

A professional development experience to rekindle the passion for learning in makerspaces of the public Unified Educational Centers (CEUs) São Paulo, Brazil.

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ABSTRACT

The present work will discuss and share the practices and results of a maker educator's professional development course created and led by me as the educational design manager in collaboration with the founders of MundoMaker (Fábio Zsigmond and Orlando Lobosco) in partnership with the Municipal Secretariat of Education of São Paulo, for the piloting makerspaces called LEDs (Digital Education Laboratories) located in the Unified Educational Centers (CEUs) of the Municipality of São Paulo, project with the support of Lemann Foundation. There were 15 participants, including technology educators and coordinators of the program.

MundoMaker is a private company focused on unleashing the student's and educator's full potential to better understand the relationship among themselves, their peers (society) and the world (represented by the maker practices and how one can act upon the world, design and change it). Through Constructionist and Holistic Education, MundoMaker offers intracurricular Maker program for K-12 schools, extracurricular programs and educator's formation for both public and private schools in many areas of Brazil, with profit and non-profit practices. Their programs are aligned with the Brazilian National Level Benchmarks (BNCC) and their socioemotional development Matrix which involves the relationship among three dimensions and its respective competences: 1. "The world" represented by software and coding, manual fabrication, digital fabrications tools and electronics, 2. Society (the relationship with others) and 3. Individual (the relationship with oneself), where each dimension is subdivided in socioemotional competences such as empathy, collaboration, problem solving, self-awareness among others.

Keywords

Educator empowerment; teacher's formation; professional development; maker-centered learning;

2. DESCRIPTION

2.1 Description of your setting

The settings for the educator's professional development were the first piloting makerspace projects located in the periferia os São Paulo: [CEU EMEF Pêra Marmelo](#), [CEU EMEF Feitiço da Vila](#) and [CEU EMEF José Saramago](#) makerspaces located in public Elementary Schools in the outskirts or rough areas which have the Unified Educational Centers (CEUs) of the Municipality of São Paulo. There were 15 participants, including technology educators and coordinators of the program. The makerspaces are fully equipped with soldering stations, woodworking and general tools, physical computing/ robotics kits, laser cutter, 3D printer and other tools for exploration, creative materials for making and self-expression.

2.2 Description of the educational experience

Underpinned by the pillars of Experiential and Holistic education, Constructionism and Critical pedagogy, this hands-on and minds-in program has been a reflective experience for educators to rekindle their passions for learning and teaching through maker centered learning approaches such as Agency by Design from (HGSE) and Lifelong Learning Kindergarten (MIT) Creative Learning approaches. Despite all the awesome technology our focus was on empowering people - from the simplest technology - like a pencil - to a laser cutter to reinvent their pedagogical practices, rekindle the passion to empower themselves and students for critical action in today's society.

The 24-hour program challenged educators (in four-hour meetings) to understand and use digital fabrication, programming, physical computing and woodworking/analog tools as self-expression tools which reflect how can we make our place in the world, reflecting our identity and personality. Besides empowering this team to feel more confident to explore all the technologies and integrate it to their curricula, it was possible to raise the biggest issue which are the timeless values which won't be expired as technology might be. We could notice making as giving access to their thoughts and intrinsic motivation. Through many collaborative hands-on and minds-in challenges we could see themselves feeling the essence of learning, having a passionate, resilient and lifelong learner's mindset.

The 24-hour Program focus was

- To deepen the conceptions of the Technologies for Learning Curriculum of the Municipal Secretariat of Education (*Currículo da Cidade: Ensino Fundamental: Tecnologias Para Aprendizagem*);
- To instrumentalize educators who work at the mentioned school units to know, explore and create with the available resources present in the makerspaces of the LEDs (Digital Education Laboratories);

- Improve collaborative and interdisciplinary practices and educator's digital inclusion;
- Develop socioemotional goals with intentional powerful questions and mediation;
- Understanding and apply Safety protocols, learn how to use the makerspace tools and machinery responding to their own needs, demands and expectations mentioned in the beginning of course assessment;
- Introducing the *Agency by design* Framework to understand the thinking routines and the importance of student's documentation of their learning process and suggestions of media and tools to keep track of their learning;
- Improving digital and fabrication tools usage and knowledge (Paper circuitry, physical computing, coding, woodworking);
- Developing awareness about digital fabrication practices (3D Modelling and 3D printing, remixing projects, ethics, Creative Commons, collaborative communities, repositories).

