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We respectfully acknowledge that at SFU's three campuses, where our journal is edited and distributed, we live, learn and work on the unceded traditional territories of the Coast Salish peoples including the Squamish, Tsleil-Waututh, Musqueam, Semiahmoo, Kwantlen, Katzie, Kwikwetlem, Qayqayt and the Tsawwassen First Nations. We also note that, as the University remained closed, many of us continued working from home in British Columbia and across Canada. We acknowledge the many Native communities around Canada on which we as First nations people, as settlers and as uninvited guests have been living, working, and learning.

SFU Educational Review Journal is a graduate student run journal at Simon Fraser University and supports diverse scholarship in the field of Education. The journal is fully open access. Published work is licensed under *Creative Commons Attribution-NonCommercial 4.0 International License.* The copyright for content in Ed Review is retained by the author(s), with first publication rights granted to the SFU Educational Review. We practice a double-blinded review process to ensure the highest quality of submissions. We publish three issues per year, with one issue focused on specific themes from the educational field. This practice has unfortunately not continued through the pandemic, as we have only published two issues between Fall 2020 and Summer 2021. We endeavour to return to three publications from 2022.

All of our issues are published online at *www.sfuedreview.org* and are publicly accessible.
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A brief history: The SFU Ed Review published its inaugural first issue in the spring of 2007. Originally, the Ed Review followed a traditional academic journal format; however, in 2012, the Ed Review was redesigned in order to make it more welcoming and accessible. Through these changes the Ed Review hopes to:

- be more inclusive of our academic community;
- promote discussion and reflection;
- provide a medium that better supports diverse scholarship and research;
- provide a format that better supports shorter works.

Ultimately, we are hoping to initiate a medium that will promote better awareness about the current work being pursued in the Educational community, offer a safe environment for peer-to-

peer dialogue, and encourage emergent scholars to explore and develop their own voice within academia.

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LETTER FROM THE EDITORS

Dear SFU Educational Review Community,

We would like to welcome you again to the SFU Ed Review's regular issue – which has been written and edited in very *ir*regular times. This is our second publication during the pandemic lockdown, and, knowing the kind of world we are living in, we are extremely humbled, honoured and privileged to have been able to publish this edition at all.

2021 was promised to be our turn-around year from 2020. Sadly, with the un-ending water crisis in our Canadian First Nations communities, the January 6th insurrection in the United States, the on-going lockdowns around the world, vaccine shortages – especially in the developing world - new variants ravaging countries like India and the UK, and untold numbers of lives lost due to the on-going Covid-19 pandemic, 2021 was looking like more of the 'same-old-story' rather than a new beginning.

But in this month of August, with case numbers dropping in British Columbia, where most of us are based for our studies, there is hope: for health, for a chance to really address the existing inequities exposed by the Covid-19 pandemic both around the world, and in our own bubble in Academia, and for a chance to do better – and we *must* do better.

We would like to thank you all: the authors who contributed, our Readership and the entire Education community at SFU for your continued support, patience and understanding during these continually trying times.

Though we have only published 2 issues since the pandemic, our authors have submitted high quality, engaging and timely works that we are proud to publish here. As we, hopefully, begin seeing the light at the end of the tunnel in BC's Lower Mainland, and as we start heading back to a new, more open 'normal', we are optimistic that the Ed Review's future will be just as bright.

We look forward to plans to resume regularly scheduled publications for the fall/winter months, and for a complete return to 'normal' in 2022 with two regular publications, and one special issue. We hope you enjoy reading these works as much as we enjoyed compiling them for you, that they make you think, learn, question, and inspire you to write your own contributions in the future.

Thank you again, for your continued support and contributions. Please see below for a very brief summary of each article published in this current journal edition.

The first article of this issue, *Fighting for Social Lives: Public versus Market Pedagogies*, is a critical reflection by Ki Wight, which raises the old but very current question about the purposes of higher education. Drawing on the author's own teaching experiences, critical pedagogies are explored in a search for reconciling industrial and market logics with critical and social rhetorics in higher education.

Canan Güneş, in her article *Reciprocal Influences in a Duo of Artefacts: Identification of Relationships that Serves to Multiplicative Thinking,* investigates the use of *duo of artefacts* can enhance the learning and understanding of multiplicative thinking in Mathematics. More specifically, the author studies how a more reciprocal use of *duo of artefacts,* in place of the common physical to digital order, can bring benefits to mathematical ideas. Güneş conducts and analyzes interview with a 5-year old to present her findings of how the reciprocal use of a duo can accelerate students' meaning making process.

In *A Critical Policy Analysis of the Implementation of the Bi-Literacy and Trilingualism Language Policy in Hong Kong: From a Postcolonial Perspective***,** Young Li adopts a critical lens in analyzing the Bi-literacy and Trilingualism Language Policy in Hong Kong that proposed the use of Cantonese, Mandarin, and English. Drawing on the contexts of policy making framework, Li examines the implementation of this language policy in Hong Kong and explores the reasons for resistance to Mandarin. Li suggests that postcolonialism and anti-cultural imperialism perspectives may shed light in understanding people's attitudes and perceptions toward these languages in Hong Kong and therefore, may help in refining the existing language policy.

In *The Implementation of Project-Based Learning,* Bingjie Qi provides a narrative literature review of project-based learning in K-12 school settings. Qi includes both research findings and peer-reviewed journal articles, as well as social media posts, such as teacher blogs, which document the first-hand experiences of teachers using project-based learning approaches in a variety of contexts, and provide different perspectives. The strengths and success of project-based learning are discussed, as well as challenges, and suggestions for implementation of project-based learning in classrooms.

And finally, Jade Leong and Dr. Poh Tan present a collaborative visual scholarship in *Teacher and Researcher in Entangled Relations,* created through and about a collaboration between an early childhood teacher and researcher. Their scholarship explores the entanglements of assumptions and perceived tensions that occur during a co-created research project and the be-coming together of the "teacherresearcher" in relations of materiality, ideas, movements, actions and dialogue.

Sincerely,

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ARTICLES

FIGHTING FOR SOCIAL LIVES: PUBLIC VERSUS MARKET PEDAGOGIES

KI WIGHT

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Abstract

Vocationalism and other market logics dominate over social logics in contemporary higher education discourses. This personal critical reflection explores how theories of critical pedagogy can inform and inspire educators to centre social justice.

Keywords: critical pedagogy, social justice, neoliberalism, vocationalism

Fighting for Social Lives: Public versus Market Pedagogies

Occasionally when I teach, interactions with my students leave me off-kilter and searching for critical pedagogical theory to address, transform, expand or withstand the tension points coming to a head in the classroom. There is a common question arising in these unnerving exchanges: is the purpose of higher education to enable students to get a job, or is it for enhancing social good? While social justice and finding a career are not mutually exclusive, my experience is that neoliberal business logics in higher education have the capacity to overshadow critical and social sensibilities and actions. The challenge in this situation is how to appropriately address students' concerns about the social realities, and perhaps problems, within career-focussed courses or programmes. What happens if critical and social perspectives are routinely eschewed over rote curricula and educational practices? What impact will this have on students and the industries they are seeking careers in? In an effort to reconcile industrial, critical and social rhetorics in higher education, this writing is an example of my reflective process that links teaching experience in a Canadian public university to critical educational theory.

During a seminar I was teaching about the economic and social landscape of the North American entertainment industry, one of Hollywood's most powerful movie executives, Harvey Weinstein, was charged with several counts of sexual assault and other egregious offences (Simon, 2018). During this semester, the students came to class every week with many fervent observations, questions and reflections about the Weinstein charges and other industry abuses being exposed.[1] Revelations included systemic and persistent abuses of power, workplace harassment, overtly and covertly racist practices, and rampant sexual assault, and this left many students questioning their choice of pursuing an education and a career in the entertainment industries. Our classroom conversations subsequently intensified as public discourse and other allegations became frequent, and particularly focused on abuses based on race and gender. In light of the media revelations over several weeks, one student's comment stands out:

> I'm Iranian, and my family didn't want me to study film because they don't think it's possible for someone like me to succeed here in film. They think the industry is too racist to accept me.

This student was a relatively new citizen, and was clearly feeling the weight of racism in public discourse, and perhaps also in practice in my film production program. In response to this statement, I tried my best to facilitate a discussion about systemic racism, about industry, community and individual strategies for addressing and resisting racism, and about employee rights and protections in the industry and in law, but I kept thinking that the discussions fell short of where there needed to go. This sense of feeling like my students needed better support and educational framing made me consider my pedagogical approaches. Elaine Unterhalter (2010) draws on Melanie Walker's "capability approach" to describe pedagogy as "an ethically informed process in which we are alert to questions of equitability, a humane justice, and what

[1] Weinstein was convicted on some of the charges in March 2020 and sentenced to twenty-three years in U.S. prison. (Dwyer, 2020).

we want students to be and become" (p. 93). My sense of disquiet echoes Unterhalter's words, and can be understood as a pedagogical drive to enable social justice through teaching and learning. However, in thinking back, I didn't find a way for this student to see themself reflected in media production education and beyond, so Walker's *capability approach* was likely never realized. Did I falter in the face of the neoliberal pressure to quiet the critical mind and fall in line with the rote technical aspects of media education? What other work would I need to do to realize more socially just pedagogical commitments, and what other learning did I need to do in order to better address these important issues?

The same semester, but in a different seminar on business writing and industry preparedness for media artists, my class talked about industry abuses of power and about swiftly changing workplace policies and standards to address harmful workplace practices and cultures. We considered a selection of objectifying images from Hollywood films, and talked about why images can be objectifying, and potential impacts of this objectification. I asked the students, if our industry creates representations that objectify and degrade certain bodies, is it possible that our images are connected to the ongoing workplace violence experienced by many industry workers? What happened next stunned me, partly because the class was engaged in an in-depth discussion. One student stood up and yelled at me:

> How dare you disrespect our industry in this way. If the industry knows that sex sells, or wants to use images that make them money, how dare you question that.

I was taken aback at this student's position, as it had naively not occurred to me that being critical about the entertainment industry presented such a threat to them in the context of our class. In the conversations that followed, the student was not interested in critiquing the entertainment industry because the student was in the media program as a means to get a *good* job. I responded by saying that employees can have opinions, and the more informed and considered their opinions, the better. We looked more closely at changing employment policies to show that issues of workplace abuses were being confronted at a high level. Again, though, I was left with a feeling that I hadn't responded to this fully or satisfactorily, and I certainly did not find a way to address the economic threat that fueled the student's comments. Certainly, in teaching vocational content critically, I am placing students in a bind because students do need to find employment that can pay their bills, and possibly even bring them a sense of joy and accomplishment. Furthermore, push-back is to be expected when students have received messaging about the purely functionalist vocational value of their educational programmes. The educational challenge, then, is how to situate critical and social content so that students can find ways to apply it within workplace contexts. The work must be to build bridges between industrial contexts and critical and social curricula; these bridges most certainly have to be about confronting, speaking to, and strategizing remedies to social inequities that manifest in media workplace culture (Allen, 2013; Ashton & Noonan, 2013; Berger et al., 2013). What comes into question while considering bridging social and critical curricula and pedagogy to vocational content, are the broad economic and social pressures faced by the public post-secondary education landscape, and the resulting discourses taken up by these institutions.

While my university is a public institution, the newer technological and career-centred programs are priced as *cost-recoverable*, and students are paying tuition amounts that are getting closer and closer to pricey private institutions. In fact, one of our university administrators recently delivered a self-proclaimed "state of the union" where they launched a new operational plan, and explained that our former way of institutional planning was "no way to build a business." In this address, clear departmental actions were noted, but they were not linked to our core institutional values of access and student well-being. The disparities between institutional visions and institutional actions are well documented in academic literature, particularly with respect to the ways equity initiatives are often managed in performative ways and have limited impact (Ahmed, 2012; Dua & Bhanji, 2017). Dua and Bhanji (2017) note, in particular, that equity initiatives are easily absorbed by neoliberal commercial rhetorics wherein it is important for institutional competitiveness to speak a language of equity and diversity without operationalizing these sentiments. The tensions in these institutional critiques play out in a variety of ways. Stromquist and Monkman (2014) warn that:

> The privatization of public education…contributes to the depoliticization of the university as students in private universities are readily inculcated by 'careerist' as opposed to 'critical' norms…the privatization of higher education puts it squarely in the productive sphere and weakens the principle of education as a public good… (p. 14)

If students and instructors sense that the purpose of their education is simply for obtaining a job, then the critical and social functions of higher education might be lost. In my experience, there is a rift or tension between colleagues who are concerned with bridging critically-minded and social justice approaches to our vocational programs, and those who are focused on teaching pure technologies and rote job skillsets. In trying to find a way through these tensions, different critical pedagogy theories offer generative notions for prioritizing the *public* in public educational institutions.

Two critical concepts that I have encountered describe the tensions that I experience in academic life: public and market pedagogies. Giroux (2014) defines public pedagogy in neoliberal terms "that privileges the entrepreneurial subject" (p. 1) and "attempts to undermine all forms of solidarity capable of challenging market-driven values and social relations…" (p. 2) Giroux's concept of public pedagogy aligns with Stromquit and Monkman's warning that careerist logics have the potential to erase topics and perspectives of social good from educational contexts. The vocational logic they warn against includes emphasis on productivity, prioritization of rote workplace skills, and the reduction of socially critical course and program offerings in the social sciences and humanities (Stromquist & Monkman, 2014). Together, these theorists criticize market logics for infiltrating the public sphere. Paulo Freire's (2017) sense of public pedagogy differs immensely by theorizing how teachers can embed notions of deep democracy in education. Freire's work entails a deep faith in the capacity of all people, particularly people who are typically cast aside or considered invaluable. For Freire, education is a non-hierarchical dialogical act "between learners and educators as equally knowing subjects" (p. 182). In other words, formal education offers the chance for teachers and students to learn

together in a community that values different perspectives and rich dialogue. From a Freirean perspective, public pedagogy has the capacity to democratize the production and exchange of knowledge, thus having the potential to challenge or transform systems of power. Freire's work has been built upon by critical scholars such as bell hooks (1994) who advocates for responsive and democratic methods of teaching critical thinking, and who also extends her scholarship to media culture because of the potent public pedagogy of popular entertainment on dominant ideas about gender, race and class (hooks, 1996). Media scholars have taken up hooks' work in critical media public pedagogy and developed critical media educational courses that seek student agency through the exploration of resistant interpretations and production of popular entertainment (Patterson et. al, 2016). What this work evidences with respect to public education is a need to vigilantly pay attention to mechanisms of democracy, ethics and social justice that might become overshadowed by industrial and marketplaces demands and logics. These tensions between notions of public and market invoke the image of fighting for social lives in the face of policies, communications, and pedagogies that undermine critical thinking and inculcate rote commercial mindsets. The following section explores educational theory that supports social pedagogical concerns.

Theories of resistance to neoliberal and capitalistic, market-driven forms of education have the potential to support different approaches to critical pedagogy. Pinar's (2017) concept of the *reconceptualist* educator draws from Michael Apple's work theorizing social justice in education. A reconceptualist approaches pedagogy through critical theory, historical perspectives, and away from technical or corporate function towards "a fundamental reconceptualization of what curriculum is, how it functions, and how it might function in emancipatory ways" (Pinar, 2017, p. 172). Pinar's reconceptualist approach is important as it encourages educators to centre social good and teach critical theory with concern for history and ethics over marketplace concerns. Apple (2004) notes that it is essential for educators to develop a clear purpose and prioritization of social values underlying their teaching practices. Since market-based neoliberal values are embedded in our educational systems, and "Since these values now work *through* us, often unconsciously, the issue is not how to stand above the choice. Rather, it is in what values," we, "must ultimately choose" (Apple, 2004, p. 8). So, the site of resistance for Apple is in the centring of values for social good as a way to offset or destabilize the rationality of neoliberal educational mechanisms. Freire (2017) and hooks (1994) look more closely at the character and core values of educators, and suggest that in order to check our own superiority in the classroom, we must engage the students' knowledge, and remove hierarchies and one-way directionality of learning. For Freire (2017), the educator should be "a person constantly readjusting his knowledge, who calls forth knowledge from his students" (p. 185). Freire and hooks' democratic approach to education is a critical pedagogy that ultimately promotes a teaching practice that values instructor self-reflection and openness to change through the prioritization of students' knowledge critique and production from their social locations and areas of social concern. This democratic approach to curriculum and pedagogy extends to decolonizing or postcolonial approaches. Pedagogical strategies include reviewing

structures of colonial nomination in history and social practice, working with the difficult knowledges inherent to colonial histories, appropriately integrating local histories and knowledges, particularly Indigenous histories and knowledges, and ultimately using these strategies for the goal of enhancing students' sense of relationality and self-determination (Cote-Meek, 2014; hooks, 1994, 2010; Stromquist & Monkman, 2014; Unterhalter, 2010). Reading this kind of theoretical work offers me energy, insight and focus on centring social justice and critical social theory in my teaching, and in how to respond to highly individualist and instrumental neoliberal pressures within my institution.

