies between this activity and our lives?

1. There is a famous saying that states: “There is no such thing as free lunch”. What do you think it means? The children will need time to think.

   - In politics, it means that anything that is given by the government to some people, will come out of the pocket of other people, through taxes. If we load certain sector of the society with money, you must take away from another sector.

   - Sometimes grownups work more hours a day than others to make more money. However, doing this, they pay a price scarifying (subtracting energy) their health and precious time they would have for the activities they enjoy most.

**h) Homework:**

Think about your life and try to remember an occasion when you had to give up something to get another thing you really treasured.
Appendix 3 Sessions #34 #35

Title: Understanding the concept of decimal numbers

a. Objectives:

1. To realize that the positional value of numbers in the decimal system extends itself infinitely in two opposite directions: towards bigger (to the left) or smaller numbers (to the right: decimals). Cognitive flexibility.

2. To understand the ratio 10 to 1 between adjacent values. Organization.

3. To comprehend that addition and subtraction with decimal numbers are based on the same concepts of addition and subtraction of natural numbers, according to its place value. Organization.

4. To train cognitive flexibility and sustained attention utilizing different number of decimals after the point, realizing that there isn’t one specific representation for the units, it is the result of a convention. Cognitive flexibility and sustained attention.

b. Curriculum field: Mathematics / Concept of decimal numbers.

c. Modality: Graphic and digital.

d. Executive Functions Targeted: Organization, sustained attention and cognitive flexibility.

e. Material: Computers and software Pare e Pense!
f. **Session Design:** This session will be mediated in the school’s computer lab, utilizing the Decimal Number with Base 10 Blocks activity, comprised in the software *Pare e Pense!* Students will work in pairs.

g. **Instructions:**

*Introduction*

- Teacher shows students the flat, rod, and cube from the base 10 block set. Then ask students what they think the flat, rod, and cube stand for. Students share their thoughts.
- Now tell students that for this lesson, the flat equals 1 and stands for the ones place. Ask students to consider what this means the rod and cube would equal. Give students time to discuss this in pair.
- Have students share their answers. Explain that the rod is equal to one-tenth (1/10) and show how 10 rods fit into a whole. Explain that the cube is equal to one-hundredth (1/100) and show how 100 of them fit into one whole.

*Explicit instruction*

- Show a place value chart on the screen that shows the ones place, tenths place, and hundredths place. Make sure to include a space for the decimal point. Type in the decimal 1.5 in the place value chart. Ask students how they would pronounce this number. Students will be tempted to say the number as a decimal, one point five, but encourage them to say it as a fraction, one and five tenths.
- Show them how teacher came to this fraction using the place value chart.
- Next, write the decimal 2.08. Again, ask students what number this is. Show students using the chart how to determine that this number is two and eight hundredths.
- Lastly, write the decimal 0.75. Ask students what number this is. Once again, show students using the place value chart that this number is seventy-five hundredths.
- Now, go back to each decimal. Show students what each one would look like using the base 10 blocks. For example, 2.9 would be two flats and nine rods.
Interactive practice and assessments

- Divide the class into groups of four to five students.
- Explain that as a group, students will be working together to represent various decimals using the base 10 blocks. They will record this on their computers. Students will also be writing the name of the decimals next to the visual representation.
- Give students the following decimals to represent: 2.5, 0.9, 1.33, 1.03, 0.07.
- Monitor groups of students as they work and provide support when needed. Encourage students to present the place value chart to help them pronounce each decimal.
- Review each answer as a class. Note where group of students may have struggled, and give additional examples if necessary.

Interactive practice and assessments

- Give students the following decimals to represent and pronounce: 5.21, 2.07, 0.6, 2.08, 3.25.
- Tell students that they will continue representing decimals with base 10 blocks on their own, without the help of a group. They will also continue to practice saying and writing the names of these decimals on their device or notebooks.
- Ask students to find equivalent decimals for 1.80, 2.70, 5.06, 0.45, and 7.80. Students should represent these decimals using base 10 blocks in the simplest way possible and type the names for each equivalent decimal. For example: 1.90 is equivalent to one and eight-tenths, and can be represented with one flat and eight rods.
- Have students continue to use base 10 blocks during independent time. Students who continue to struggle could be pulled into a small group for more instruction from the teacher.
Appendix 4 Computer Skills Checking List

Students' Computer Skills Checklist

Students name: ____________________

Please mark the computer skills that you already have with “╳”

1. □ I know how to turn on the computer.
2. □ I know how to turn off the computer.
3. □ I know how to do single click.
4. □ I know how to do double click.
5. □ I know how to locate the website icon on the desktop.
6. □ I know how to type the website address in the address bar.
7. □ I know how to close the window.
8. There is something else that I want to add: __________________________
Reference


