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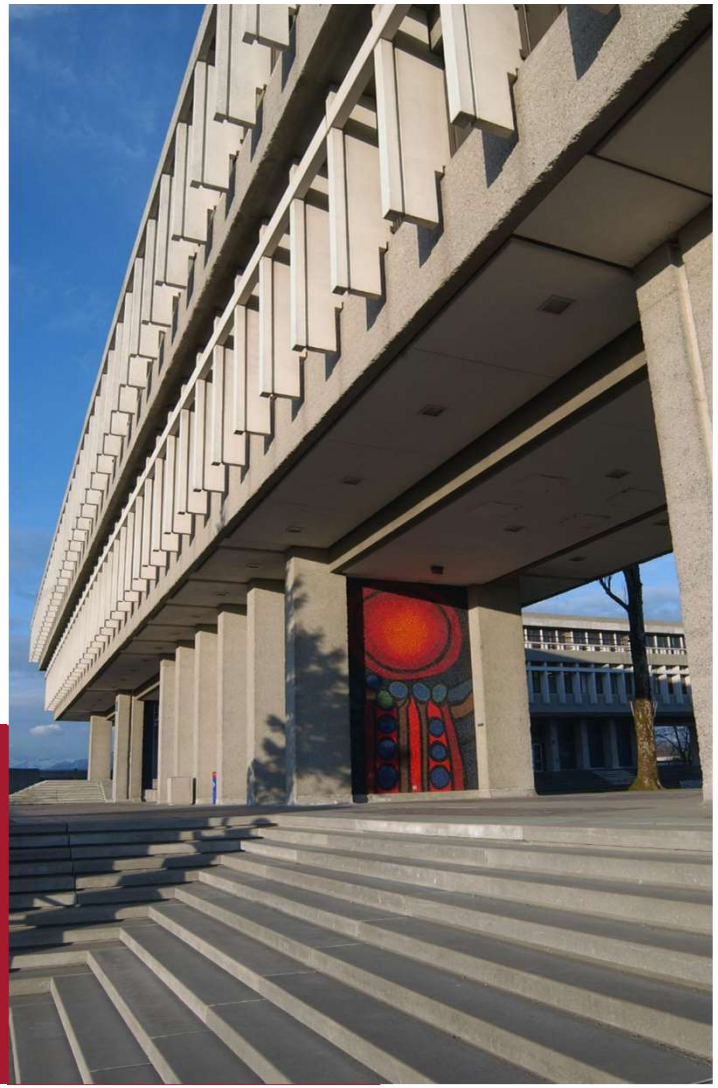

Examining Sources of Self-Efficacy in Whole Class Problem Solving

Annette Rouleau – Santiago 2018 Research Seminar

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aRPa
Activando la Resolución de Problemas en las Aulas

UNIVERSIDAD DE CHILE

Opportunity knocks

- International collaboration
- ARPA
- Cristina in the public lesson

Cristina

- 11-year-old, fifth-grade student in the Chilean public school system.
- Diagnosed with mild intellectual difficulties and a neurological speech disorder which affects expressive speech.
- Described by teachers as shy, insecure and dependent. Usually silent in class and unlikely to communicate with peers or teachers. Weak in problem solving, with a limited, procedural understanding of mathematics.
- Self-describes as very shy. Mentioned disliking math and feeling weak in the subject.
- Strong parental support. Views daughter as a dependent learner.

Cristina's disability had not changed, but nonetheless, her performance had.

Many special education learners resist academics, "thinking that they lack the ability to succeed, even if they expend great effort" (Margolis & McCabe, 2004, p. 241).

In other words, these students have low self-efficacy and are unlikely to experience academic success.

It appears that, for Cristina, something had happened to reverse that trend.

A desire to better understand the process of that change led us to use a lens of self-efficacy.

Self-efficacy

> “People’s beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives” (Bandura, 1994, p. 2).

These beliefs affect the choices they make, the effort they put forth, the perseverance they display in challenges, and the degree of anxiety or confidence they bring to the task at hand.

Self-efficacy beliefs “can powerfully influence the level of accomplishment that people ultimately realize” (Pajares, 2006, p. 340).

High self-efficacy

1. Approach difficult tasks as challenges to be mastered rather than as threats to be avoided.

2. Set challenging goals to which they are strongly committed.

3. Persevere in the face of failure.

4. Attribute failure to insufficient effort or deficient knowledge and skills which are acquirable.

(Bandura, 1994)

Low self-efficacy

1. Shy away from difficult tasks.
2. Low aspirations and weak commitment to the goals they choose to pursue.
3. When faced with difficult tasks, they dwell on their personal deficiencies and on the obstacles they will encounter.
4. Give up quickly in the face of difficulties.
5. Slow to recover following failure or setbacks.
6. View insufficient performance as deficient aptitude.
7. Fall easy victim to stress and depression.

(Bandura, 1994)

Effect of self-efficacy on performance in mathematics

Strong predictor of:

1. Task achievement (Pajares & Schunk, 2001)
2. Problem-solving capability (Pajares & Miller, 1997; Pajares & Kranzler, 1995)
3. Computational accuracy (Thien & Ong, 2015)
4. Student motivation and academic choices (Hackett & Betz, 1989)
5. Math anxiety (Pajares & Kranzler, 1995)
6. Academic achievement (Pajares & Schunk, 2001; Thien & Ong, 2015)

Stronger predictor of mathematics achievement than general mental ability

(Stevens, Olivárez & Hamman, 2006)

Self-efficacy

Developed as students interpret four sources of influence:

1. Mastery experiences
2. Vicarious experiences
3. Social persuasion
4. Emotional/physiological states

Sources of self-efficacy: **Mastery experiences**

- The most powerful of the four sources.