Despite the ways that critical pedagogy critically informs my teaching approaches and philosophy, a question remains in my mind: how is it possible to build the stamina to fight for social lives in higher education? Rogowska-Stangret (2017) urges academics to "win the gag reflex back and to learn from the bodily impulses and instincts in order to form a visceral politics," (p. 14) and to do so while considering "the potentials of collectivity" (p. 12). These visceral politics remind me to centre the feelings associated with the pangs of identifying and addressing injustices in curricular or institutional structures, and to constantly remind myself of the ways that collective action influences change. The various ways that oppressive aspects of dominant culture evaluate, reward or regulate instructors in inequitable ways, is also well documented in academic literature (Henry et al., 2017; Mayok, 2016). For speaking up, and working on initiatives that promote student or instructor equity, I have certainly experienced harassment, even in one instance being accused loudly of having a "gay agenda" after routinely following up with a department head regarding the budget for a queer-themed course with significant student demand. In this instance, my supposed transgression was simply requesting information on an established course, but one that inherently challenged heteronormative dominance in my department. I am not alone in these interactions, so collective action is an important path forward for instructors to build community and support each other in transforming the institution through just measures, and at times, in supporting more just outcomes through instructor hiring and evaluation processes themselves (Henry et al., 2017). While instructors have a relatively high degree of agency and autonomy by contract, there are persistent tensions within the culture and working processes of the university that seek conformity, accountancy, and consistency with the ways things have always been done. Instances of institutional push-back and harassment are also a reminder to retain the visceral and student-centred sensibility of resistance. While I've never used the metaphor of war or fighting to reflect on my teaching career, I have had an instinct lately to use my privilege as a full time instructor to perform a blockade between the students and crushing hegemonic institutional structures violent and oppressive curricula or pedagogical practices. Harmful institutional practices that are well-documented include a dearth of culturally-appropriate counselling and student services, or curriculum and pedagogy that focuses solely on oppressive histories, hierarchies or cultural representations and assumptions (Cote-Meek, 2014; Dei, 1996; Henry et al, 2017; Sensoy & DiAngelo, 2017). This oppression might be even greater in vocational or career-based university departments, as the social problems of those industries embed themselves

in the curriculum and pedagogy of these programs. Scholars such as Allen (2013), Ashton (2013), Lee (2013), and Saha (2018), chart the ways that race and gender, in particular, are sites of exclusion in both the media industries and media vocational education; these authors explore strategies for resistant pedagogies, curricula, and institutional practices for the betterment of student experience, agency, and for the future impact on cultural industry work. In my own institution, there are instructors who are following these lines of resistance and transformation, and some that simply want to teach technological processes or old canons in uncritical ways. These differences form sites of tension, and contribute to my visceral sense of a blockade. Through this feeling, I find resolve for embedding histories of injustice and resistance into my curricula, thinking creatively about how students can complete courses using knowledge from their lived experiences, and finding ways to allow students to complete work outside of institutional timelines. All of this work underscores my commitment to contributing to a healthier and more just educational experience and landscape. By doing this, I hope to engage what Freire (2017) referred to as the "utopian state of *denunciation* and *annunciation*" (p. 188), which I see as a form of emancipatory and empowered personal expression. Denunciation and annunciation are a utopian vision of education that sees the learner coming to a place of dismantling socio-political systems that affect them, and communicating or envisioning their way through or beyond these systems. In practice, students have commented that my courses that sit amongst other more instrumental curricula or hegemonic canons have offered them an oasis that has allowed them to explore their own connections to curricula, and see beyond normative cultural paradigms. This is particularly the case in my queer cinema history course, wherein the students explore a plethora or films and theories that emphasize non-dominant cultural expressions of gender, sexuality, race and nation. So, my impulse as an educator to perform a blockade is ultimately a phenomenological mechanism that gives space for students' epistemological reckoning, or just some time so that they can reach their goals. In the classroom stories I shared that left me off-kilter, my blockade failed in these moments as they needed to be responded to with more sustained action and focus, particularly in how these student concerns connect to the students' future workplaces in their desired careers in the entertainment industries. The critical pedagogies that I explored in this writing will assist me in staying focused on centring students' experiences and knowledges in their learning, ongoing reflection and strategizing on critical issues of injustice, and engaging critical theory as a necessary pedagogical intervention to centre social care and social justice in higher education. If I can make space for critical pedagogy in vocational or applied learning environments, I hope that will assist in transforming both the institution and the industries that our programs link to.

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RECIPROCAL INFLUENCES IN A DUO OF ARTEFACTS: IDENTIFICATION OF RELATIONSHIPS THAT SERVES TO MULTIPLICATIVE THINKING

CANAN GÜNEŞ

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Abstract

The combined use of a physical pedagogical artefact and its digital counterpart is described as a duo of artefact. In the literature, duos of artefacts are mostly presented with a certain order: non-digital artefact is followed by the digital counterpart. This study examines the influence of reciprocal use of artefacts in a duo on a 5-year-old child's identification of multiplicative relationships between the objects. Data is created through the video record of two clinical interviews with the child. The results showed that the reciprocal use of the artefacts enriched the child's experiences of each artefact and mediated the relationships which were important for multiplicative thinking.

Keywords: duo of artefacts, multiplicative thinking, drawing, educational technology

Introduction

Studies show that mathematical tasks which require students to manipulate physical artefacts enhance mathematical teaching and learning (Carbonneau et al., 2013). However, the rigid structure of artefacts might prevent teacher from modifying them in a way to increase their mathematical potentials. At this point, their digital counterparts add value to the use of physical objects as classroom teaching equipment because different artefacts trigger different signs (e.g. natural language, gestures, and mathematical semiotic systems), and different signs lead to different meanings. Digital counterpart can achieve this through "offering students a new opportunity to identify the mathematical properties embedded in the artefact behavior and more abstract and conventional representation of mathematical objects" (Soury-Lavergne, 2017, p.1). This combined use of a physical pedagogical artefact and its digital counterpart is described as *duo of artefacts* (Maschietto & Soury-Lavergne, 2013).

Integrating duo of artefacts in mathematics classes is a recent practice, but it has already demonstrated some positive outcomes (see below for more detail). In most of these studies, the duo of artefacts is presented with a certain order: first, students are introduced the physical artefact and then they are given the digital counterpart. This restrictive order suggests that the duo of artefacts enhances mathematical ideas through the added value of digital counterpart only. However, this one-directional approach might hinder the potential of physical artefact to enrich the affordances of the digital counterpart. In the literature, various duos of artefacts have been used to introduce students to various mathematical topics. I will study how reciprocal use of a duo of artefacts enhances the mathematical ideas related to multiplicative thinking which, to the author's knowledge, has not been studied with respect to a duo of artefacts yet. In this study, the digital artefact is a free tablet application called TouchTimes (Jackiw & Sinclair, 2019) which is designed to develop multiplicative thinking through creating quantities in specific ways. The physical artefact is the pencil and paper, through which students draw the target numbers they created with Zaplify – one of the TouchTimes "worlds".

Duo of Artefacts

Drawing on instrumental approach, Soury-Lavergne (2021) proposes a difference between "two artefacts" and "duo of artefacts". According to the instrumental approach, when individuals encounter an artefact (material entity), they construct utilization schemes (psychological entity) as they interact with the artefact. The combination of the material and the psychological entities generates a specific instrument for the individual. This is called instrumental genesis. For example, upon seeing a plastic circular object (material entity), someone might think of placing it on the paper and circumscribing (psychological entity) to create a geometrical diagram.

The difference between "two artefacts" and "duo of artefacts" depends on the nature of instrumental genesis they prompt. The former suggests two separate instrumental geneses of two separate artefacts. Whereas the duo of artefacts constitutes a system that emerges through the joint instrumental genesis of two artefacts. Soury-Lavergne (2021) acknowledges that the new

instruments integrate the previously developed instruments into its form creating a system rather than an isolated independent instrument. As it is not practical to identify all the previous instruments in a system, she proposes to reduce the complex system of instruments into duo of a tangible entity and a digital one to study their influence on learning.

Drawing on Bourmaud, Soury-Lavergne (2021) indicates three conditions for the joint instrumental genesis triggered by a duo of artefact: complementarity, continuity and antagonism. When two artefacts are used together (either simultaneously or successively) they complement each other. However, the complementary use of artefacts may not result in a joint instrumental genesis without a continuity between them. When the artefacts are used in relation to each other, shared characteristics or elements of the artefacts build a continuity. On the other hand, the divergent features/functionalities of the artefacts result in antagonism between them. These divergences create constraints for the users' existing schemes and prompt them to adapt their schemes when passing from one artefact to the other.

These three conditions explain why providing two artefacts may not be effective in creating a system of artefacts that results in joint instrumental genesis. This is illustrated in Lei et al. (2018) that examined an ineffective combination of a material and a digital tool. The material artefacts were a tape measure and theodolite. Whereas the digital artefacts were two apps installed in tablets called EasyMeasure and Angle Meter. The teacher provided the students with this duo of artefacts to introduce the concept of percentage error. One of the main reasons Lei et al. (2018) attributed to the failure of the duo was the difference between the artefacts. Apart from their functions, which was to measure, they did not share any feature. When we consider Lei et al.'s (2018) finding with respect to the conditions cited by Soury-Lavergne (2021), it could be said that there is little opportunity not only for continuity but also for antagonism. So, unlike a duo of artefact, these two tools did not lead to a system of artefacts that triggered a joint instrumental genesis. Therefore, it is not appropriate to call them as duo of artefacts from Soury-Lavergne's perspective. Unlike this counterexample, the literature presents various successful use of duo of artefacts in teaching and learning mathematic. The following section summarizes a few of them. The exemplar studies are chosen to represent the diverse use of duos in mathematics lessons.

Teaching and learning through various duos of artefacts

Maschietto (2018) studied how the Pythagorean theorem was introduced to 7-grade students in a composite environment which consisted of a material and a digital tool. One of the material tools was a mathematical machine which consisted of four congruent wooden right triangles that fitted into a wooden square. The square was covered with a red paper and surrounded by a frame. The digital tool was an Interactive Whiteboard (IWB) on which the teacher created the digital version of the mathematical machine. The tasks were (1) to obtain red square areas by placing the triangle prisms into the square frame and (2) to change the configuration to obtain a larger red square which is surrounded by the triangle prisms. While students directly manipulated the mathematical machine, the digital tool was manipulated only by the teacher and a few students to switch between the configurations of the triangles on the

board. Even though many students did not manipulate the digital tool directly, Maschietto (2018) proposed that the conservation of the square areas was emphasized through linking the manipulations of the triangles in the digital tool with the manipulations of the triangles in the mathematical machine. This conversation helped students deduce the Pythagorean theorem.

Van Bommel and Palmér (2018) compared six-year-old students' responses to a combinatorial task when they used only physical artefacts and when they used a duo of artefacts. The task was to find how many different ways three toy bears can be arranged in a row on a sofa. The physical artefacts were the toy bears, paper and a number of coloured pencils to record the arrangements. The analysis of the children's drawings revealed many duplicates in students' solutions and thus indicated that students did not systematize their solutions. The digital artefact was designed based on these findings to provide the children with feedback about the duplicates. When the students used the duo of artefacts, they were first introduced the digital artefact and then asked to find the number of seating arrangement by using paper and pencil. The results show that the children who solved the task via the duo of artefacts were found to keep more systematic records of the situations and to enhance their understanding of what a duplicate means in a combinatorial problem.

Soury-Lavergne and Maschietto (2015) studied how a duo of artefacts was used by six years-old students to learn about numbers. The students first worked with pascaline, a mechanical machine made of gears which allowed students to create and to add numbers symbolically by rotating them. The digital counterpart of pascaline was embedded in an e-book. The students were given two tasks. One of them asked students to add two numbers. The other one asked them to write a number with minimum rotations. The findings showed that the duo of artefacts prompted the students to connect the separate conceptualizations of quantity and digit.

All the duos used in these studies conform to the three principles that would result in a joint instrumental genesis. While they differ from each other in terms of mathematical topics they develop, the type of artefacts involved in the duo and the nature of the tasks they posed; the order of the artefacts was the same across all of these studies: either the digital artifact was followed by the non-digital counterpart or vice versa except for one case. In Soury-Lavergne and Maschietto (2015), one teacher made the physical artefact available again after the students had difficulty to solve the tasks in e-pascaline. This bi-directional use of duo is unique among these studies and it suggests a new way to exploit the potential of the duo. Compared to using each element of a duo individually in successive occasions, manipulating them reciprocally during a mathematical activity might enhance the integration of instrumental geneses more strongly.

In this study, I will examine reciprocal use of a duo which involves pen and paper as its non-digital element. Compared to the artefacts like the mechanical machines used in Soury-Lavergne and Maschietto (2015) and Maschietto (2018), pen and paper provides students with a special medium to create meanings with less restrictions that stem from the physical structure of the artefact. This use of pen and paper is different from using drawings only to express and record thoughts after manipulating the mechanical artifact, which was the case in all three studies. However, the unrestricted diagramming might deviate learners from the target

mathematical idea unless it is repeatedly restructured based on the manipulation of the digital artifact which embeds the intended mathematical relationships within its design in this study the multiplicative relationships.

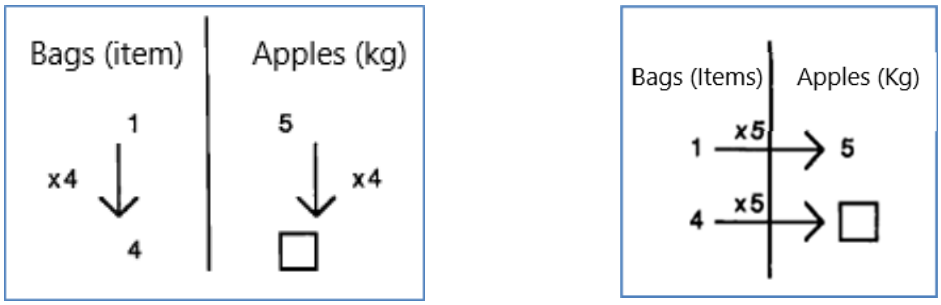
Multiplicative Thinking

Multiplicative thinking is conceptualized by many researchers in a unique way. Even though they slightly differ from each other and focus on the different aspects of the concept, one thing is shared by all: it is different from additive thinking. Schwartz (1988) focuses on the referents of quantities in these operations. While the quantities refer to the same entity in addition (e.g., 5apples + 4 apples = 9 apples), different type of quantities are operated on in a multiplication (e.g., 5 kg of apples per bag x 4 bags=15 kg apples). Similarly, Clark and Kamii, (1996) points to the abstraction of the number of units involved in both operations. While addition is conducted with only one unit-count (that quantifies only the individual apples in the previous example), in multiplication one operates on two unit-counts (one that quantifies the kilos of apples, the other that quantifies the price of the apples).

Vergnaud (1988) emphasizes the relationship between the unit counts a child establishes in an operation and distinguishes scalar relationships from functional ones. For example, when asked the problem "Amy wants to buy 3 bags of apples. Each bag has 5 kg of apples. How many kilos of apples does she buy in total?", a student might show the solution either with 4x5=20 or with 5x4=20. Even though they are both multiplications, Vergnaud says that "the relationships that leading to these choices are very different" (p. 145) and illustrates the difference using the following T tables in figure 1.

Figure 1

Illustration of 4x5=20 and 5x4=20



Note. Adapted from "Multiplicative structures" by G. Vergnaud, G., in J. Hiebert & M. Behr (Eds.), *Number concepts and operations in the middle grades* (pp. 141–161), 1988, Lawrence Erlbaum Associates. Copyright 1988 by The National Council of Teachers of Mathematics.

In the first case students attends to the ratio between the same quantities which is a scalar. Therefore, 4x5 is a "concatenation" of 5+5+5+5: the amount of apples =the amount of 1 bag, plus the amount of 1 bag, plus the amount of 1 bag, plus the amount of 1 bag (Vergnaud, 1988, p. 146). Whereas in the second case (5x4) the student attends to the ratio between the different

quantities. In this case 5 is not a scalar, it is associated with a many-to-one correspondence between the unit counts: 5 kilos per 1 bag.

In addition to this static relationship between the two unit-counts, Davydov (1992) points to a dynamic feature of multiplication when he defines it as the transfer of unit counts. He explains the meaning of multiplication with respect to measuring activities and distinguishes a small and a large unit-count which both quantify a given magnitude of an object. Measuring a magnitude (e.g. apples) with the small unit (kg) would be impractical. Therefore, one indirectly quantifies the magnitude in relation to the smaller unit by transferring the unit count from the smaller to the larger (bags) thanks to the established relationship between the two (5kg/bag). This transfer implies a simultaneous multiplicative action.

Drawing on Davydov's notion of transfer of unit-count and Vergnaud's notion of functional relationship, Jackiw and Sinclair (2019) designed TouchTimes (*TT*) to enhance multiplicative thinking. *TT* consists of two models or "worlds" – Zaplify and Grasplify. Davydov's and Vergnaud's multiplicative notions are conveyed in both worlds, yet through distinct models. Thus, Zaplify and Grasplify prompt learners to experience these multiplicative ideas in two different ways. This paper will focus only on the former world (see Bakos & Pimm, 2020) for more details on how Grasplify world prompts these multiplicative notions).

Zaplify

When entered, this world shows an empty screen. When the tablet is placed horizontally on a surface, seven fingerprints and a diagonal line appear respectively in order to guide users to place their fingers both horizontally and vertically in the designated areas separated by the diagonal (see Figure 2a &2b).

Figure 2

(a) Fingerprints and (b) fingerprints and the diagonal.

a)  b) 

When a user places and holds any finger on the screen, a "lightening rod" (I will call them "lines" from now on), which passes through the point of touch and crackles dynamically, appears on the screen either horizontally or vertically according to the position of the touch with respect to the diagonal. The upper-left triangular area formed by the diagonal allows horizontal lines (HL), while the lower-right triangular area allows vertical lines (VL). Screen contact can be made with one finger at a time or with multiple fingers simultaneously. Multiple fingers that maintain continuous contact can create either only HL, only VL or both VLs and HLs (see Figure 3 a-c).

Whenever two perpendicular lines intersect, an orange disc gradually appears on the intersection points. The numerical value of the total number of intersections, which is the product of the two factors, appears in the upper right corner of the screen (see Figure 3c). If there is no intersection, only the number of factors appear (see Figure 3 a,b).

Figure 3

(a)HLs, *(b) VLs* *(c) VLs and HLs*

There are two modes of manipulation of the app: locked and unlocked. In the unlocked mode, the lines disappear as the fingers separate from the screen, whereas in the locked mode, lines remain on the screen even when the user's finger is lifted, but no longer crackle dynamically. This allows a user to create products that involve more than ten fingers.

