Making the school a constructionist environment

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ABSTRACT

This is the story of a group of teachers and researchers in a low SES public high school in the northeast of Brazil who wanted to reflect upon and innovate within their educational practices. To gain the learning-richness and depth of constructionism, teachers had to experience constructionism themselves by physically building an artefact, an object to represent the application of knowledge. Inspired by the constructionist framework, the teachers decided to organize an unusual Science Fair for high school students. They experienced pedagogical innovation by planning, making and learning from the fair as they were making it. The lack of resources catalysed an intense collaboration between the teachers to solve problems. The researchers' outside perspective and network within academia and industry forged meaningful partnerships that opened the school to the community. Towards the fair and during it, ideas and initiatives sprouted making the classrooms and the corridors buzz with activity. When outcomes like the complexity of the students' projects, equipment donations, scholarships, sponsorships, academic awards and professional development opportunities became clear, even the most resistant teachers became interested in constructionism, active learning, educational technologies and maker spaces. The teachers were learning about technology because they needed it to enhance the educational experience. Teachers and students' engagement to make the fair transformed their view about the school's capacity to change from the ground up, gradually, and collectively. The fair affected the school, and the school affected the community's concept of the potential of a public school. The fair became a prototype, a micro-world of the constructionist environment that the school could be.

Keywords: Learning-by-making; teacher emancipation; entrepreneurship; community engagement; constructionist environment.

1. THE SCHOOL AND THE SCIENCE FAIR

When we think of innovative teaching practices what first comes to mind are technological gadgets and hyperconnected learning spaces. Such picture alienates most of the schools from developing countries. Teaching at an under-resourced public school can be a very lonely and demanding practice based on responding to constant deprivation and everchanging conditions. It is not always an environment that invites educators to engage in collaborative work with technology, develop professional networks, and extend their teaching beyond regular school duties. In this school, the adversities became the catalysts for collaboration that resulted in technology adoption. It all started with an idea to build a partnership between the federal university with public schools to use educational technologies developed by the university's media lab. Our research team approached the school principal to present the project. Immediately, she saw it as an opportunity to have extra brains working for the school. For the teachers, it took them some time to accept us as part of the team. As they saw us regularly going to the school to observe and discuss their teaching practice instead of imposing a pre-established instructional model, we began to build trust. The state department of education was not part of this project that lasted for two years.

There were two places where ideas were disseminated in the school, the teachers' lounge and their WhatsApp group. When the research team was invited to be part of the social media group, there was resistance from some teachers, but the principal talked to them in our defence saying that we wanted to be included to understand the school routine to co-develop new teaching ideas. The teachers' lounge, then, was like a dorm with a TV set always turned on and teachers snoozing on couches. It was a place for quick superficial social exchanges. The coordinator needed to stop by the lounge at every break to remind the teachers to be on time. There was no palpable excitement. Their job was to take the rolls, write the lesson on the board and answer questions from the students, if there were any, in the traditional one-way transmission model. After the lesson, they should sign their diary and return it to the administration. Like they were trained to do. The challenge was to get the teachers out of their comfort zone and rethink their practice to design new meaningful lessons to engage the students and address pressing social and environmental problems using technology.

The first workshop we did together was about personal and professional projects. One researcher started to talk about her experience travelling around the world and how it led to her application and proposal for the PhD at a university overseas. The teachers were then divided into groups and asked to talk about their ideas for the school without censorship and regardless of financial feasibility. Soon, the space became vivacious and ideas started to bubble over. Once it was time to present their proposals, a very quiet Physics teacher took the stage and shared with the group the website he had created for his tutors. He was a strong believer in peer-instruction and he took the time to select, prepare and delegate responsibilities to his tutors. On his website, he had curated learning resources and an academic journal to record each project development. Only the students who were selected to be his tutors knew about it. Nobody else from the school was aware of his ideas. There was another

teacher who was passionate about role-playing games and had the desire to teach Geography using the mechanics of games. The school had a course for video production and a group of teachers proposed to create video portfolios for each student to document their progress at the school. There was already a silent pedagogical movement happening, just the dots were not yet connected. After that introduction, we still did not know how to start. After attending the FabLearn conference in São Paulo in 2016, there was a connection with a social organization which offered an online course on blended learning that also explored concepts of project-based learning. We were able to obtain 30 scholarships for that course provided the entire school did it together. It was the first online learning experience for many of the teachers. The conversation in the teachers' lounge started to change towards the resources that were given at the course. Part of the course was for them to design a blended learning lesson, record its implementation and reflect upon it. Teachers were discussing ideas, arranging who was going to film whom when they decided to pair-up and collaborate in the lesson-design. 27 teachers concluded the course, including the principal, and some of them said that it was a milestone in our pedagogical innovation quest.