2.2.1 Course Step by step

Before the event: A Google Form was sent to all educators to share their needs, demands and expectations. The following program was designed to match the demands mentioned by educators and the municipal secretariat representatives, together with our program and what we believed would deepen their knowledge to reach the proposed goals, which would always include these moments: Welcoming, mindfulness, then practical hands-on situations/challenges, sharing ideas and perceptions (sharing how they felt, what they learnt, mediator's objectives for each moment) and reflection (Constructionism and socioemotional development theoretical underpinnings were discussed with examples of how these principles were put into practice).

2.2.1.2 Day 1

The demands pointed out in the forms had shown they really needed help concerning makerspace safety protocols and questions about machinery, so they were invited to build a system with three flags (red-green-yellow) as a suggestion to let students know if the environment is safe or needs attention. Educators shared how they used each machine or tools and safety suggestions were given, as well as practical tasks to use (or not) each tool.

2.2.1.3 Day 2

The Agency by design Framework (parts, purposes and complexities) and thinking routines were introduced to help educators understand the need of powerful questions and less direct answers to students, using thinking routines and strategies to make student's thinking visible such as writing down and drawing the upcoming questions, discoveries and understanding of reverse engineering of electronic waste. Each group could explore the moments of looking closely, exploring complexities and each could find different opportunities such as fixing devices, establishing metaphoric connections between objects and systems, investigating and so many different approaches to the same task, as a clear example of the importance of giving voice to each individual.

2.2.1.4 Day 3

The third day started with an activity to raise awareness for the inclusion of deaf students and the Brazilian sign language as the Unified centers include deaf students. They were challenged to communicate with ear tampons. They had demanded learning the basics of Arduino, breadboard and servos, so the challenge used images of these items to start communicating to each other without words and miming. This empathic moment helped them open their minds to create new strategies for learning. Then, they built larger scale arduinos and breadboard models with strings to understand how these parts are connected. Afterwards, they were challenged to laser cut the shape of a hand and move its fingers forming a letter of the Brazilian sign language with Arduino coding and hands-on laser cutting techniques and educational possibilities..

2.2.1.5 Day 4

The fourth day explored project based learning through the exploration of a graphite and LED circuits challenge which lead to the exploration of physical computing and teamwork creation of a physical computing project with Makey Makey and Scratch programming as platforms for discovery and self-expression. Some educators have exposed their fear and insecurity in the beginning of the process and in the end of the day satisfaction, curiosity and enchantment were key words in their feedback.

2.2.1.6 Day 5

This day started with maker attitude and real solutions to the makerspace environment, such as assembling a workbench which was there since the opening of the space. That was a very strong metaphor for the necessary initiative to strive to reach the desired goals, to get out of the comfort zone and take risks. As their demands involved using woodworking machinery, two challenges were proposed and groups of interest were formed: mounting a pipe quadripod as a "documentation station" for students to remember the importance of documenting experiences using mobile devices (besides stop-motion project samples and videmaking) and a wooden bench model to be recreated by exploration. Tools and machinery such as jigsaw, hacksaw, saw, bench drill press, sandpaper, measuring devices were used and discovered (tape measure, caliper, measuring hacks). While using the tools recalling safety practices, protocols and mediation tips such as asking open questions, not giving ready answers, clearing doubts with peers among others were shared.

2.2.1.7 Day 6

The first challenge was to make a hand laser beam travel through a set of pipe and wood structures with mirrors to reach a final target. With this analog game we could recover the use of the laser cutter and introduce a new challenge: using Tinkercad, they should create a 3D printed button or a new part so the bolt in the pipe structure could be better used or a function improved. They could learn the basics of 3D modelling/ slicing software and 3D printing, including a discussion of critical use of 3D printing, ethical issues like mentioning authors and understanding Creative Commons, remixing projects, online collaborative communities and repositories, debugging the 3D printer and a strong awareness over the keychain syndrome and acritical use of digital fabrication.