The Zaplify objects, the gestures that create these objects and the relationship between these objects are all associated with various aspects of multiplicative thinking. The vertical and the horizontal lines represent the two unit-counts of multiplication. The orientations of lines may help students distinguish these units-counts. In addition to this visual difference, the separation of the units may be associated with the difference in the haptic experiences. While the horizontal lines can be created only by touching the upper triangular area, one must touch the lower triangular area to create vertical lines. Pressing fingers to create parallel lines on one triangular area and then pressing down a finger on the opposite side to create a perpendicular line canbe associated with Davydov's notion of transfer of unit counts. In this case, the unit count is transferred from the parallel lines to the perpendicular line. This transfer results in Vergnaud's notion of many-to-one correspondence between the units: many units represented by the parallel lines correspond to the new unit which is represented by the perpendicular line (see Güneş, 2021, for a more detailed explanation of how Zaplify can prompt multiplicative thinking).

Theoretical Framework

This study draws on Bartolini Bussi and Mariotti's Theory of Semiotic Mediation (TSM). This theory focuses on the relationship between the representation systems and the human cognition. Human beings create representations through using artefacts and this has two consequences: the modification of the environment and the cognitive development. TSM is based on this double nature of artefacts.

An artefact does not guarantee a specific use for the subject. Indeed, Rabardel (as cited in Bussi & Mariotti, 2008) distinguishes artefacts from instruments. An artefact is a concrete or a symbolic object itself. It becomes an instrument by the subject through its particular use. For

example, a glass is an object which is designed to carry liquid. If a cook uses it to crash some walnuts into smaller pieces by pressing the walnuts between the bottom of the glass and a cutting plate, the glass becomes an instrument.

The instrumental approach to artefacts can be informative in analyzing the cognitive processes related to the use of a specific artefact and its semiotic potential. However, it is not adequate to analyze the more complex process of teaching and learning mathematics through artefact use. At this point, Bartolini Bussi and Mariotti (2008) resort to Vygotsky's approach to artefacts.

Vygotsky talks about the difference between an individual's developmental levels in two different situations: (1) when an individual is able to accomplish a task him/herself, and (2) when an individual can accomplish a task with the guidance of a more knowledgeable individual (as cited in Bussi & Mariotti, 2008). This difference is called the *zone of proximal development*. Within this zone, the communication between the individual and the more knowledgeable one leads to the cognitive development of the learner. The theory of semiotic mediation elaborates more on the relationship between tasks, signs and mathematical meaning making within this process and distinguishes semiotic mediation of artefacts from teachers' cultural mediation.

Using an artefact in a social context, learners produce certain signs which are essential for semiotic mediation. These signs have a dual role: expressing the relationship between the task and the artefact on the one hand, and the relationship between the artefact and mathematical meaning on the other hand. The former is called an *artefact sign* and their meaning is associated with the operations conducted to achieve the task. The latter is called a *mathematical sign* and it is aligned with the existing mathematical culture. On the way to the evolution of artefact signs into mathematical signs, pivot signs are important. The pivot signs "may refer both to the activity with the artefact...and to the mathematical domain" and they are distinguished from the other signs based on the extent of generalization they carry (Bussi & Mariotti, 2008, p.757). In this study I asked how the signs evolved during reciprocal use of a duo of artefact.

Method

Data is created through the video recording of two clinical interviews with a 5-year-old child, whom I name Zach. Both interviews lasted for approximately half an hour. Zach used Zaplify and pencil-and-paper during the interviews. The interviews consisted of number-making tasks, drawing tasks, and what-happens task in which I (denoted as R in the below transcripts) asked Zach (denoted as Z in the below transcripts) to anticipate how the number would change if I added more fingers.

Clinical interviews conducted in this study could be described as the derivative of joint inquiry activities which naturally occur in every individual's life (DiSessa, 2007). I conducted the interviews at Zach's home. Zach's father (denoted as F in the below transcripts) was present during the first interview, and he participated in the interview by asking questions to Zach when he seemed hesitant to respond. My goal was to help Zach to make sense of Zaplify and to discover how he makes sense of it. Even though the interviews did not carry an instructional

orientation (I avoided evaluative comments based on a normative response to the tasks), it would be problematic to deny that manipulating the artefacts while communicating with the interviewer did not contribute to Zach's learning.

The participant is recruited through convenience sampling. Multiplication is generally introduced in the second and the third grade of elementary schools. However, studies show that before formal schooling, young children can demonstrate some aspects of multiplicative thinking (Bakker et al., 2014), for example by extracting the invariant proportional relationship between two numerical magnitudes (McCrink & Spelke, 2010). Therefore, choosing a young participant, this study also contributes to the discussion of whether multiplicative thinking can be developed with instruction in younger ages (as per Askew, 2018) and whether the ordering of the mathematical topics in the curriculum documents that positions learning of multiplication after addition based on a hypothesized developmental learning progressions can be challenged (as per Bicknell, et al., 2016).

In this analysis, I focused on the signs Zach created via the duo of artefacts, drawing from Arzarello et al.'s (2009) concept of *semiotic bundle*. There are two ways to analyze a semiotic bundle: synchronic and diachronic analysis. The former focuses on a specific moment where the subject produces different signs spontaneously. The latter focuses on the evolution of the signs produced by the subject in successive moments. I also analyzed different signs created by different artefacts at different time points in a synchronic manner in order to examine the relationship between the artefact signs.

Findings

In the following, I highlight how Zach identified relationship between mathematical objects via duo of artefacts. I characterize the instances with excerpts from the interviews.

At the beginning of the first interview session, Zach randomly made one orange disc on Zaplify. Zach described the orange disc as a dot. When I asked him to make one more, he could not make it. During the following 18 minutes, while Zach was holding HLs, I was adding VLs one by one, making 2, 4, 6, 8, 10, and 3, 6, 9, 12, 15 respectively. Then I asked Zach to make "one" again, assuming that creating numbers repeatedly on Zaplify might have helped Zach to identify the relationship between the lines and the discs. As I pointed to the upper right corner of the screen, I said: "I want to see the [numeral] one here and one orange ball". After a few attempts, he could not make any disc. Then I asked him to draw one disc:

1 R: In order to get one dot, what we should see? How does one dot appear? Can you draw one dot? How was it on the screen when we see one dot?

2 Z: It was small and red [*drawing a circle*]

3 R: Were there anything else other than the dot?

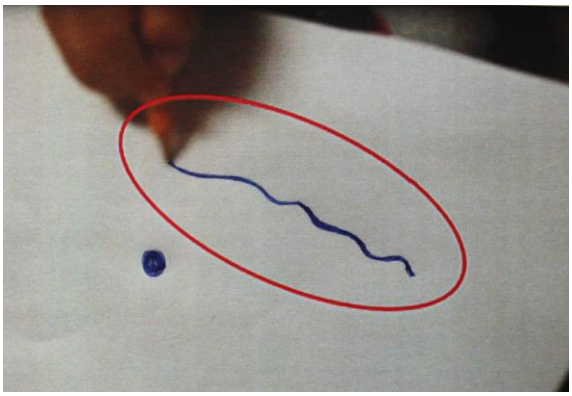
4 Z: A yellow line

5 R: Where was it?

6 Z: … [drawing a curvy line which looks like a wave just below the circle]

Figure 4

Horizontal curly line



Note. The author retraced the pencil marks in the pictures to improve visibility.

Zach used the words "small" and "red" in order to describe the dot. These artefact signs refer to physical features of the ball unlike its position, which might suggest a relationship between the other artefact signs such as lines and the intersection point. When I drew Zach's attention to the other artefact signs (line 3), Zach uttered the word "yellow line". This artefact sign includes a mathematical sign, which is a "line", yet it also refers to the color of the line in order to describe it. Again Zach created signs related to the physical features of the objects rather than their orientation (e.g. horizontal/vertical), which is important in terms of multiplicative relationships. When I hinted the orientation by asking where it was (line 5), Zach created a sign in another modality. Rather than describing it with verbal signs, he created a visual sign with his drawing (see Figure 4). This sign illustrates the line in horizontal orientation as in the Zaplify, yet separate from the disc. So it seems that Zach did not relate the disc with the HL except for their quantities. For one disc, he created one line.

The relationship between the signs appeared in our second trial. After Zach and I together made a disc the second time on Zaplify, I asked him to draw a disc on the paper.

7 R: How did we do one dot? Can you draw it?

8 Z: … [drawing a circle]

9 F: Draw what you saw on the screen. Where were the yellow lines?

10 Z: Where were the yellow lines? One is here and one is here.

11 R: Why don't you draw it here [*pointing to the paper*]

12 Z: … [drawing one vertical curly line from top to the bottom of the paper, then another one from left to right of the paper crossing over the VL]

13 F: [*pointing to the dot on the paper*] Is this dot on the same spot compared to the screen?

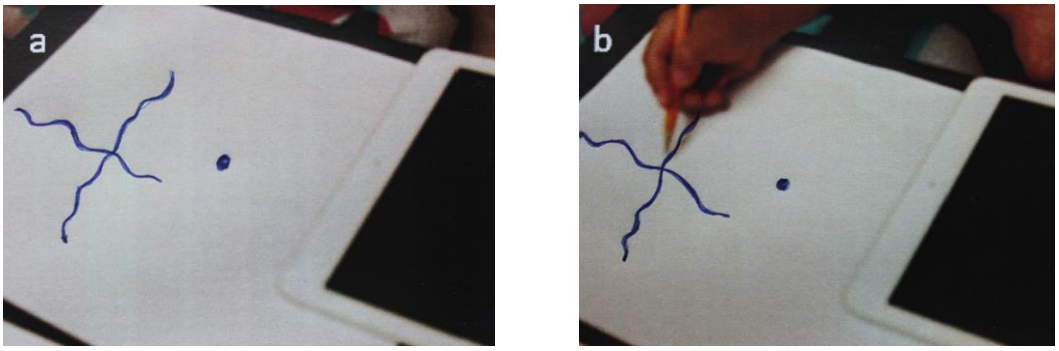
14 Z: No.

15 F: Draw the dot. Where should it be?

16 Z: It should be in the middle of here [*pointing the intersection of the lines*]

Figure 5

(a) Dots and the intersecting lines, (b) pointing to the intersection of the lines



Note. The author retraced the pencil marks in the pictures to improve visibility.

Compared to the first drawing, Zach produced more signs in this episode. First, he drew one disc and then two lines next to the disc, which intersected each other. So this physical separation between the lines and the disc in Zach's drawing indicates partial relationship between the artefact signs in that the lines are related to each other, but they are not necessarily related to the disc.

Zach transferred the orientation of the lines from Zaplify to the paper directly. He drew two perpendicular lines as in Zaplify (see Figure 5a). When we made one disc together, Zach first held his finger and made a VL, and then I put my finger and made a HL. Similarly, first he drew the VL in this episode. While the order of the lines created in Zaplify was mirroredin his drawing, it was not the case for the order of the disc. In Zaplify, the disc appeared following the lines, but on the paper, he first drew the disc and then the lines. Thus, he did not transfer the location of the disc in relation to the lines in his darwing. Zach connected the disc with the lines (see Figure 5b) only after he was asked to compare his drawing of the disc with the diagram in the Zaplify (no. 13-16).

Zach started to create the intersecting lines on the screen after he used his second drawing as a reference to make one disc in Zaplify. However, the relationship between the intersecting points and the discs became solid after we discussed the relationship between the lines at the second interview. Until this episode, Zach answered few "what happens" tasks correctly. After our discussion, he started to demonstrate a consistent strategy to answer these tasks correctly. The following episode presents one such discussion:

After Zach made one disc on the screen, I asked him: "What happens here?" as I pointed to the intersection of the lines.

17 Z: One dot.

18 R: What is happening to the lines here where the dot stays [*pointing to the intersection*]?

19 Z: The dot stays in the middle [*pointing to the dot*] of these [*tracing the VLs and the HLs*] lines

20 R: How did you make this [*pointing to the dot*] in the middle?

21 Z: I put my finger here [*pointing to the bottom of the VL*] and make the line, and then I put my finger here [*pointing the HL*] and make the line, and then I make the dot with this line [*tracing the HL back and forth*]

22 R: You made this line [*pointing the VL*] first, and this one [*pointing the HL*] second, right?

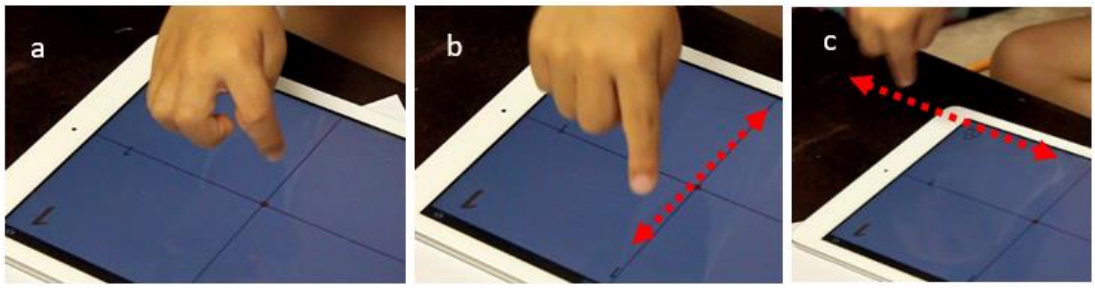
23 Z: Yes.

24 R: What did the second line do to the first line? What happened here [*pointing the intersection*]?

25 Z: Second line crossed [*tracing the HL*] the first line [*tracing the VL*]. The dot is with the second line.

Figure 6

(a) Pointing to the dot, (b) Tracing the VL, (c) Tracing the HL



Zach referred to the intersection point via a sign “the middle”, which he created during a drawing task in the previous interview (line 16). The verbal sign “the middle” and “these lines” are used together with gestures (line 19). They all together suggest that the orientation and the intersection point of the lines are both related to the location of the disc. The pointing gesture (see Figure 6a) and the word “middle” refer to the intersection point, and the tracing of the lines (see Figure 6b & 6c) refers to the perpendicular lines. According to Zach’s verbal accounts, the intersection seems to be necessary for the disc to appear. He stated that he made the disc with the second line, which crossed the first line (line 25). Thus, the sign “cross” points to the relationship between the lines and it is an important sign to create the disc.

Discussion and Conclusion

In this study I examined the evolution of signs during the reciprocal use of a duo of artefact. The digital artefact was Zaplify which was an iPad application designed to develop multiplicative thinking. The non-digital artefact was pen and paper. The tasks were designed for the duo to help a five-year-old child to identify relationships which can be associated with the two unit counts of multiplication (as per Clark & Kamii, 1996, Davydov, 1992, Schwartz, 1988, and Vergnaud, 1988) and the functional relationship between them (as per Davydov, 1992, and Vergnaud, 1988). So rather than to multiply two numbers correctly, the child was prompted to sense multiplicative notions by distinguishing HL's and VL's of Zaplify which represent two factors of multiplication and by making one object (the dot) out of two objects (the lines), which is contradictory to additive thinking.

The findings show that after manipulating the digital artefact, the child first created the signs which were related to the individual characteristics of the objects such as their shape (e.g., curly lines), their size (e.g., small dot), and their colors (e.g., yellow line), instead of the spatial relationship between the objects. Moreover, the former signs illustrated more additive thinking. The child created one line next to the dot when asked to make the numeral 1. This might indicate that for the child the numeral which symbolizes the dot must be created with one object which is the single line. By interacting reciprocally with each element of the duo, the child started to create signs which expressed the spatial relationships among the Zaplify objects and to create quantities in a way which would challenge the additive relationships between the objects.

The result of this study shows that a child as young as five years old can fluently identify the difference between the referents of the quantities and coordinate them to create a multiplicative product after interacting with a duo of artefact which is designed to prompt multiplicative thinking. Thus, it supports Askew's (2018) finding that under the appropriate instruction younger children can also learn multiplicative concepts which are assumed to be difficult for them. Even though the child might have been introduced some notions related to addition in the kindergarden or by his family, he has not been formally trained on addition which happens in the grade 1. Therefore, like Bicknell et al., (2016), this study also challenges the hypothetical learning trajectory which situates learning of multiplication after the formal introduction of addition.

The findings show that creating dots in Zaplify was not enough for the child to right away identify the multiplicative relationships between the objects. At the beginning of the interview, while exploring the app, Zach created a dot right away probably by chance as he could not achieve it when the interviewer asked him to make a dot again. Then he made many dots with the interviewer for a relatively long time (18 minutes). He started to express the relationships between the Zaplify objects after drawing. However, moving from manipulating the digital artefact to drawing the screen configuration in one cycle was not effective to make the relationships between the objects salient, either. Zach created several pivot signs in different modalities via reciprocal use of this duo of artefacts in several cycles before he fluently answered

the "what happens" questions which required identification of the relationships between the lines and the dots.

This study does not propose that the digital artefact must be provided with the non-digital counterpart to develop multiplicative thinking. The child might have identified these multiplicative relationships after interacting only with the digital artefact for a longer time with additional tasks which prompt him to compare various configurations of his fingers with the resulting products. However, I propose that shifting between manipulating the digital artefact and drawing has a potential to speed up the process of identifying the multiplicative relationships.

In addition to accelerating learning process, the reciprocal use of duo helped the child build various meanings for the lines. As soon as a finger is pressed on the screen, a line always appears as a complete discrete object. Whereas the child created a line on paper as the trace of a continuous hand movement. However, these varying meanings attributed to the Zaplify objects were not confined to the specific medium they were created. Zach's verbal accounts that described the relationship between the Zaplify objects were accompanied with dynamic gestures that mirrored his drawings. These dynamic gestures were accompanied some verbal signs (e.g., "the second line crosses the first line") which emphasized the relationship between the lines. Mariotti and Montone (2020) describe this interaction as the synergy between the artefacts of the duo. So, the reciprocal use of the duo enriched the child's experience of multiplicative relationships embedded in the digital artefact through this synergy. In this study pen and paper provided the child with a medium to build and extend meanings in addition to record his interpretation of the digital artefact (de Freitas & Sinclair, 2012; Thouless & Gifford, 2019).

While interacting with the duo of artefacts, Zach was communicating with the adults most of the time. Therefore, discussing with adults (both the researcher and the father) through specific signs seemed to play a role in mediating the relationship between one disc and the intersection point of two lines. While these discussions guided the child to attend to specific relationships, the child's responses did not always indicate an alignment with the intended direction of the adults' questions. For example, the interviewer asked "how" questions to direct the child's attention to the process of making a dot. While the child responded to these questions by creating independent static signs (e.g., drawing of a single dot, saying "a yellow line") at the beginning of the interview, his responses included multiple signs in relation to each other (e.g., tracing gesture on both lines in Zaplify) as his interaction with the duo of artefact progressed.