The constructionist environment was taking shape from the ground up, with the engagement of teachers and the support of the principal. When the Maths teacher left the school, there were no substitute teachers for year 10 students. A researcher with a group of teachers proposed to the principal to use Khan Academy to gauge each students' math level and work with smaller groups and tutors to target their needs. The school had some computers for basic ICT training that were idle for half of the time. There was a competition sponsored by Khan and the group decided to participate. The entire year 10 got involved and we found out about the power of WhatsApp to communicate with the students. As we analysed their performance at Khan, we used that to sparkle a conversation and guide them to new sources of knowledge, their peers, video tutorials online and the teacher support group. Not only the students were learning, the teachers too were learning by making and learning just in time. That initial experience with Khan revealed the potential of open learning resources to address such a diverse range of students. The Spanish teacher came to ask if there was something similar that he could use to spice up his classes and we thought of Duolingo. He wanted to start with a classroom as experimentation, but the idea spread out so quickly that he had to extend the use of the app to the entire cohort. The English teacher was hesitant to change as she did not want to review her planned lessons or stop to learn about a new tool that was not imposed by the secretary of education. When she realized that the students who were more participant in her classroom were the ones using Duolingo, she also decided to integrate it into her lessons and assessments. The idea of the Physics teacher to divide the class in two where one half would be at the lab with tutors and the other would be in the classroom with the teacher demonstrated that learning could happen in stations without the need to hire more teachers or increase the school area. The school was gradually occupied by diverse learning activities. Students were coming to the school on weekends and teachers were taking turns, in their free time, to supervise them. As the students felt empowered as tutors, they also become more responsible for the schools and its resources. There were only a few incidents with stolen equipment and misuse.

But there was still a need to find a project that would unify the school and reinforce its identity as a progressive school that used technological pedagogical tools to engage students and integrated their learning with real-life applications. Outside the school space, there was a growing conversation about innovation, start-ups and smart ideas to solve social and environmental challenges. Our goal was to bring that discussion to the fore and integrate it with their formal learning and the best opportunity to do that was at the annual Science fair. The plan was to create a fair like a conference with parallel workshops, exhibitions and key lectures for the students to experience academic entrepreneurship. Most teachers had never supervised research projects, and the university researchers scaffolded the process with them. The teachers guided the students to ask more complex questions and search for solutions already available in the literature. The researchers suggested articles and open learning resources. One teacher said that he was reading an academic paper for the first time. When teachers saw the positive change in some students, when they saw teachers' winning prizes and being recognized for their innovation, even the most resistant ones wanted to know more about constructionism, active learning, educational technologies and maker spaces. The lectures were the future of work, the digital revolution, becoming a scientist, finding your passion, entrepreneurship and project management. The classrooms became stations for smaller workshops on robotics, Arduinos, research methodology, clowning, coding, poetry and design-thinking. The principal made a point to make the project exhibitions very professional and the local church donated some money to rent exhibition displays. The students were dressed up and become very nervous while presenting as it was counting as a grade. But when they heard the level of feedback from the assessors, the presentation dynamics became more engaging and less stressful. In a learning-by-making framework, the teachers, students and researchers co-constructed this trailblazing Science fair. Before teaching the constructionism method, teachers had to experience it themselves, using the available tools and resources to re-construct their practices centered on the students. This experiment was at a school which had never embraced the maker movement, despite having adequate resources and offering vocational courses. More than technology and gadgets, maker education is a culture. As some teachers got inspired, their engagement became contagious. Circuits were fired up and their energy ignited new connections. Ideas generate more ideas and the desire to make them happen, to construct them with a purpose should be the drive for the development and use of makerspaces.

Both teachers and researchers learned immensely from this collaborative work that ended when the Principal was dismissed and the partnership with the university ceased. The independent partnerships that acted at the school have demonstrated that change could be from the ground-up, gradual and simultaneous, but it should involve the Department of Education to be sustainable. At the same time, more stakeholders need to be involved, the university as a continuous source of knowledge and support for research and the industry and the community to bring real-life challenge and provide technical and financial support. If we believe that schools should be open spaces for learning using technology to address community challenges, it demands strategic collaboration from all levels, and this should be part of a National Educational Policy. The researcher's role as a connector perceiving talents, motivating teachers to reach their potential by working in teams has enabled an innovative pedagogical grassroots movement using technology. By empowering the local level, we can learn and inform the design of

high-level policy that is more likely to be enacted. The constructionist experience at this school was an example of a public education system students, teachers and community are drawn by the desire to learn and to apply their knowledge to improve their lives and become authors of their history.