2.3 Assessment

Besides the oral moments for sharing and reflection which always focused on how the participants felt at the moment, what was learnt and which pedagogical and socioemotional intentions were noticed) there was a final assessment form regarding every meeting, recovering the daily objectives and asking participants to choose 1-5 levels of answers as well as open responses, as in the following examples:

- a. Regarding today's activities and learning, assess:
 - Activities and Objectives
 - Relevance
 - Use of time and space
 - Were you inspired by the experiences lived in this module?
 - Was it possible to establish connections with your practice?
 - Which other information were useful or valuable?
- b. Regarding attitude and socioemotional competences (participants should self-assess, rate and comment):
 - I was open to new experiences.
 - I was proactive and had the initiative to do things
 - I collaborated with my peers giving opinions and ideas
 - I could hear my peers attentively and I considered their opinions and ideas
 - I was attentive to my feelings and thoughts during the practices
 - I could focus on the activities and I was participative
 - I could document new learning for future use
 - I looked for opportunities to deepen my knowledge looking for help among my peers or other people
 - I could see mistakes as an opportunity for growth and tried to be flexible with adversities
- c. End of course assessment:
 - Describe the feelings you've had throughout the course;
 - Which was the most relevant learning in this course?
 - Which strategies did you observe during the mediation which were intentionally used to foster collaborative work?
 - Which other strategies have you noticed for the development of competences such as resilience, empathy, initiative and problem solving?
 - Did you feel you could express yourself during the meetings, showing your individuality?
 - Did you notice any tacit knowledge (something you knew and you weren't aware of) during the meetings?
 - How would you improve this course?
 - Assess your level of skills and learning in the beginning and end of this course.
 - What are your main interests and needs for the next modules?

3. CONCLUSION



3.1 Results

We've shared a Google form to assess their experience. The best possible results have been seeing educators unleashing the desire to learn new skills and reinforcing the importance to reflect about how they learn and also how their students learn through social interaction and sharing ideas. Embracing learning and communicating by doing, making creative decisions and unimagined uses of materials to solve real problems (Known, personal or community ones) - integrating electronic and craft materials, analog, handcraft to digital fabrication, hands-on designing and disrupting pre-conceived paradigms about transmissive views of learning. We strongly believe the maker-centered learning has allowed the democratization of powerful tools, new ideas and inventions, working for equity and a sustainable ecosystem.

According to most educators, the most relevant learning occurred both during the sharing moments and the collaborative work activities, and they were very sensitive to the gains of these moments. We could also learn from public school educators that they can do a lot with so little, with their examples using recyclables or that some of our suggestions using cardboard or water pipes were seen as powerful tools to bring enchantment and curiosity. Their comments have shown a strong importance for courses like these so they could overcome fears, insecurity about using technologies and the need of different strategies and approaches to run maker activities. They expressed a need for strong motivation and mediation of their leaders and professional development heads to keep up with the system's constraints and never let it impact their belief in the power of their practices.

3.2 Broader Value

It's really rewarding to empower other makers listening to their needs, co-creating, collaborating, encouraging, engaging for critical reflection and fostering invention, self-esteem and developing socioemotional competences. When we see educators overcoming personal barriers, experiencing the desire for new skills, making new connections and constructing new meanings we believe this is the right path to reimagine Education. Making is embracing chaos. It's debugging, dismantling, reconstructing, iterating and reflecting. It's failing successfully and proudly - to rekindle the passion for learning.

When most educations emphasized the importance of the collaborative moments, teamwork, being open-minded and giving strong importance to their group reflections we noticed we could reach our goals - focusing on the possible processes and holistic development of students rather than the making of exhibitionist products. Good making is not only enhancing existing practices, it's making for real people, their contexts and real needs. It's making a difference with others, making yourself and the others heard through sustainable practices which aren't simple making - develop timeless values underpinned by the Constructivist and constructionist thinkers and makers along educational history.

4. BIO

Juliana Godinho Ragusa Marcicano (Juliana Ragusa)- Passionate educator who's been working in the educational field for 26 years. Master's Degree (*stricto sensu*) in Applied Linguistics (Language, Education and Technology) by the Pontifical Catholic University of São Paulo (LAEL- PUC-SP) with special focus on teacher's formation. Postgraduate degree in 21st Century Pedagogies of The Tampere University of Applied Sciences - TAMK, Finland. Specialist (*lato sensu*) in Psychopedagogy (PUC-SP). Language Arts (English and Portuguese) Licentiate (UNISO). Focus on educator's formation and professional development, curricular design and implementation of active methodologies, STEAM and Maker, with digital fabrication and analog/handcraft technologies focusing on Holistic Education and socioemotional competences. In the maker field since 2013 (We Fab educational consultant and LAB Educação/Rhyzos Educação Learning designer). MundoMaker Educational Design manager from 2017 to 2018. Coordinator of Technology and innovation at Escola Internacional de Alphaville (present).

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