This study presents the preliminary results of reciprocal use of a duo that is designed to develop multiplicative thinking. These tentative findings show that moving repeatedly back and ford between each element of the duo while communicating with others can accelerate students' meaning making process and expand their meanings by prompting a synergy between the two media. The next step will be to analyse the relationship between the signs created through each element of the duo based on extensive data.

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A CRITICAL POLICY ANALYSIS OF THE IMPLEMENTATION OF THE BI-LITERACY AND TRILINGUALISM LANGUAGE POLICY IN HONG KONG: FROM A POSTCOLONIAL PERSPECTIVE

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Abstract

On 1st of July, 1997, the sovereignty of Hong Kong was transferred to the People's Republic of China and the Bi-literacy (Chinese and English) and Trilingualism (Cantonese, Mandarin, and English) Language Policy was initiated by the Hong Kong Special Administrative Region Government in order to include Mandarin alongside English and Cantonese as the official languages of Hong Kong to be taught in the public school curriculum. However, there was much resistance to this policy and cases of discrimination against Mandarin and its speakers, even in schools, were reported. Using the framework of Contexts of Policy Making, this study examined the implementation of the Bi-literacy and Trilingualism language policy in Hong Kong. The analysis reveals that the resistance to Mandarin on the part of the populace of Hong Kong can be understood from the perspectives of postcolonialism and anti-cultural imperialism. This analysis makes a useful resource for policy makers to refine the Bi-literacy and Trilingualism Language Policy in the future.

Keywords: language policy, postcolonialism, anti- cultural imperialism, language beliefs, Hong Kong

1. Introduction

In 1960, the United Nations issued the Declaration on the Granting of Independence to Colonial Countries and Peoples, declaring its resolution to liberate former colonies for the purpose of safeguarding fundamental human rights and freedoms (The Declaration, 1960). The adoption of a national language subsequently became an important focus for the newly independent nation states to forge a national identity among their people (Wright, 2016). On 1st July, 1997, the sovereignty of Hong Kong was transferred to the People's Republic of China (PRC), and the Bi-literacy (Chinese and English) and Trilingualism (Cantonese, Mandarin, and English) Language Policy (BTLP) was initiated by the Hong Kong Special Administrative Region Government (HKSARG), in order to include Mandarin, alongside English and Cantonese, as the official languages of Hong Kong, to be taught in the public school curriculum (Education Bureau, 1997). However, there was much resistance to this policy (Lai & Byram, 2006), and cases of discrimination against Mandarin and its speakers, even in schools, were reported in Hong Kong (Gu & Tong, 2012; Gu & Qu, 2015). Mandarin has been the national language of China since the late feudalist Qing Dynasty; it continued to be used throughout the Republic of China, and later the PRC (Wang, 2014; Zhang & Jing, 2011). Since the majority of the inhabitants of Hong Kong are immigrants from the Chinese mainland and their descendants, their resistance to such a Chinese language incurred the author's confusion and curiosity. Moreover, in 1960, UNESCO published the Convention against Discrimination in Education, which prohibited language-based discrimination (The Convention, 1960).

This policy analysis assesses the resistance to Mandarin as part of the implementation of the BTLP in Hong Kong. The analysis is conducted from the perspectives of postcolonialism and anti-cultural imperialism and includes suggestions for refinements to the policy which seek to safeguard language diversity and the dignity of Mandarin users in Hong Kong.

2. Policy background

There has been a considerable amount of debate in Hong Kong regarding language planning, the majority of which was concerning three languages: English, Cantonese, and Mandarin (Lai & Byram, 2006). Due to Hong Kong's British colonial history, English has long been regarded as the official language, and it is widely used in the areas of legislation, government administrative policy, international commerce, and as the medium of instruction in pre-tertiary education and higher education (Pierson, 1992). A language hierarchy usually exists in a colonial setting, with a particular language being dominant, and others marginalized (Thompson, 1991). In Hong Kong, English is regarded as the higher language and is a symbol of the elite; while Cantonese, the vernacular of the majority of the inhabitants, is treated as a lower language and is considered unsuitable for intellectual activities (Baker, 1997). Meanwhile, the use of Mandarin Chinese, a sibling of the Cantonese language, was restricted before the handover (Adamson & Lai, 1997).

Mandarin shares the same writing system as Cantonese, but differs in its articulation, intonation, grammar, and vocabulary (Wang & Kirkpatrick, 2018) and speakers of one language

cannot understand the other. Unlike Cantonese, which derives from, and is spoken in, the Pearl River Delta area in the southeast of China, Mandarin is based on the dialects of northeastern China. Mandarin possesses an important status as the national language of China. It was appointed as the national language of the country in the late Qing Dynasty (1616-1912), which was the final reigning dynasty of the feudalist empire of China (Zhang & Jing, 2011). The language was further legitimized by its connection to Chinese nationalism in the May Fourth Movement, an anti-imperialism and anti-feudalism movement led by progressive intellectuals and university students in the Republic of China between 1912 and 1949. Moreover, when the communists came to power in the PRC in 1949, Mandarin was recognized as the national language (Wang, 2014; Zhang & Jing, 2011). Despite the political significance of Mandarin, other than the several waves of Mandarin speaking immigrants from mainland China entering Hong Kong in the twentieth century, and a short-lived fashion in Hong Kong for using Mandarin in films and music (Yu & Kwan, 2017), Mandarin speakers were soon assimilated into speaking Cantonese (Pierson, 1992).

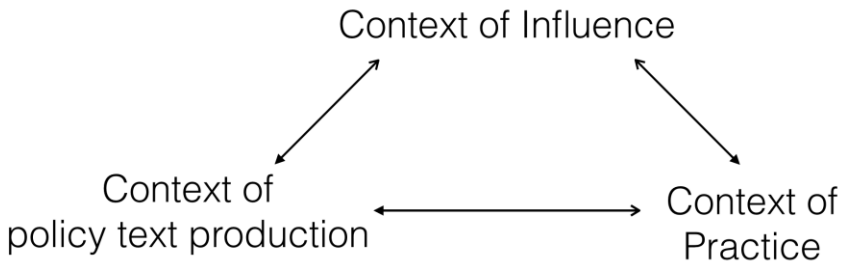
Following the handover of Hong Kong's sovereignty to China in September 1997, the HKSARG enacted the BTLP which sought to change the medium of instruction from English to Chinese in most secondary schools, and included Mandarin as a formal subject in the curriculum (Education Bureau, 1997). The most significant innovation of the policy was to reinforce the use of Mandarin in the local education system, as English and Cantonese were already in use in Hong Kong schools to differing extents. As the short term plan of the BTLP, Mandarin was introduced as a subject to both primary and secondary schools, and then in 2000, Mandarin became an elective subject in Hong Kong Certificate of Education Examination (Wang, 2019). Mandarin gradually evolved as a core subject in the pre-tertiary education curricula (Evans, 2013). As the long term plan of the BTLP, the Hong Kong SAR is determined to transform Mandarin into the medium of instruction (MoI) of Chinese lessons initially at the secondary school (Wang, 2009). Though the policy did not declare its intention to instantly promote Mandarin as MoI in primary schools, through a large scale survey of 474 primary schools, Wang (2019, pp. 322-323) found out that already "65 schools (41.94%) used almost 100% Putonghua in teaching this subject (Chinese language subject)". Though the HKSARG allows schools to make the final decision in choosing the MoI language suitable for them, a six-year sponsoring scheme to support schools in using Mandarin as MoI to teach or to pilot the course of Chinese Language has been released in the 2008/9 academic year (HKSAR Press Release, 2018). To Cantonese native speakers in Hong Kong, learning Mandarin is nothing easier than learning any foreign languages, as Li (2017) emphasized that the two languages, though share many vocabularies, are found to have major differences in their tone systems and have different extent of social acceptance and usability in Hong Kong. However, additional assistance to those who has challenges in using Mandarin as MoI was not included in the BTLP.

3. Policy analytic framework

Policy is commonly understood to be a linear, top-down, unproblematic public document that aims to resolve certain problems, and which is stipulated by the policymakers or experts following a rigorous process of design and evaluation. Policies are expected to be adhered to by the populace. While this view is generally too reductive and static (Trowler, 2003), this static process of policy making is sometimes adopted by a centralized government (e.g., the UK's Thatcher government 1979-1990) (Bowe et al., 1992). Contrary to this static approach to policy making, Hill (2013) argued that the nature of policy is a power relationship while Bourdieu (1984) explained that the hierarchy between the classes, such as those ruling and those being ruled, is produced through the classes' struggle in the field to retain capital, and that those with the advantage will possess greater power to shape the field in a way that is beneficial to them. Public policy is an instrument of this hierarchy for the ruling class, which imposes on and controls the will of those being ruled (Goodin et al., 2006). Moreover, Knoepfel, et al. (2007) argued that a winner group and a loser group are often derived from the policy process. Therefore, the process of public policy making is considerably more complicated than the aforementioned commonly held static process. In response Bowe et al. (1992) developed a triangular model, known as the Contexts of Policy Making, to explain the influence of stakeholders on policymaking and enactment.

Figure 1

Contexts of Policy Making



Note. From *Reforming Education and Changing Schools: Case Studies in Policy Sociology* (p. 20), by R. Bowe, S. J. Ball, and A. Gold, 1992, London: Routledge. Copyright 1992 by R. Bowe, S. J. Ball, and A. Gold.

In this policy cycle, the first stage is defined as the context of influence, which represents the starting point of a policy, in which different interested parties struggle to ascertain the meaning and ideology of the policy. In the second stage, context of policy text production, power relations also prevail, with different parties struggling and compromising, often in an unpublicized manner, to determine the text that should be employed to represent the meaning of the policy which in turn will be used to persuade the public. The third stage, context of practice, delivers the message via the policy enactment, and the actors may mediate the policy's meaning

in line with their own interpretation and particular context (Braun et al., 2011). According to Ball (1994, p. 10) "policy is both text and action, words and deeds, it is what is enacted as well as what is intended." There are also other renown models of language policy study like Spolsky's (2007) framework, in which he suggests that research in language policy could investigate language management (how authorities regulate a language policy), language beliefs (the ideological aspect of a community's attitude towards a language), and language practics (the norm of language use among people). Spolsky's (2007) framework can indeed be transferred to many contexts. However, the reason this analysis follows Bowe and colleagues' version is because their model is addressing the process of policy making, so to discuss the possible factors influencing the context of practice of BTLP is claiming that the policy making process of BTLP should be unfinished, more resilient and more self-reflexive.

This framework helps narrow down the author's analysis of the BLTP to focus on the context of practice among Hong Kong's inhabitants, particularly those who resisted the adoption of Mandarin. Resistance to Mandarin was not directly discussed by the policy makers or HKSARG. Therefore, this analysis employed some third party sources, such as some peer reviewed journal articles concerning the resistance to Mandarin in Hong Kong and some media reports of Mandarin confrontations in Hong Kong. The sociological perspectives of postcolonialism and anti-cultural imperialism is used to analyse the resistance.

4. Postcolonialism

Before discussing postcolonialism, it is first necessary to introduce colonialism, which can be defined as "the conquest and control of other people's land and goods" (Loomba, 2005, p. 8). Colonialism assisted in the development of the capitalism of European countries, via their territorial expansion, and the exploitation of the resources obtained from their colonies (Loomba, 2005). The decolonization activities in the latter half of the twentieth century marked the end of the colonial epoch, and the study of the inhabitants of the ex-colonies located around the world is now termed 'postcolonial'. Beyond the exploitation of the colonies' resources and territory, colonialism altered the inhabitants' identity and knowledge. As Asante (2006, p. ix) observed, "The colonizer did not only seize land, but also minds." As a result of the changes they made to education, language, and culture in their colonies, the colonizers stifled the agency of the inhabitants, forcing them to forego resistance thereby legitimatizing the colonial ruling (Asante, 2006; Dei, 2006). Moreover, the independence of a colony is not necessarily defined by the total liberation of its territory (Dei, 2006), as the colonial legacy, in the form of the ideology of race, ethnicity, and social class, continues to influence the inhabitants' knowledge (Sylvester, 2017). In general, the later the liberation of a colony, the greater the challenge for its inhabitants to dispense the colonial legacy (Sylvester, 2017), as is the case with Hong Kong, whose British colonization ceased in 1997. Postcolonial studies seek to unveil the colonial history and legacy of the former European imperial countries (Loomba, 2005) in order to raise the ex-colony inhabitants' awareness and to truely emancipate them from the colonial chains (Dei, 2006).

5. Anti-cultural imperialism

As previously stated, it is a postcolonial reality that the inhabitants of former colonies may continue to be influenced by the view of their former colonizers. Indeed, the inhabitants of Hong Kong exhibit a preference to British, rather than Chinese governance (Carroll, 2007). The Chinese government's attempts to unite the national identity of the inhabitants of Hong Kong are seen by Hong Kong people as a pan-Chineseness ideology with the intent to "mainlandize" Hong Kong (Lowe & Tsang, 2017). In other words, the people of Hong Kong feel that China's actions constitute a form of cultural imperialism.

Neo-Marxists view cultural imperialism as an arbitrary cultural influence of a dominant nation over a peripheral nation by exerting political and economic measures to force the latter to accept the values, perceptions, beliefs, and even the way of life of the dominant nation (Salwen, 1991). According to Beltran (1978), a precondition of cultural imperialism is that the dominant nation imposes its culture at the expense the local culture of the peripheral nation. However, cultural imperialism may not be successful in assimilating local cultures, as localism often revitalizes as a form of anti- cultural imperialism, a resistance to such homogenization protecting the local cultural integrity and identity (Tomlinson, 1999).

6. Policy analysis: resistance and possible reasons

Many years after the BTLP policy enactment, Cantonese remains the predominant vernacular in the media, the Legislative Council, artistic performances, and local communication, while English retains its status as the language of business and academia, leaving little room for Mandarin usage in the society (Bolton, 2011). In recent years, academic publications and public media have even reported cases of Hong Kong residents' resistance to learning and using Mandarin. For example, Gu and Tong (2012) and Gu and Qu (2015) found that students whose mother tongue was Mandarin were forbidden to speak the language in lessons other than Mandarin, and certain teachers reinforced the opinion that Mandarin is both useless and not respected. Moreover, Gu and Tong (2012) discovered that many Mandarin speaking students in schools were isolated by their Hong Kong peers while Gu and Qu (2015) reported that using Mandarin when shopping can provoke confrontations. In 2018, Hong Kong university students' occupation of the Language Centre of Hong Kong Baptist University to oppose the Mandarin test as a graduation requirement was headline news (BBC, 2018). Furthermore, a local legislator openly prevented a foreign guest from using Mandarin when making a presentation in a Legislative Council meeting stating, "I think the presentation… is quite unnecessarily done in Putonghua (Mandarin). This is Hong Kong. We stick to, we tend to, at least, use English and then Cantonese" (Speakout, 2019, 01:2). These anecdotes represent only a few of many such cases of the resistance to Mandarin. The following sections explore this resistance from the perspective of postcolonialism and anti-cultural imperialism.

6.1. The emergence of the Hong Kong identity as a postcolonial legacy

Hong Kong was under British colonial rule from the mid-19th century until 1997, with the exception of the period of Japanese occupation between 1941 and 1945, which represented a watershed moment for the British colonial government's treatment of the Chinese residents in Hong Kong (Lau Chan, 1994). Before the Japanese occupation, the British rulers had no intention of integrating with the local Hong Kong Chinese, instead they adopted a racial segregation policy by residing on the mountains of Hong Kong island and forbidding the Chinese to reside in the locale, claiming that they introduced an unhygienic and unsafe environment (Wesley-Smith, 1994). From the founding of the colony, conflicts between the Europeans and the Chinese were frequent, some caused by some street vendors and harbour workers' resistance to the unfair treatment of the colonial government (Tsai,1994), while later conflicts, such as the Canton-Hong Kong railway workers' strike and the 1967 strike, were due to rising Chinese nationalism (Tsai, 1994). In some urgent cases, the British rulers even introduced a curfew to limit the activities of the resident Chinese (Wesley-Smith, 1994).

After WWII, waves of anti-colonial movements had challenged the British rulers. In a final attempt to maintain the British Empire's control over Hong Kong, the colonial government introduced a benevolent policy that sought to pacify the population and obtain their support (Lau Chan, 1994). More importantly, Britain's alliance with the US during the Cold War meant that the borderline between Hong Kong and mainland China was a bulwark against the communists in the same way that the Berlin Wall was against communist Eastern Europe (Tang, 1994). Therefore, the Hong Kong colonial government adopted a series of measures including altering its language planning and distancing its inhabitants from China to guard against the interference of communism, and therefore to sustain the legitimacy of the colonial governance.

6.1.1. De-nationalising the Chinese language, and differentiating Cantonese from Mandarin speaking mainland China

The British colonial government of Hong Kong denationalized the Chinese language in education to avoid the ideological interference of Taipei and Beijing through Chinese language since WWII (Wong, 2012). A government committee was formed in 1953 to review the Chinese language courses in schools, and to determine a course of action based on the principle of strengthening "the intimate ties that bind Hong Kong to Great Britain" (Hong Kong Government, 1953, p. 1). The committee criticized the Chinese curriculum adopted by the schools in Hong Kong, claiming that it was strongly influenced by the Republic of China (Taipei) and resulted in a curriculum that produced "arrogant and bigoted Chinese nationalists" (Hong Kong Government, 1953, p. 19). As Wong (2012) explained, it was claimed that the curriculum portrayed Western cultures as invaders of China, who were therefore not suitable for the legal rule of Hong Kong's inhabitants. The colonial government subsequently regulated that the aim of learning Chinese was only to articulate the mother tongue, to appreciate Chinese tradition and literature, and to "make their way in Hong Kong" (Hong Kong Government, 1953, p. 17).