2. DESCRIPTION

2.1 Description of your setting

It was a new school constructed accordingly to a national blueprint with 12 classrooms, 4 stem labs, 2 computer labs, 3 professional labs (audio/video, electronic/mechanical, multimedia), 1 library, 1 gymnasium, 1 auditorium, 1 refectory and good outdoor spaces. The model was the professional school model with imposing facilities and a curriculum that contemplated technical skills. The school was situated in the middle of 3 large slums, and its building was impressive, a huge contrast to the neighborhood. All the lessons were in the classrooms with the desks in rows. There were 29 teachers and they were most full-time employees. Only 5 of them had a secure job, the others were temporary teachers working under 2-year contracts. They had very low expectations about their students. In packed classes of 45 students, maybe 1 or 2 would be able to pass the university entrance exam. There were more students interested in enrolling than its capacity. The selection criteria were based mainly on primary school grades, but with so many different feeding schools, it was hard to state that grades were a trusted parameter.

2.2 Description of the educational experience

It all started with an idea to bring the federal university into public schools to contribute towards a more equitable education. After presenting a very open plan to the university, our research team approached a school principal and pitched the project. She immediately saw it as an opportunity to have extra brains working for the school. It took some time for the teachers to accept us as part of the team, but as they saw us regularly going to the school to observe and discuss about their teaching practice instead of imposing a pre-established instructional model, we began to build trust. We thought that the school should be an open space for learning with a clear political and pedagogical plan to address social and environmental challenges.

3. CONCLUSION

3.1 Results

The themes of the conversations at teachers' lounge and how they integrated active pedagogies enhanced with technology became our indicators of how the project was progressing. A researcher printed long sheets with science concepts and started to fill in how it could be taught with sensors and Arduinos. The exchanges on WhatsApp also changed as teachers started to share information about online courses, books on pdf, news on education and award opportunities. After doing thematical analysis, we could see an increase of the usage of pedagogical, technological and social justice terms like: empowerment, generative themes, democracy, inquiry-based and project-based learning, maker-movement, blended learning, active learning, learning analytics, research methodology, evidence-based practice. There were more interactions between teachers and the nature of those exchanges also had been transformed. The usage of the labs increased. The level of complexity of the scientific projects increased and some were presented at a Start-up fair. One project was accepted at the national Science fair. Teachers and students had their first experience traveling to present at a conference. Four teachers were accepted at master programs. The school became a reference for technology applied to public education.

3.2 Broader Value

It was the first occasion that researchers, professionals, university lecturers came to a public school. As they came to give workshops and lectures, they also became assessors of the students' projects that were exhibited in panels and demonstrated by the students themselves. They were affecting the school, but the school was deeply affecting their concept of the potential of a public school. There were many outcomes after that episode including important partnerships for the school. A private university offered 70 research initiation scholarships where students would get a monthly allowance to be part of research projects. One entrepreneur donated to the school a 3D printer. Another private university offered to the school 20 tablets. The Federal University made available 20 Arduino kits for the school. Looking back, I picture a neural network where axioms started to fire up together and create new pathways. New synapses with the community that would transform the educational experiences for the teachers and the students started to happen.

3.3 Relevance to Theme

Papert's constructionism that has inspired the maker movement does not need to have a fancy hyperconnected space with sophisticated equipment. Technology must come as a need from the community to efficiently materialize better problem-solving tools. A constructionist pedagogical approach starts with the collective act of creating something together. In the case of that school, the first event that we planned, created and implemented together was the Science Fair. The complexity of that exercise enabled teachers to contribute spontaneously with their skills. It revealed a great deal about the researchers, the teachers and the school's potential. It also made visible the importance to open the school to the community, universities, business companies and social organisations. The challenge is to open the school to those stakeholders, and yet maintain its independence as a democratic space for knowledge building. I believe the relevance of this report is to demystify the idea that makerspaces are unattainable through promoting a culture rooted in conscious collaboration. Before the materialization of an idea, there needs to be a strong community. As educators, we have no idea what the future ramifications of our actions will

be, but if there is a space for dialogue, reflection and trust, those connections and interactions will turn the school into a constructionist environment that welcomes epistemological pluralism towards a common goal.

4. BIOS

Solange Macedo Lima (panel member), researcher and PhD candidate on Educational Technologies at The University of Queensland. She is currently a Lemann Fellow at Stanford University developing an educational project for constructionist high schools.

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