Moreover, under colonial rule, the Hong Kong curriculum presented Chinese history from a white European-centric perspective that stereotyped other races as uncivilized (Yip, 2013). The history textbooks were adapted to a version that disregarded the invasion by European countries, but stressed the invasion of China by Japan and Russia (Wong, 2012). The May Fourth Movement (an anti-imperialism and anti-feudalism patriotic movement led by intellectuals and students in 1919) was depicted as a literary reform (Wong, 2012), and all the content regarding the contemporary China was not covered in the textbooks (Yip, 2013). Rather than viewing westerners as enemies, Hong Kong pupils were required to study western culture, in order to obtain "a liberal, balanced, and international outlook" (Hong Kong Government, 1953, p. 19). These represent only a few of many such examples of a curriculum that detached the learning of China from acquiring Chinese nationalism.

In addition, the colonial government implemented an arbitrary cultural exclusion of Mandarin (Wong, 2017), e.g., intentionally omitting the Mandarin subject from the official school curriculum (Yip, 2013) and eliminating it from public usage (Pierson, 1992). Mandarin therefore became taboo in Hong Kong, despite the presence of a large number of Mandarin speaking immigrants from mainland China (Yu & Kwan, 2017), who were quickly assimilated into speaking Cantonese (Pierson, 1992). As Holmes (2008) observed,

> Where one group arrogates political power and imposes its language along with its institutions - government administration, law courts, education, religion - it is likely that minority groups will find themselves under increasing pressure to adopt the language of the dominant group. (p. 57)

The 1974 confirmation of Cantonese as the co-official language of Hong Kong along with English (Bolton, 2011) strengthened the ties between the Cantonese language and the identity of Hong Kong citizens. Concurrently, the intentional connection between Hong Kong identity and Cantonese language imposed an invisible boundary between the people in Hong Kong and those in mainland China who use Mandarin as national language. This connection ultimately distanced Hong Kong people from recognizing themselves as a part of China. What happened in Hong Kong illustrates Wright's (2016) claim that language differentiation strengthens political borders, and dilutes the national identity of the inhabitants of adjacent regions.

Nevertheless, even now, two decades after the end of the Cold War and the return of Hong Kong to China, Hong Kong inhabitants fear the manipulation of themselves and future generations by the mainland communist Chinese government. As a result, "language has become for them an important front in the struggle for control over the destiny of Hong Kong" (Wong, 2016, p. 200). Subsequently, the cornered opportunity for Mandarin to be used in Hong Kong (Bolton, 2011) reduced it into merely a symbolic language rather than a language of utility. This loss of utility damages the competent use of the language (Wright, 2016) not to mention the language's real status. In consequence, in Hong Kong society Mandarin is more typical of a foreign than a second language (Li, 2017):

> In speech, the Chinese variety that is recognized and used as the co-official language is Cantonese rather than Putonghua, the latter being used mainly for transactional and ceremonial purposes; Putonghua is rarely used by local people for intra-ethnic communication among themselves. (p. 93)

6.1.2. A colonial technology: Cantonese popular culture reinforces a Hong Kong identity

The rise of a Hong Kong identity through the purposeful differentiation between Mandarin and Cantonese was accompanied, in part, by the colonial government's promotion of local popular culture spread via Cantonese. Following the 1967 strike[1], the colonial government feared further communist uprisings by the citizens; therefore, they encouraged the development of the local culture to mollify the populace's relationship with the government, and to create a Hong Kong lifestyle that differed from that of the mainland (Ho, 2009). Previously, cultural activities during the colonial period were for the elite, and the emergence of a local identity was suppressed (Ho, 2009.), but the post-1967 rejuvenation of local culture witnessed the flourishing of the television, film, and music industries, which were instrumental in disseminating a modern Hong Kong lifestyle (Yu & Kwan, 2017) using Cantonese. Concurrently, many of the films and television programs portrayed mainland China as a "chaotic, poor, and backward" place (Ho, 2009, p. 81), despite the fact that mainland China was involved in a class struggle cultural revolution.

While the support of the development of popular culture can be viewed as evidencing the colonial government's increasing concern for the well-being of the citizens of Hong Kong, in reality it functioned as a soft precaution against the inhabitants' participation in anti-colonial social activities, such as the 1967 strike. According to Marcuse (1991), public entertainment can be considered a new technological means of ruling people as it eradicates the sense of class differences by encouraging the audience to use the same products and to enjoy the same shows. Furthermore, the encouragement of a local identity represented another means of preventing the mainland's communist ideology from influencing Hong Kong (Ho, 2009). Most citizens of Hong Kong were unaware of these covert intentions of the colonial government, and at least on the surface they began to regard themselves as Hong Kong people living in a modernized, international city that differed considerably from the chaotic backwater, or 'other', China (Chan, 2014). Since the popular culture concern was generally delivered via Cantonese in films and on the radio, the Hong Kong identity that emerged was one that favoured Cantonese (Yu and Kwan, 2017), in contrast with mainland China, where the national language is Mandarin. However, the creation of the Hong Kong identity, or Hong Kongneseness, (Lowe & Tsang, 2017) was not only an act of justice, as it was also the colonizer's means of oppressing the populace of the colony to maintain their colonial governance (Loomba, 2005).

[1] A large scale violent communist-led workers' demonstration against the British colonial rulers in Hong Kong,

6.1.3. The anti-colonial context of Hong Kong against the backdrop of the UN Declaration of Decolonization

Colonial discourse(s) and influence may linger after the independence of a colony is achieved (Sylvester, 2017), due to the fact that colonizers employed all means of education and consumption practices to reshape the beliefs of the inhabitants of a colonized nation, subjugating them to sponsor their ruler, and belittling their own original culture and language (Dei, 2006). Perhaps these could explain why, two decades after the 1997 return of Hong Kong to China's sovereignty, the citizens still have a preference for the rule of their former British colonizer to that of the Chinese government (Carroll, 2007).

Studying and exposing such a colonial legacy in an ex-colony is the focus of postcolonialism (Loomba, 2005), together with highlighting the excluded past of the peoples of ex-colonies, and their shared history with their mother country, which was of great importance for resisting the colonization, and promoting emancipation (Dei, 2006). Decolonization proved to be an irresistible and irreversible historical process, and the UN's Declaration on the Granting of Independence to Colonial Countries and Peoples states: "the continued existence of colonialism prevents the development of international economic co-operation, impedes the social, cultural and economic development of dependent peoples and militates against the United Nation's ideal of universal peace." (The Declaration, 1960, para.8) The end of colonialism was deemed to be not only a respect of people's human rights, but also of their inalienable right to complete freedom (The Declaration, 1960). A restoration of national language education is a powerful weapon for resisting any lingering remnants of colonialism, and to recollect the agency of the inhabitants of the former colony (Dei, 2006). As language was once the vehicle by which the colonizers warped the inhabitants' perceptions and produced the discourse of oppression in the colonies (Sylvester, 2017), just like how the British colonizers detached Chinese from Chinese nationalism.

However, the text of the BTLP made no mention of postcolonialism nor did it make any justification for why Mandarin, as the national language of China, should be learned in Hong Kong, or the ways in which is it important for Hong Kong citizens. Without such justification, any pragmatic justification or administrative enforcement of Mandarin may look pale. Rather, the BTLP merely expressed the hope that in future, the citizens of Hong Kong would be proficient in English, Cantonese, and Mandarin (Education Bureau, 1997).

6.2. Localism clashes with Chinese nationalism: The Hong Kong people against China's cultural imperialism

6.2.1. Mandarin is 'mainlandizing' Hong Kong

In the wake of decolonization, many new independent nation states were founded, and in order to achieve self-determination, these newly forged states sought to promote a national language to create a national identity and shared culture (Wright, 2016). For example, in Ghana, a former British colony in Africa, English has been the official language since the period of colonization and is used in almost all the public communications (Agykum, 2018). English

formulated an arbitrary discourse in Ghana, and even after the country's independence, few newspapers were printed in local newspaper, which seriously endangered the local language (Agykum, 2018). When some broadcasting media started to use local language like Ga, Agykum (2018, p. 94) believes that it "serves as a mechanism for the storage of expressions, reservoirs and reference points for the circulation of words, phrases and discourse, proverbs and other aspects of Ghanaian language and popular culture", which are the preservation of the shared culture to the Ghanaian people. The mainland China adopted Mandarin as its national language in 1955 and when Hong Kong was restored to China in 1997, the Chinese government encouraged the HKSARG to stipulate the adoption of BTLP to create a Chinese identity for the inhabitants of Hong Kong, with the policy stating: "Our community is essentially Chinese. We speak, read and write Chinese in our daily life. The government has therefore been promoting the use of Chinese over the years" (Education Bureau, 1997, para.2).

However, national cultures, and even nations, are imagined communities forged by the elite (Tomlinson, 1999), and the construction of a common national identity is inevitably pre-conditioned by a people sharing common memories, values, emotions, and destiny. As discussed previously, an identity that differentiated Hong Kong citizens from mainland Chinese was created gradually from the 1960s onward (Ho, 2009), and Hong Kong citizens eventually developed a common life experience and destiny after more than a hundred years of colonial governance (Yu & Kwan, 2017). The recognized Hong Kong identity potentially clashes with the Chinese nationalism that the mainland imposes. Therefore, to the inhabitants of Hong Kong, promoting Mandarin threatens their local identity and culture, and they are inclined to consider it an act of China's cultural imperialism that attempts to 'mainlandize' and culturally homogenize Hong Kong (Chan, 2014; Yu & Kwan, 2017).

6.2.2. Localism as a form of anti-cultural imperialism

Cultural imperialism is viewed as one of the earliest theories of cultural globalization (Tomlinson, 1999). It is considered to be the product of the dystopian imagination fearing a hegemonic culture that threatens cultural diversity due to the increasing interaction of ethnicities, races, and countries (Tomlinson, 1999). Localism emerges in opposition to such homogenization, and it can be defined as a populace's persistent recognition and support for their local culture (Cohen & Kennedy, 2013). Hence, the resistance of the populace of Hong Kong to Mandarin can be argued to be the product of their fear of China's hegemonic culture. Such fears result in the inhabitants of Hong Kong adopting a Hong Kong ethnocentric perspective that specifically positions the Hong Kong identity and culture in opposition to that of mainland China, in order to create a sense of cultural superiority over their mainland counterparts (Tomlinson, 1999). Therefore, the localism of Hong Kong citizens represents a form of resistance to mainland China's cultural homogenization and explains why Mandarin speakers are subject to confrontations and limitations in Hong Kong when speaking Mandarin. As Wright (2016, p. 49) explained, "Nationalist ideology discouraged minority language use with a variety of sanctions from mockery to punishment". While this Hong Kong form of localism does not

constitute a national ideology, the above quote illustrates the role localism had in expulsing the use of Mandarin in Hong Kong.

6.2.3. Beware of locality as destiny

The handover of Hong Kong to China and the subsequent promotion of learning Mandarin gave many Hong Kong citizens, such as those who transferred their industries to the mainland, the opportunity to prosper (Cheng, 2014). However, interactions between Hong Kong and mainland China as part of the process of globalization does not distribute resources equally, and as such can lend priority to some, while marginalizing others (Tomlinson, 1999). Those who retain Hong Kong ethnocentrism as a form of resistance to Mandarin and mainland China culture may have a locality as their destiny "as their life chances are gradually reduced and they are increasingly stuck in the micro-territories in which they were born" (Morley & Robins, 1995, p. 219). However, there is no pure form of localism that can segregate itself from the outside (Morley & Robins, 1995). Therefore, the citizens of Hong Kong may want to reconsider the barrier they have created with mainland China through language differentiation, not only because Hong Kong is now part of China, but more importantly because Mandarin Chinese as a lingua franca is growing (Crystal, 2003).

Mandarin may therefore represent an opportunity for the marginalized and the poor to transform their destinies that are currently embedded in the locality (Tomlinson, 1999). It should be noted that BTLP failed to highlight the value of learning Mandarin in the globalized world. Such an omission may have also inevitably resulted in the emergence of a rift among the Hong Kong people: those who supported Mandarin as the medium of instruction on one side, and those in opposition on the other (Lai & Byram, 2006).

7. Conclusion

The resistance to Mandarin on the part of the populace of Hong Kong can be understood from the perspectives of postcolonialism and anti-cultural imperialism. This policy analysis makes a useful resource for policy makers to refine BTLP in the future. Without the presence of the British colonial legacy and its remaining influence on Hong Kong and without an emphasis on the damage that localism and a resistance to using Mandarin might cause, the people of Hong Kong may not fully comprehend either the decolonization intentions of the country, or the opportunities that mastering Mandarin can bring. Most importantly, as the UNESCO 1960 Convention declared, a world with no language discrimination should be founded, in order to guarantee education for all and to safeguard the true democracy (The Convention, 1960). Furthermore, through the lens of Bowe and colleagues' (1992) policy making model, readers may change from seeing BTLP as a static and completed policy to seeing it as an on-going process remained to be refined. However, this policy analysis model was not specifically designed for language policy research, and from the analysis, ideological issues regarding the three languages in Hong Kong emerge. Therefore, future studies can try to use more language-oriented frameworks like the Spolsky's (2007), particularly the framework's language belief

component, to investigate the language beliefs of Hong Kong people as more concrete feedbacks to the BTLP policymakers. This study is mainly following the postcolonial perspective the author holds, and it means the author has a bias that decolonization should be the mission and destiny of all the people in the colonies or ex-colonies, which may inevitably influence the author to over-generalize a heterogeneous community of people.

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THE IMPLEMENTATION OF PROJECT-BASED LEARNING IN K-12 EDUCATION: TEACHER QUALITIES AND STUDENTS ACHIEVEMENTS

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Abstract

Project-based learning (PBL) is a constructivist teaching strategy that encourages students to explore real problems and acquire knowledge and skills by adhering to teachers' guidelines. This study aims to examine the effects of project-based learning on students, and qualities required of K-12 teachers who engage in PBL. This study will use a narrative literature review to synthesize previous findings on the implementation of PBL in primary and secondary levels, and to interpret teachers' and students' perceptions regarding project-based learning. This review argues that PBL is beneficial for students in terms of attitudes towards learning and academic performance, as well as the development of practical skills. The review also examines the challenges that teachers may face and the features of highly successful PBL teachers. Based on the results, implications and recommendations are presented.

Keywords: project-based learning, student-centered teaching strategies, academic achievement, authentic skills, teaching qualities

The Implementation of Project-Based Learning in K-12 Education: Teacher Qualities and Students Achievements

Project-based learning (PBL) is a constructive instructional strategy that originated in progressive education in the late nineteenth and early twentieth centuries, which called for a student-driven and teacher-facilitated approach to teaching and learning (MacMath et al., 2017). According to Wurdinger et al. (2007), in a PBL classroom, students are guided by teachers through a step-by-step and interdisciplinary learning process: identify a problem; plan; solve the problem; reflect and evaluate the experience (as cited in Mahasneh & Alwan, 2018). Teachers act as the coordinator in classrooms, connecting the subjects taught with the world outside the classroom in PBL curriculum design so that students can learn knowledge and solve authentic challenges. An inspiration for a project can be hearing news or a story, reading an article, or experiencing an event to get students' creative juices flowing (Dayna, 2020). For instance, Ms. McIntyre, a science teacher in a high school, launched a PBL class in the environmental field. She showed a video in class about the closure of a beautiful beach, and let students think about why the beach had been closed and how to solve ocean pollution as a project plan (Larmer, & Mergendoller, 2010).

Many research studies illustrate that PBL is an effective tool for engaging students in the real world of the twenty-first century (see, e.g., Bell, 2010; Doppelt, 2003; Kaldi et al., 2011; Tamim & Grant, 2013). Bell (2010) states that skills such as practical thinking, research, collaboration, and communication, are not measurable through standardized tests. Compared with the teacher-centered instructional approach and traditional assessment, PBL creates flexible learning environments for students to improve their thinking and problem-solving abilities (Doppelt, 2003). For example, Ms. Laur, a social studies teacher, often buys things through Amazon, which led her and a math teacher to discuss whether 'shipping' could be used as an entry point to design for a sixth-grade class. For instance, students could design new systems for courier companies and online stores to ship items so that fewer and smaller boxes are used. The purpose of the class is to teach students mathematics and inspire their awareness of environmental protection (Laur, 2020). However, to achieve maximum benefit from PBL, teachers might face challenges and they need to be motivated to shift their teaching methods and philosophy (Tamim & Grant, 2013). This literature review argues that PBL is beneficial for students' attitudes towards learning, academic performance, as well as practical skills, but there are challenges in the implementation of PBL, which should not be neglected. Hence, the features of highly successful PBL teachers are also examined in this review, including role transition, collaboration, and motivation.

Research Questions

The research questions that guided this literature review are:

1) What are the advantages and disadvantages of PBL for K-12 students' learning?
2) What are the teacher qualities that lead to successful implementation?

Literature Review

Current Trends of PBL

According to Lunenburg (2011), in an inductive curriculum design, teachers first identify the students' circumstances, such as age, grade, and cultural background. After that, "content vehicles" (Weinstein and Fantini describe content vehicles as "life experiences of the learner, attitudes and feelings of the leaners, and the social context in which they live" (as cited in Lunenburg, 2011, p.5)) and learning skills can be explored by teachers to design curriculums, meeting students' learning concerns and interests. The last step is outcome evaluation, according to learners' performance (Lunenburg, 2011). PBL is one type of inductive instructional strategy as compared to the traditional paradigm of teaching, and the ethos of PBL is to facilitate students' self-motivation, logical criticism, and responsibility for learning (Mahasneh & Alwan, 2018). PBL is not a new educational theory. It originated in the constructivist approach by John Dewey. PBL strategy promotes autonomy in learning to cultivate independent and critical thinking in learners (Speckels, 2011), and requires students to find problems, develop solutions, and integrate life experiences and cognition to create a project (Thomas, 2000; Webb, 2003); at the same time, the teachers act as facilitators to provide resources and guidance (Thomas, 2000).

Some scholars and researchers have analyzed the principles of PBL and investigated the effectiveness of PBL. According to Doppelt (2003), PBL integrates knowledge of different disciplines and explores new areas and scientific issues. Scarbrough et al. (2004) agree that PBL can overcome knowledge boundaries to generate a high level of learning. It is worth mentioning that most features of PBL conform to problem-based learning (Grant, 2011; Kokotsaki et al., 2016). However, PBL focuses on results. Learners in PBL classes need to select problems and develop solutions, and create a project in the end, such as a report, model, or presentation, while the strategy of problem-based learning emphasizes the new knowledge that students can acquire in problem-solving (Blumenfeld et al., 1991). Kaldi et al. (2011) believe that PBL is an inclusive teaching-learning method that supports all learners to develop their abilities and put them into practice, but it is not "a panacea for ills" (p. 37) in education. Since PBL requires active engagement of students for an extended time, it cannot be widely adopted without adequate attention for supporting students in the classroom (Blumenfeld et al., 1991; Prince & Felder, 2006).

Research Methodology

This study aims to examine the effects of the PBL approach on students and the qualities required for teachers of PBL in K-12 education. Consequently, the method used in this study is a narrative overview that is a useful type of educational literature review (Green, Johnson, Adams, 2001). It summarizes the author's findings and information into a readable format, which helps present broad perspectives and describe the development in a topic area (Green et al., 2001). The method chosen is one of the most feasible ways to acquire a variety of standpoints of students and teachers for the PBL approach in varying grades and subjects. The author used electronic search engines to find educational-related publications, peer-reviewed journal articles, and social

media posts, objectively evaluating PBL by combining different contents. Key word phrases were used, including 'the definition of project-based learning,' 'the effect of project-based learning for students,' 'the implementation of project-based learning in K-12education,' 'cases of project-based learning,' and 'teachers' perception and motivation of project-based learning' to narrow down the search results. Most of the data and journal articles used in this study are from within the last 15 years.

Table 1

The Studies on the Effect of PBL on K-12 Students

Study Reference	Study Design	Population Studied (n)	Outcome Positive (Yes/No)	Findings
Kizkapan, O., & Bektas, O. (2017)	Quantitative, Quasi-experimental design	Seventh-grade students (n=38)	No	There is no significant difference between PBL and traditional teaching groups' scores. The authors suggest that pre-activities should be performed for the adaption of teachers and students before PBL units.
Kaldi, S., Filippatou, D., & Govaris, C. (2011)	Qualitative Quasi-experimental design	Primary school students (n=94)	Yes	PBL is beneficial for students to gain content knowledge and group skills and develop a positive attitude toward peers from different backgrounds.
Hernández-Ramos, P., & De La Paz, S. (2009)	Qualitative Quasi-experimental design	Eighth-grade students	Yes	Students improved their historical thinking skills and many students grasp a fundamental understanding of history knowledge in PBL groups.
Doppelt, Y. (2003)	Qualitative Quasi-experimental design	Tenth to twelfth- grade students	Yes	Scientific-technological PBL boosted students' motivation and achieved effective learning. Most of the low-achieving students succeeded with high scores in the matriculation exams.
Bell, S. (2010)	Qualitative method Literature Review	Literature	Yes	Students can enhance viable technology, communication, collaboration, problem-solving skills, and creativity from the PBL approach.
Study Reference	Study Design	Population Studied (n)	Outcome Positive (Yes/No)	Findings
Ergül, N. R., & Kargın, E. K. (2014)	Qualitative Experimental design	Elementary school students (n=92)	Yes	Teaching with the PBL method contributed to students' science success more compared to teaching according to the current program.

Based on the analysis of previous research on the exploration of PBL in K-12 education, this paper used a narrative literature overview method to collect data, including interpretation of students' and teachers' attitudes and perceptions towards PBL (shown in Table 1 and Table 2). A total of twelve journal articles were included. This review uses previous research findings and several PBL program cases to explore the effects of and requirements for PBL in K-12 education.

Table 2

The Perception of Teachers for PBL

Study Reference	Study Design	Population Studied (n)	Outcome Positive (Yes/No)	Findings
MacMath, S., Sivia, A., & Britton, V. (2017).	Qualitative procedure, Interview	Secondary school teachers	Yes	Investigation results provide the requirements for successful implementation of PBL, benefits and challenges of PBL for both teachers and students.
Lam, S. F., Cheng, R. W. Y., & Choy, H. C. (2010)	Qualitative procedure, Questionnaire	Hong Kong secondary school teachers (n=182)	Yes	Results indicated that teachers received stronger school supports for teacher competence and autonomy; they could have higher motivation in PBL and stronger willingness to persist in educational innovation.
Mahasneh, A. M., & Alwan, A. F. (2018)	Qualitative Quasi-experimental design	Student teachers (n=79)	Yes	Results showed differences between PBL and the control group in student teachers' self-efficacy and achievement scores. Researchers recommended applying PBL in teaching-learning situations.
Study Reference	Study Design	Population Studied (n)	Outcome Positive (Yes/No)	Findings
Tamim, S. R., & Grant, M. M. (2013)	Qualitative, Interview and document collection	Teachers from grade four through twelve	Yes	Teachers in the PBL approach "emphasized scaffolding, through clarification, facilitation, and guidance" (p. 93). Collaboration with other teachers is an essential aspect for teachers in the PBL approach.
Baysura, O. D., Altun, S., & Yucel-Toy, B. (2016)	Qualitative phenomenological study, interview	Teacher candidates (n=58)	No	Results show that teacher candidates are familiar with the PBL method, but they lack professional skills and knowledge, which could cause difficulties in practice.
(Chang & Lee, 2010)	Qualitative Quasi-experimental design	Computer teachers and subject teachers	Yes	Team-teaching approach is a win-win situation for all teachers and students in PBL classroom.

This study also reviewed social media articles to retrieve real PBL classroom cases in K-12 schools, and to access voices from schools and social media for PBL strategies. Altogether, there are five representative articles identified from senior education consultants, pedagogy bloggers, webinars, and public schools websites within the last 5 years (shown in Table 3).

Table 3

The Perspectives of Social Media Posts for PBL

Title	Author	Education Level	Opinions
9 Reasons to Use the Project Approach in Your Inclusive Early Childhood Classroom (2018)	Brookes Publishing Webinar Focusing on Inclusive Education	Early Childhood Classroom	PBL strategy satisfies the curiosity of young children by allowing them to delve into interesting topics in-depth. Project methods can provide opportunities for children to research and investigate, acquiring firsthand experiences.
Title	Author	Education Level	Opinions
Project-Based Learning in the Early Years (2018)	Diana Wehrell-Grabowski, Ph.D. Science and STEM education consultant	Early Childhood Classroom	PBL approach encourages students to actively seek knowledge and interact with the community and environment. It also is beneficial for teachers to explore the right direction for different children and freeing teachers to provide diversified instruction. However, students' different projects and opinions are challenging for teacher workloads.
Project-Based Learning in the K12 Classroom (2018)	Lacey Lyons Freelance writer and editor	K-12 Classroom	PBL promotes student engagement. It can help to narrow down the achievement gap among students in different social-economic backgrounds or with different learning abilities.
Power of One Change Makers Project (2016)	Melissa Cochran On a public charter school website	Eleventh Grade	The author provides a case of eleventh graders working with nonprofit organizations. This project encourages students to care about the local community and develop students' authentic skills.
Project-Bases Learning and Problems Analysis (2018)	Penny (screen name) Blogger	K-12 Classroom	The author provides some PBL class cases in USA and China to demonstrate that PBL curriculum design includes selecting problems, project planning, solving problems, and evaluation.

Table 1 and Table 2 reviewed pieces of research in qualitative design, which used experiments and data to prove arguments, while social media posts in Table 3 allows readers to view and experience PBL from the perspective of working on the front line of K-12 education. Moreover, the relevant content of the social media posts mentioned in this review merely served as the reference, and more importantly, it provided real and effective PBL cases in recent schools and communities. Therefore, social media posts would not affect the authority of the research findings.

Results

Advantages of PBL for Students

Academic achievement. Project-based learning is effective in advancing students' academic achievement. Many students believe schoolwork is meaningless because they do not perceive a need for what they are learning and why they would need it (Larmer & Mergendoller, 2010). In education sectors where large-scale standardized testing is the norm, the shortcoming of traditional teaching and learning approaches is the decontextualized nature of learning.

Students passively receive the knowledge by traditional and didactic approaches (Bell, 2010). Indeed, students' academic performance can be improved by attending lectures, but it fails to recognize the constraints of traditional teaching and learning, which make it difficult for students to practice the knowledge and skills they learn to solve authentic problems. However, in PBL classes, students engage in projects meticulously designed by teachers to explore problems, hypothesize, generalize knowledge, solve problems, and experience success.

Some studies compare students' learning outcomes in the conventional education approach and PBL, confirming that PBL plays a positive role in improving students' learning achievements. Ergül and Kargın (2014) investigated the effect of PBL on sixth-grade students' learning in science subjects. They found teaching with the PBL method contributed to students' success more than teaching with a teacher-centered method. Moreover, Hernández-Ramos and De La Paz (2009) state that eighth-grade students' work in the PBL class revealed greater growth in history study than students in the more conventional instruction setting. Doppelt's (2013) research results over three years show that most of the low-achieving students across tenth to twelfth grades "succeed with distinction in the same matriculation exams" (p. 255) by participating in PBL activities.

Students participate in learning activities in real scenarios through teamwork and coordination to achieve precise goals. For example, in a mathematics class in Beijing Shun Yi International School for 12 to 13-year-old students, teachers supported students in learning the function y=kx+b through a project of designing barrier-free access for students with physical disabilities on campus, instead of drawing on the axes with a ruler in the formal classes (Jenny, 2017). In this project, some students chose to build models for experiments, and others used Ping-Pong balls to calculate the speed. They collected data for analysis and completed reports. Finally, students presented to introduce their projects to teachers and staff and received feedback (Jenny, 2017). Students learn in classes with greater passion and interest, which is an active and effective learning process.

Thirty years ago, few students acquired post-secondary credentials in China, yet they can expertly apply scientific principles to deal with life's problems. Today, almost all young people receive higher education, but they generally have a poorer ability to live independently and often lack compassion and social responsibility (Yang, 2007). Fewer people can use knowledge for practical purposes like household maintenance, such as maintaining water pipes and electric circuits in the home. One of the reasons is that the teacher-centered and student-followed methods do not provide opportunities for students to know why they need knowledge and how to apply knowledge (Xuan, 2006). Hence, today many children believe that doing schoolwork is to prepare them for their next courses or test-taking, rather than something they will use later in their life (Larmer, & Mergendoller, 2010). The advantage of PBL is that students can grasp the depth and intent of learning, choose the learning style, and initiate application by themselves. In PBL programs, students can immerse themselves in their learning projects and are willing to spend extra time gathering information and thinking (Doppelt, 2013). When working on the same theme, PBL allows different groups to present different projects according to discussion

and cooperation between team members. According to Doppelt (2003), students enjoy learning autonomously in the PBL class so that they have higher engagement and learning motivation. Hence, the flexible learning environment is beneficial for elevating students' learning capacity, motivation, and authentic skills.

21-century skills. Students can cultivate practical skills in project-based learning processes. Today, the internet provides people with massive amounts of information, so the traditional teaching-learning method that aims at mastering knowledge cannot fulfill the developing needs of current students. They need to grasp basic skills, such as literacy, language, research, science, and authentic skills, including collaboration, communication, thinking, solving-problem skills, and technology use. Researchers support PBL as a useful tool to engage students in real life. Kibett and Kathuri (2005) examined the effect of PBL on secondary students' cognitive skills. Results demonstrate that students in PBL classrooms gain high cognitive skills that outperform students in regular classes. Bell (2010) states that students benefit from the PBL approach by practicing technical skills, and become proficient communicators and advanced problem solvers. The practical ability and soft skills of individuals are valued by the labor market and employers. Lyons (2018) states that the PBL strategy helps to close the achievement gap between students from different socio-economic backgrounds or with different learning abilities, in terms of the transition from K-12 education to higher education and eventual employment. Some government offices have encouraged the implementation of PBL into schools and have organized projects with schools to provide opportunities for students to understand their future workplace environment and business world. For instance, the American Government Office of Disability Employment Policy has suggested teachers of special education should encourage students' soft skills for future employment, and NASA has co-operated with high schools and middle schools to create engineering projects and select students for engagement every year (Lyons, 2018).

An old saying in China describes the contemporary learning condition in schools is: "*liang er bu wen chuang wai shi, yi xin zhi du sheng xian shu."* It means that students pay no attention to what is going on beyond one's studies and buries oneself in textbook knowledge. A lot of parents and teachers encourage children to focus on their studies through textbook learning. However, when students finish school and engage in society, many are unable to accept and fulfill the social roles and responsibilities expected of them. It can be difficult for them to deal with complicated interpersonal relationships (Xuan, 2006). The Chinese Ministry of Education is aware of this problem and encourages schools to implement the PBL approach in the *Chinese STEAM Education White Paper* (Ministry of Education of the People's Republic of China, 2017). Some schools in Jiang Su, Shen Zhen, and Cheng Du have established pilot PBL programs and provided professional training for teachers (Ministry of Education of the People's Republic of China, 2017).

An example in an American school exhibits how PBL develops students' 21-century skills (Cochran, 2016). In the humanities class for eleventh grade, students partnered with nonprofit organizations to make a positive impact on the development of the local community.

Students researched and explored issues in the community and provided projects for the needs of partner organizations to deal with community issues. In this PBL case, eleventh-grade students investigated local community issues that they cared about, gathering and negotiating opinions and ideas with other classmates and organization staff to solve problems. They took action to make a positive impact in their local community while improving their research, communication, collaboration skills, and creativity in teamwork. Bell (2010) states that "PBL promotes social learning as children practice and become proficient with the 21st -century skills of communication, negotiation, and collaboration" (p. 40). During the project, students could assess their achievement and performance in the project. They considered whether the information they searched for was relevant, whether the allocation of work was reasonable, and if they expressed their opinions clearly. 21st -century skills are important to future success for the global economy (Bell, 2010). Consistent self-evaluation and employment of these skills can enhance students' abilities to become proficient. Although the research suggests PBL is a beneficial and valuable learning approach for students, there still are disadvantages that cannot be ignored.

Disadvantages of PBL for Students

Classroom management issues. It is difficult to supervise the engagement of all students in classes and activities. All the teacher candidates in the interviews conducted by Baysura et al. (2016) believed classroom management to be one of the most outstanding difficulties in implementing PBL. Students work collaboratively to discuss and use technology to explore knowledge in projects. Nevertheless, teachers have limited time and energy to monitor each student's behavior in activities. Students cooperatively work and discuss in groups, which does not guarantee that every student can participate in classes actively. Certain students might chat with others or search for information that is irrelevant to projects, disrupting the classroom. MacMath et al. (2017) argue that students' misbehavior and/or disengagement could be an issue in collaborative work. Although students have larger spaces to manage their learning style and to express their opinions and creativity in PBL programs, it is difficult for teachers to supervise student engagement and control classrooms, especially for those with large class sizes. Therefore, the PBL approach might reduce student learning efficiency to some extent, if there is no reasonable distribution and monitoring among team members.

Project-based learning is time-consuming. Many of the advantages and disadvantages of PBL are intertwined. Teachers require time to transition from a teacher-centered to a student-centered approach. Likewise, children, especially those newly introduced to the PBL classroom, need to spend significant time adapting to a new role that requires working collaboratively, cultivating skills, and being self-efficient. On the one hand, according to Mihardi et al. (2013), PBL "takes a very long time and teacher professionalism as a facilitator" (p. 102). For example, some students are unable to properly consider and arrange their workload and time in each stage, and they fail to develop clear learning objectives. As a result, they might spend too much time brainstorming and organizing their projects. Thus, teachers, as the facilitators of learning, have to work hard to track different learning processes of students and provide counselling and guidance

constantly. Other students who have lower comprehensive capacity might be slower than students with a strong comprehensive capacity to collect resources, solve problems, use technology, and understand others and/or express their opinions accurately. Therefore, some teachers reflected that teaching students skills before embarking on the project is necessary (Tamim & Grant, 2013).

Additionally, PBL is costly because students might think off-topic when the project boundary is not clear (Baysura et al., 2016). There are diverse and open-ended project topics for students to choose independently, so PBL classrooms need more students' time than the teacher-centered approach. As usual, students need to make several attempts to determine their projects and amend the solution before reaching a satisfactory result (Mahasneh & Alwan, 2018).

Project-based learning does not fit every student. Although PBL is beneficial for the learner to integrate better into education and modern society, it leads to frustration and anxiety for some students. Teachers participating in the MacMath et al. (2017) study stated that some higher-achieving students appreciated and preferred structured learning environments. The efficiency of PBL instruction for students depends on multiple factors. Low achievement groups of students showed outstanding growth rates in the PBL approach and displayed their strength in terms of creativity, cognitive strategy, and self-adjusting (Doppelt, 2003; Han et al., 2015). By contrast, the study results of Han et al. (2015) show that students with high-level academic performances demonstrated only slight differences in terms of the growth rate of mathematics grades over 3 years. Students with high achievement may have disappointing performance using projects. They may be reluctant to cooperate with others to learn, and while they may be good at structured learning environments, they may have difficulty coping with open-ended and complex situations. For instance, when dealing with math problems, some high achievers might not be able to present their thoughts clearly through simple language or other forms for an audience to understand, which could impact the evaluation of their learning projects and causing a sense of frustration (Han et al., 2015). Therefore, the successful PBL program cannot be implemented successfully without teacher quality and school support.

The Requirements for Implementation of PBL

Teachers' role transition. Teachers need to change roles from a controller in the class and build skills that will help them be successful in PBL implementation. Students search for knowledge and actively explore solutions, which are the main feature of PBL. Doppelt (2003) states that teachers change their role to mentors who boost students' capacity, rather than guarding pupils' growth. Brookes Publishing Webinar (2018) describes a bakery project in the early childhood education classroom. The bakery project aimed to provide students an understanding of the operations side of the business. Teachers first considered what children might be interested in, such as the process of making bread, the uniforms and work of bakers, and how bread is transported to grocery stores. In this case, students had to share what they learned with other children after visiting a bakery. Subsequently, children needed to construct their bakery with various resources and materials independently with the teachers' supports in

the classroom. At the end of the project, students presented their bakery. This example illustrates the importance of preparing prior to starting a PBL unit; the teacher must design the project processes and develop questions to meet fitting the course requirements and students' learning capacity (Kizkapan & Bektas, 2017; MacMath et al., 2017). Instructors need to consider the learning goals and what knowledge and 21st -century skills they expect students to acquire in completing the project. Teachers are to present the topic, objectives, and process clearly to students and guide them to work through PBL (Tamim, & Grant, 2013). Teachers also function as facilitators and guides during a project to provide learning resources and suggestions for students' exploration and reflection. In PBL classes, the role of the teacher is to facilitate learning and guide children to ask questions and explore solutions, instead of answering questions.

Furthermore, teachers are recorders who need to observe students' engagement and performance, and patiently support students to solve problems. Teachers should notice and record students' ideas. When students make mistakes, teachers should restrain from correcting them directly and guide students to find their problems and solutions by themselves. Teachers could record the changes and progress of students' thinking and capacity, which helps teachers to create or adjust learning spaces, promoting children's growth and development. It is worth mentioning that teachers need to help pupils demonstrate their learning outcomes publicly and provide opportunities for them to practice their communication and presentation skills. For example, Ms. McIntyre invited parents, peers, community, government organizations, and businesses as audiences to view the 'Beach Closed: Contaminated Water' project (Larmer & Mergendoller, 2010). After the project, teachers should evaluate whether students have mastered the knowledge and improved their abilities. At the same time, teachers are expected to consider shortcomings and highlight what can be improved or valued in future PBL programs (Tamim & Grant, 2013).

Teaching collaboration. PBL is an interdisciplinary learning approach, which requires the cooperation of other teachers. Teachers work closely with teaching partners to discuss student learning needs, which is a significant element in the implementation of PBL (MacMath et al., 2017). In the preparation and design stage of a PBL unit, the cooperation of teachers from different subjects could put forward the idea of open-ended courses and give play to the characteristics of an interdisciplinary approach. Tamim and Grant (2013) agree that collaboration with other teachers could facilitate the planning of the PBL program and the integration of different subjects.

In Taiwan, teachers for the National Subject-Competency Test (NSCT) must teach content following rigid rules and plans, but computer teachers can freely introduce concepts and practical software tools (Chang & Lee, 2010). Therefore, Chang and Lee (2010) formed a novel team-teaching model where the subject teachers and computer teachers worked collaboratively to facilitate the PBL classroom to examine the availability of teacher collaboration in the PBL approach. In their study, the computer teachers conducted computer-related PBL activities to prepare students for the necessary internet skills, such as facts finding, data analysis, and the use

of software. In the next stage, subject teachers conducted subject-specific project work, focusing on specific learning goals. The results show that the teacher-collaboration model improves the efficiency of both teachers and students and minimizes wasted class time in the PBL program (Chang & Lee, 2010). Therefore, a teacher-collaboration model in a PBL classroom could positively impact students' readiness for working and their learning outcomes in projects, and can help teachers and students make the transition to the PBL. Some teachers can achieve high teaching efficacy in the PBL approach, but school support is an important motivator where teachers are hesitant to transition.

Teacher motivation and school support. The motivation of teachers in PBL implementation comes from personal factors, such as the congruence between the innovation and personal teaching philosophy and teachers' perceived efficiency of PBL, and school factors, including principals' management styles and school culture (Lam et al., 2010). According to Jesus and Lens (2005), if teachers have a higher expectancy of efficacy, they have more motivation in teaching and engagement. For the implementation of a new teaching strategy, most teachers need to spend time realizing its function and learn professional skills. PBL is an educational innovation that is different from traditional teaching and learning. Encountering problems during the implementation of PBL is a risk, which may put pressure on teachers and negatively impact their motivation to apply PBL instruction. Thus, in-service professional training and resources for PBL should be provided to teachers. Wehrell-Grabowski (2018), who is a science and STEM education consultant, shares a case of training units for kindergarten teachers to practice project methods. She chose a theme of studying the human skeleton to introduce the PBL approach, and trained teachers to create a connection between different subjects in teaching and learning. After the training, schools required those teachers to reflect on and apply for this training course. Trained teachers successfully integrated the project method into their classrooms and tended to redesign their existing educational structure (Wehrell-Grabowski, 2018). Therefore, the format of the in-service training used PBL is necessary to teach teachers the fundamentals of PBL.

Furthermore, in Baysura's et al. research (2016), some teacher candidates stated they typically learn PBL in theory and do not have a chance to practice it. One of the reasons is that project-based learning has not been a mainstream instructional approach in many regions and schools. Therefore, available PBL classrooms are not only reliant upon the effort of teachers and students, but also the schools where teacher candidates practice teaching. Lam et al. (2010) found that information about how schools support PBL could be instrumental for teachers who advocate instructional innovation but are concerned about being rejected or marginalized. If the school encourages teachers to use the PBL method, the school and administration must provide teachers the support they require. For instance, schools must provide financial and resource supports, allow teaching autonomy, and involve teachers in decision-making.

Conclusion

The purpose of this narrative literature review was to examine the benefits and shortcomings of project-based learning on students and the qualities required for teachers to implement PBL in K-12 education successfully. Based on interpreting previous research experiments and different PBL classroom cases in different countries, this study shows that PBL is effective in advancing students' academic performance and practical skills. However, owing to the shortcoming of PBL, including classroom management issues, time-consuming processes, and the need for flexibility, some teachers and students are frustrated in PBL programs. It is worth acknowledging that the benefits of PBL far outweigh its disadvantages. In order to improve the positive impact of PBL instruction, in addition to the effort of students, an achievable PBL class is also reliant upon more supports in many aspects. Teachers should receive professional training to be proficient in PBL teaching skills to deal with any problems that may occur in classrooms. Meanwhile, they need to adjust teaching routines and work collaboratively with other teachers from different subjects to design PBL curriculums and facilitate students learning independently. Schools should provide professional training and allow teaching autonomy, which can motivate teachers to practice PBL instruction effectively.

The strengths of this study exist in synthesizing research findings and social media posts about non-scientific PBL examples on the implementation of PBL in K-12 school levels. The results reported here are valuable for institutions and teachers that are considering practicing PBL in classes. However, this study analyzed the research results and cases in different countries. When discussing the effect of PBL on students and the qualities required of teachers, the author recognized not all issues are universal. Therefore, future research is recommended to discuss the implementation of PBL, macro educational reform policy, national education resources, and professional teaching development, in a particular country.

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WORKS OF ART AND OTHER ACADEMIC PIECES

TEACHER AND RESEARCHER IN ENTANGLED RELATIONS

POH TAN

Simon Fraser University

JADE LEONG

Simon Fraser University Childcare Society

Description

This collaborative visual comic between an early childhood teacher (Jade) and a researcher (Poh[i]) describes a process of relationality to disrupt perceived levels of power and authority between researcher and teacher. The researcher and teacher began a research journey to understand the development of scientific literacy through science workshops and lessons with young children between 4-5 years of age. Although the researcher and teacher were working in the same classroom and with the same children, the working relationship between them did not go beyond research objectives. The level of strict "keeping to the task" practice led to assumptions about each other's level of authority and perceived tensions about expectations between researcher and teacher. These *assumptions* and perceived *tensions* often impeded deeper connections, conversations and more importantly, relations between researcher and teacher. This prevented a deeper connection and relational experience to fully realize the entirety of connections to each other and other, including the more-than-human (e.g., classroom resources, sounds and movement from the children, dialogue, etc.). For example, the teacher's assumptions of the researcher's authority prevented her from fully contributing to the project. The teacher assumed, "The researcher has so much more knowledge than I and she is trying to finish her research, I hope I gave her all she needed. I won't say anything to disrupt her project". On the other hand, the researcher's assumption of the teacher's authority of the classroom prevented the researcher from fully engaging with the teacher. For example, the researcher assumed, "I am intruding on the teacher's space and interrupting her class. I'll keep my presence in the classroom to a minimal and won't ask for too much".

Researcher and teacher began questioning the relationship when subtle reactions during the workshops were *questioned*. When the researcher reflected on a moment of engagement from the teacher, when she apologized for an incomplete workshop. In addition, the teacher reflected on her role during the sessions and how her reactions with the teacher influenced the researcher's work brought her to moments of questioning. Curiosity, distilled from moments of assumptions, tensions, and questioning (Driussi, 2019), led to both, teacher and researcher wanting to connect with each other. A *reconnection* between researcher and teacher began to form through open conversations about authoritative expectations from each other's assumptions. These conversations confirmed that teacher and researcher's assumptions self-conflated with perceived notions of each other's authority over the other.

A *reconnection* through meetings and through this 9-month, collaborative visual comic *shifted and transformed* the teacher-researcher relationship to become entangled where their assumptions, tensions, and questions created a comfortable space for in-depth conversation about their practice in education and research. The visual scholarship captures these critical moments of a collaborative journey between teacher and researcher, and concludes with a depicted movement from assumptions, tensions, through questioning, and finally shifting to a transformative place between a ruler (representing the teacher, Jade) and laboratory flask (representing the researcher, Poh) to form a heart. Assumptions, tensions perceived levels of power and authority dissolved through conversations, shared emotions, and common interests for

the children. The abstractness of the heart is intentional and illustrates a be-coming together between researcherteacher. It is an unpredicted emergence of another way to become teacherresearcher where "it becomes impossible to differentiate between creation and renewal, beginning and returning, continuity and discontinuity, and here and there" (Barad, 2007, p. ix). Through this visual scholarship, a relation of material, ideas, movements, actions, and dialogue is the becoming of teacherresearcher and researcherteacher.

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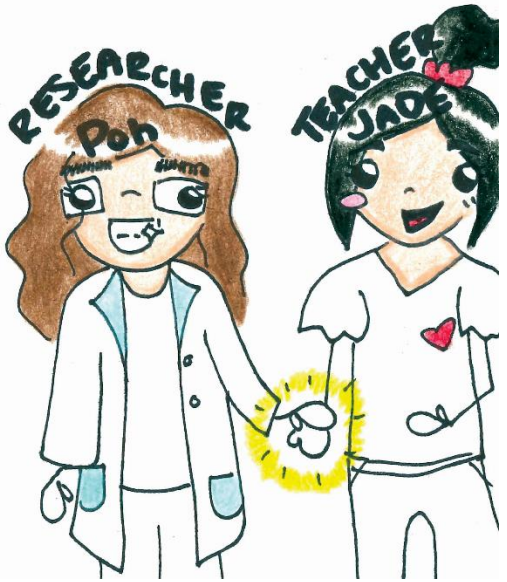
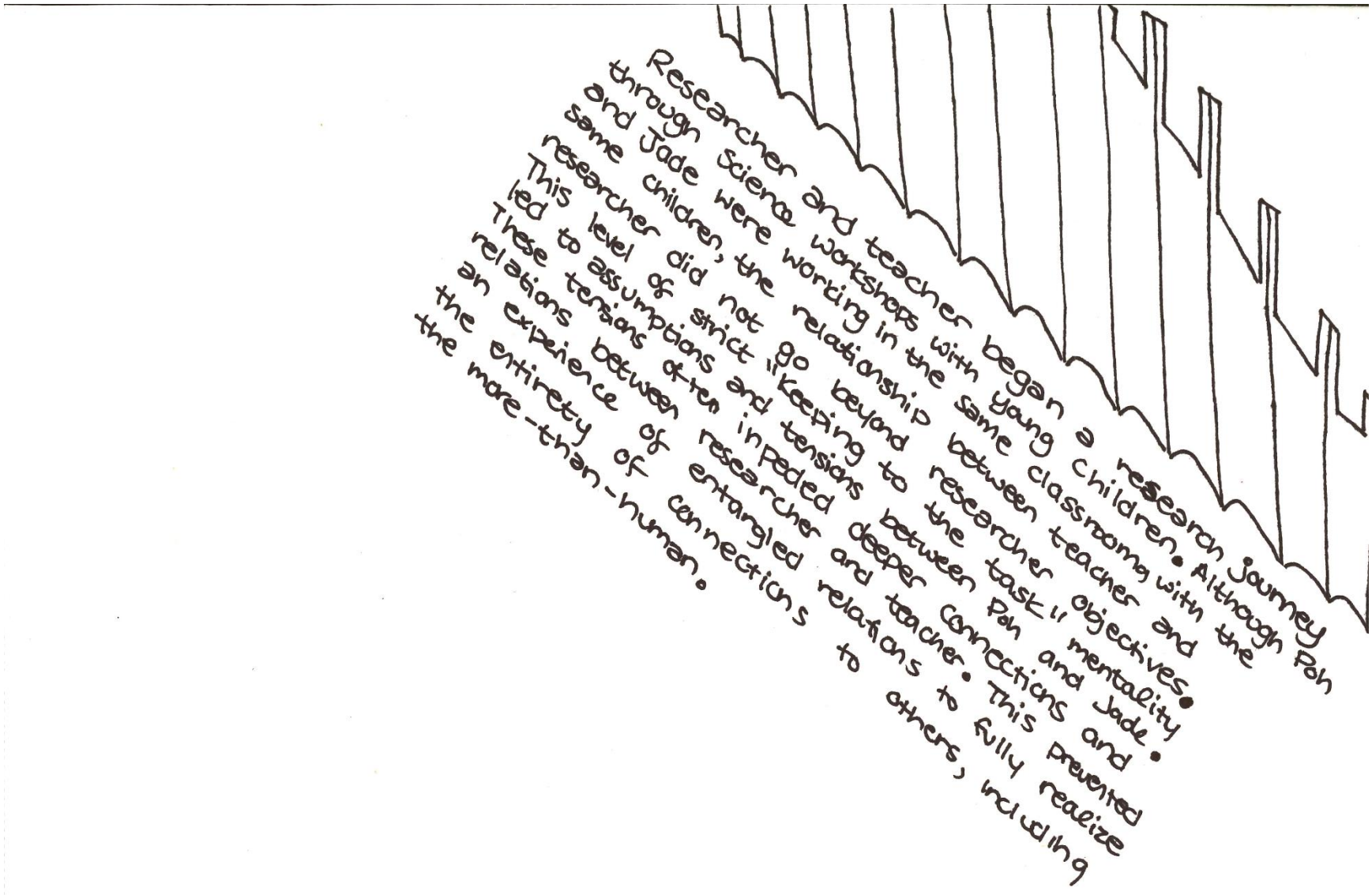
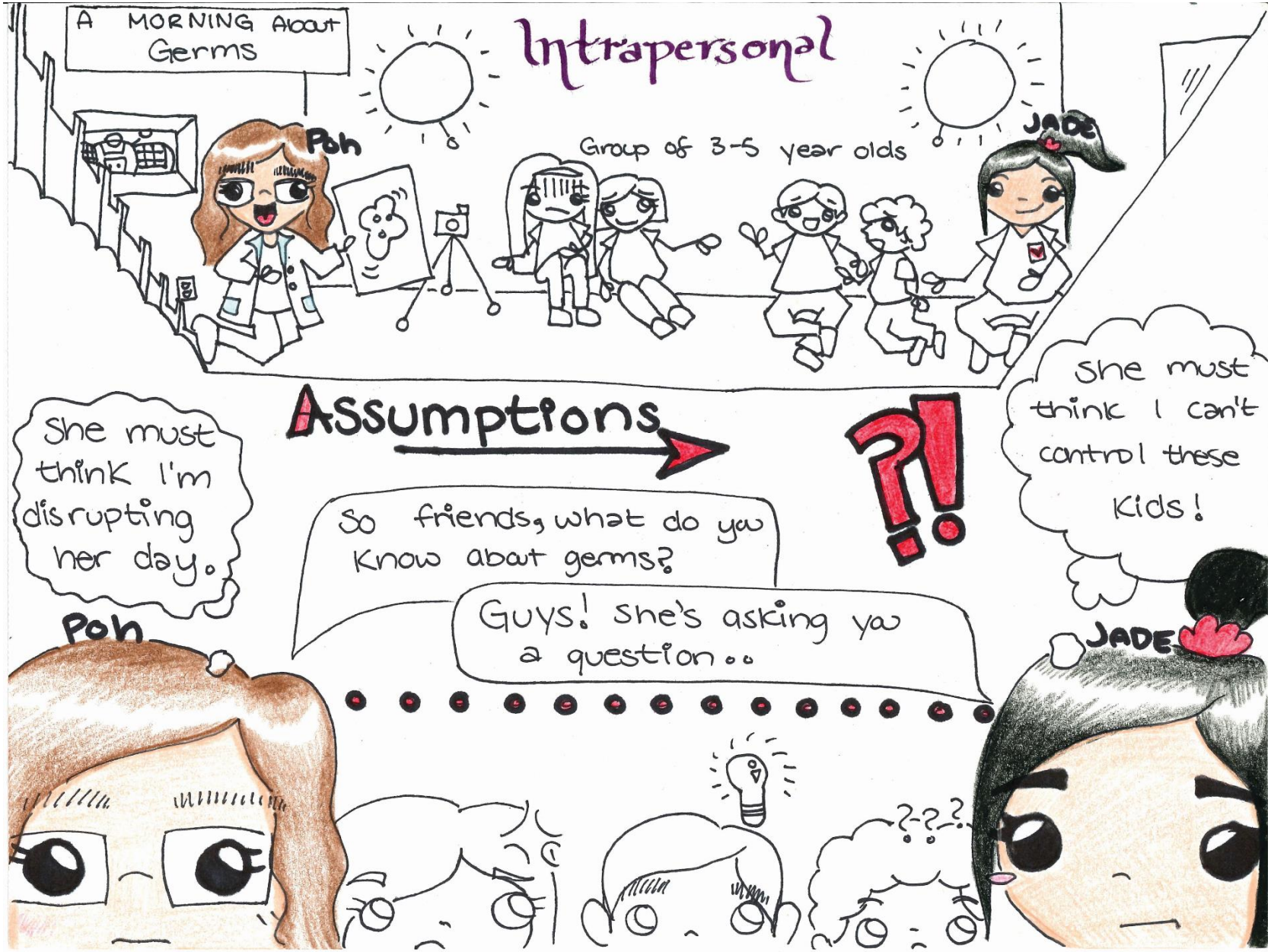
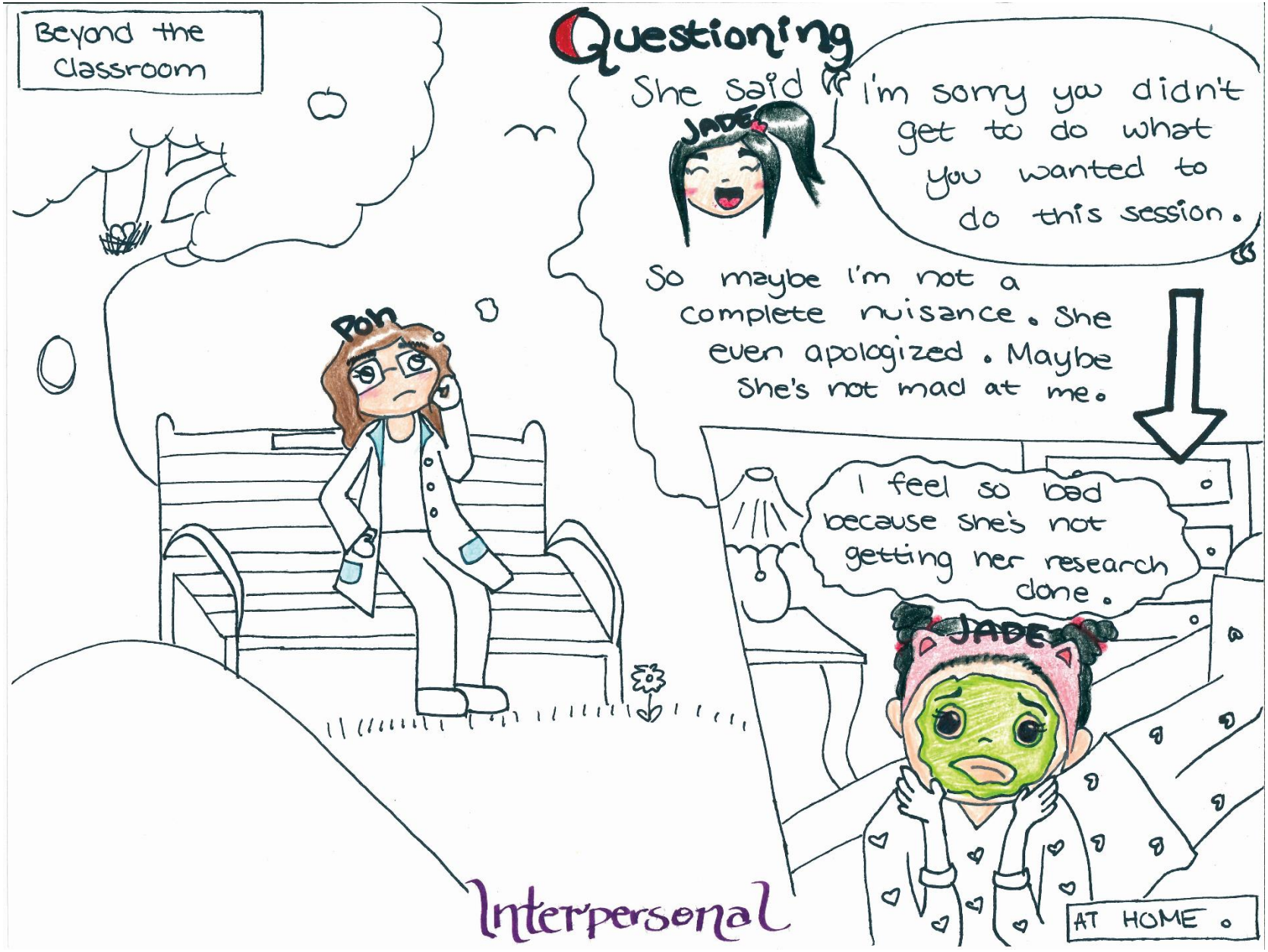
Teacher And Researcher In Entangled Relations

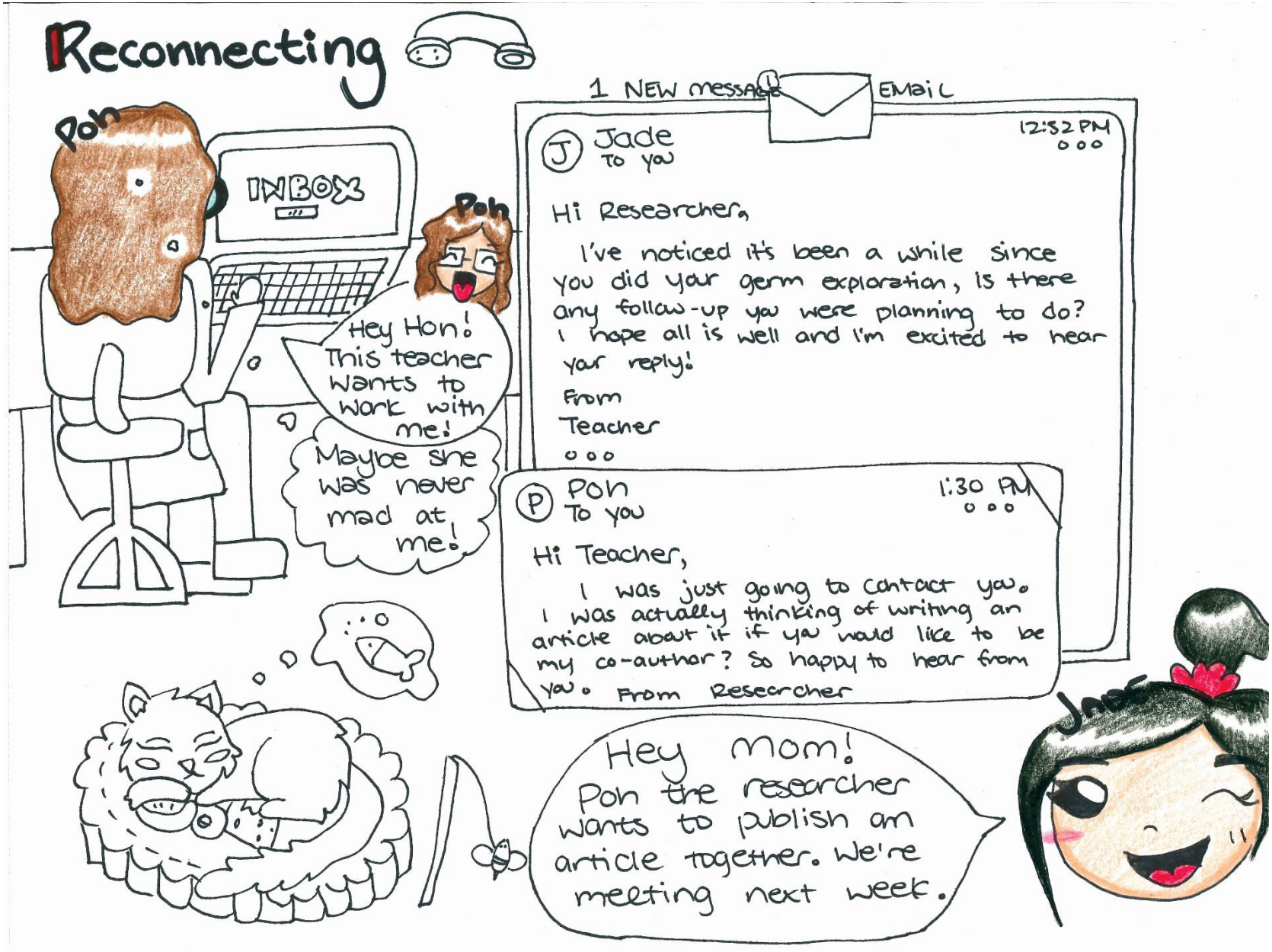


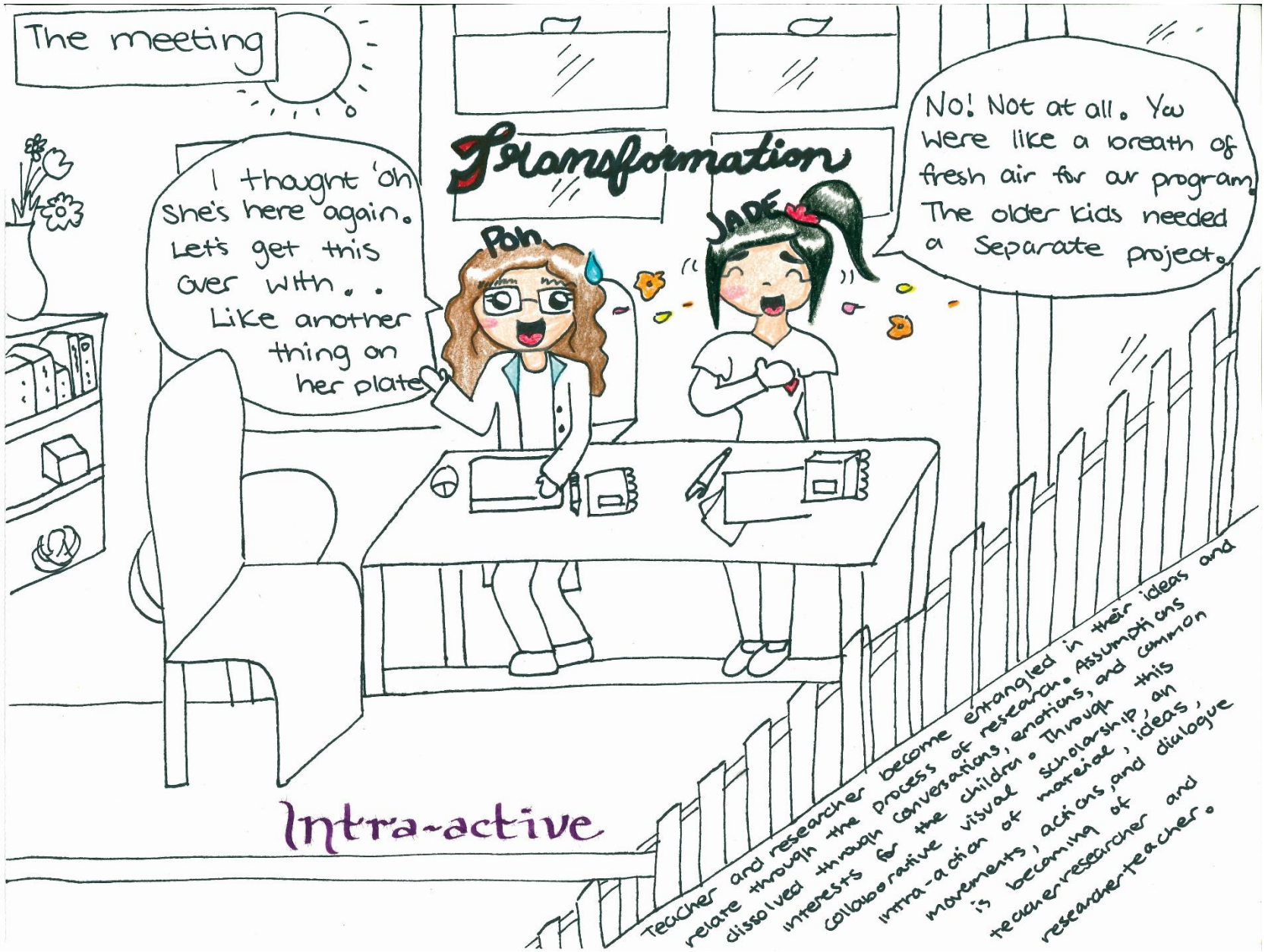

Researcher and teacher began a research journey
through science workshops with young children. Although Pan
and Jade were working in the same classroom with the
same children, the relationship between teacher and
researcher did not go beyond researcher objectives.
This level of strict keeping to the task-if mentality
led to assumptions and tensions between Pan and Jade.
These tensions often impeded deeper connections and
relations between researcher and teacher. This prevented
an experience of entangled relations to fully realize
the entirety of connections to others, including
the more-than-human.

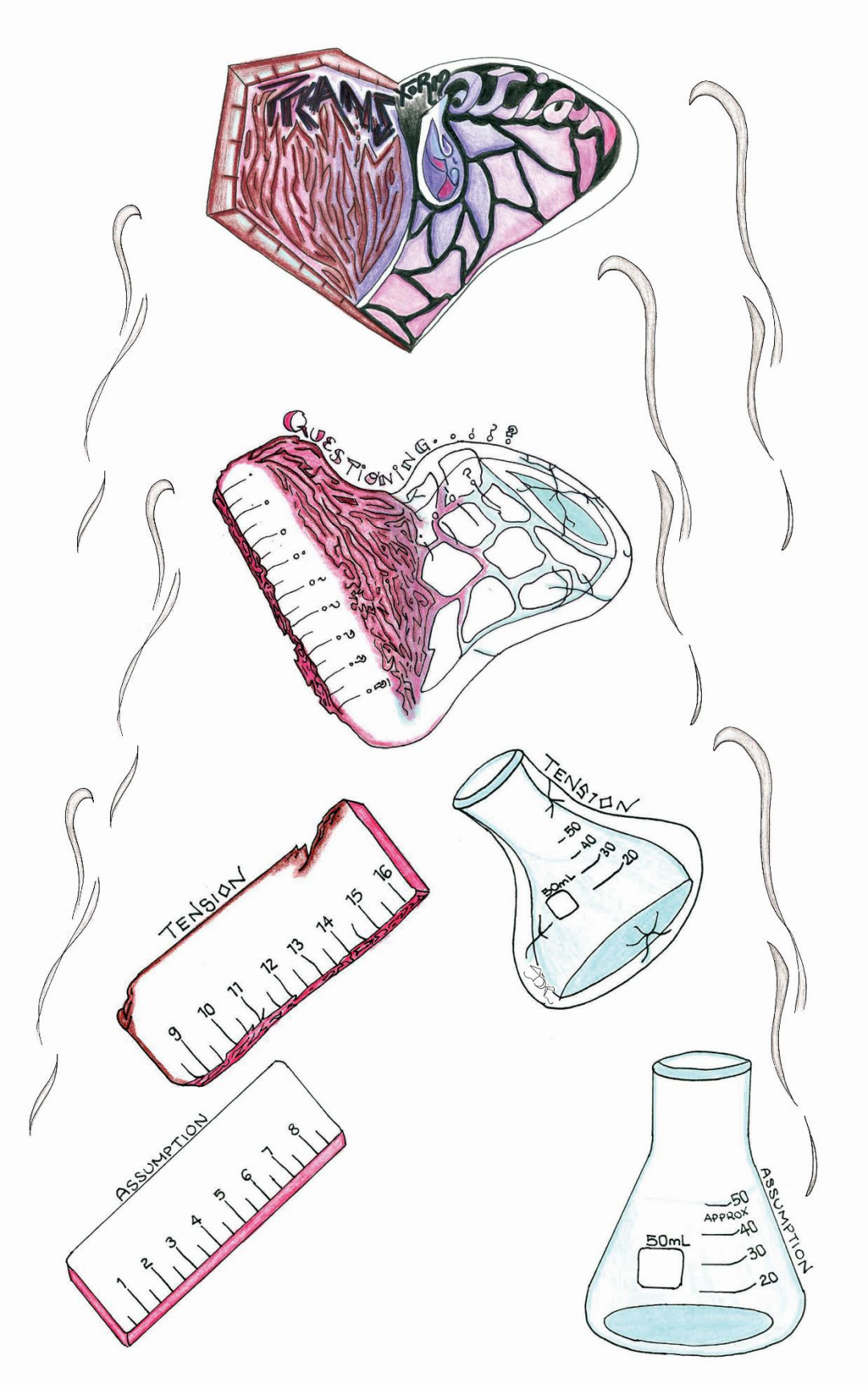

A MORNING About Germs
Intrapersonal
Poh
Group of 3-5 year olds
JADE
Assumptions
She must think I'm disrupting her day.
So friends, what do you know about germs?
Guys! she's asking you a question..
She must think I can't control these kids!
Poh
JADE


She must think I'm
Wasting her time!
Poh
JADE
TENSION
She must think
I don't Know Anything!


Beyond the classroom
Questioning
She said
JADE
I'm sorry you didn't get to do what you wanted to do this session.
So maybe I'm not a complete nuisance. She even apologized. Maybe She's not mad at me.
Pon
I feel so bad because she's not getting her research done.
JADE
Interpersonal
AT HOME.


Reconnecting
Poh
INBOX
Poh
Hey Hon! This teacher wants to work with me!
Maybe she was never mad at me!
1 NEW MESSAGE
EMAIL
Jade
To you
12:52 PM
Hi Researcher,
I've noticed it's been a while since you did your germ exploration, is there any follow-up you were planning to do? I hope all is well and I'm excited to hear your reply!
From
Teacher
Poh
To you
1:30 PM
Hi Teacher,
I was just going to contact you. I was actually thinking of writing an article about it if you would like to be my co-author? So happy to hear from you. From Researcher
Hey mom! Poh the researcher wants to publish an article together. We're meeting next week.


The meeting
I thought 'oh She's here again. Let's get this over with... Like another thing on her plate
Transformation
POH
JADE
No! Not at all. You were like a breath of fresh air for our program. The older kids needed a separate project.
Intra-active
Teacher and researcher become entangled in their ideas and relate through the process of research. Assumptions dissolved through conversations, emotions, and common interests for the children. Through this collaborative visual scholarship, an intra-action of material, ideas, movements, actions, and dialogue is becoming of teacher/researcher and researcher/teacher.


FRAME
QUESTIONING
TENSION
50
40
30
20
50mL
TENSION
9
10
11
12
13
14
15
16
ASSUMPTION
1
2
3
4
5
6
7
8
50
APPROX
40
50mL
30
20
ASSUMPTION

References

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Driussi, L. (2019, 05 03). *Wayfaring: A phenomenology of international teacher education* [Doctoral dissertation, Simon Fraser University]. http://summit.sfu.ca/item/19322

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