- The result of the students' own interpretation of previous experiences.
  - self-efficacy is strengthened through past successful experiences

- Requires experience in overcoming obstacles through sustained effort. If students experience only easy successes they come to expect quick results and are easily discouraged by failure.

- Mastery experiences are particularly powerful when individuals succeed on tasks that others find especially challenging.

Sources of self-efficacy: **Vicarious experiences**

- Result from the vicarious experience of students observing other students, whom they perceive as similar, succeed at a task.

- By observing others like themselves perform tasks, students make judgments about their own capabilities.

- Less stable than self-efficacy beliefs derived from mastery, self-efficacy gained through observation will diminish rapidly if the students subsequently have unsuccessful experiences of their own.

Sources of self-efficacy: **Social persuasion**

- Students' self-efficacy is affected by persuasive communication and evaluative feedback from others within their social context.

- Has less impact on self-efficacy than either mastery or vicarious experiences and also has the potential to undermine it.

- Requires two elements to be effective:
  - Must be paired with actual successful experiences
  - Must come from a source deemed credible or trustworthy

Sources of self-efficacy: **Emotional/physiological states**

- Students also rely partly on their emotional/physiological states in judging their capabilities.
  - Their self-efficacy is affected by their response to stress, their mood, and their emotional proclivities.

- However, it is not the sheer intensity of the emotional and physical reactions that is important, but rather how the students perceive and interpret those reactions.
  - Those with high self-efficacy are more likely to view their reactions as energizing, while those with low self-efficacy are debilitated by their affective state.

Research Question

How do we explain Cristina's experience through the lens of Bandura's four sources of self-efficacy?

Classroom

Class of 26 female students, classroom teacher, special education teacher

“This group has a high level. So when I taught them they go like “Ah, this, yeah, yeah”, they know it instantly.” (CT)

“A very problematic class in terms of social relations between classmates.” (CT)

“When they didn’t want Cristina in their group I was angry. I mean, you have to conceal it, but it bothers me, when that happens to anyone.” (ST)

“But what I used to do was to bring the PIE girls [with special needs] *to the Resources classroom, I’d take them out of the classroom and give them their individual material, that I created and used.” (ST)*

ARPA Project

Activando la Resolución de Problemas en las Aulas
(Activating Problem Solving in Classrooms)

- A research and development initiative developed at the University of Chile's Center for Advanced Research in Education (CIAE) and Center for Mathematical Modeling (CMM).

- Developed to address ongoing Chilean educational reforms in mathematics.

- Seeks to implement professional teacher development strategies that promote problem solving in the classroom.

ARPA Project

- program comprises many components and is based on principles of teachers *doing* and *reflecting*.

- The PSClassroom is the key workshop, with teachers meeting for nine monthly sessions.

- Its beginning focus is offering collaborative problem-solving experiences for the teachers and gradually moves to their preparing and implementing collaborative problem-solving activities in the classroom (PSAC) with their students.

ARPA Project

- Between sessions, all the teachers implement the same problem in their classrooms.

- A key aspect is these are non-routine problems that the students work on collaboratively in visibly random groups.

- Three of the lessons are videotaped and collectively form the basis for analysis and discussion in the next workshop.

- Both of Cristina's teachers participated in the workshop and implemented six PSACs, of which Cristina participated fully in two and partially in a third.

ARPA Project

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Methodology

- Semi-structured interviews with student, classroom teacher (CT), special education teacher (ST), and the student's mother.
- Interviews transcribed by two ARPA team members and translated into English by two bilingual University of Chile affiliates.
- Data first analyzed and classified as indicative of a change in self-efficacy (Bandura,1986) by each researcher independently.
- Then the classifications were discussed (vigorously!) whole group, further populating and refining the categories.

Results – Mastery experiences

Interviewer: Do you remember a moment this year when you had done well in math?

Cristina: The test. I did well, because I always study.

~

This has significance not only as a mastery experience resulting from success, but also because it is a positive memory that she attributes to her own effort rather than to luck or chance.

Attributing success to factors within their own control is an important characteristic of students with high self-efficacy (Bandura, 1997).

Results – Mastery experiences

Interviewer: Do you remember the things you did that day with the group? What were your contributions?

Cristina: I explained that there were different ice creams, 2 and 1. And I picked orange with banana, orange with orange, orange with grape.

~

This is notable for two reasons:

1. The ease which Cristina recalled the problem and her contribution to its solution, months after its implementation.

2. Her success in problem solving.

Her teachers had expressed initial doubts that she would be successful solving ARPA's non-routine problems.

Reassured by the ARPA monitors, they included Cristina in the visibly random groupings and were pleased with the results with the classroom teacher noting:

CT: This year she has improved a lot. She can solve a problematic situation and face it, read it and look for solutions. She doesn't sit still, she tries to solve it.

Results – Mastery experiences

ST: We always, always, had many materials to lower the level of difficulty, at the beginning- but later we realized it wasn't that necessary anymore. It happened that many girls – including Cristina - since they were very close to us, they were confident in that we would gave them material to simplify, but they told us themselves "No, I don't need it anymore", that they could be autonomous.

~

ST: She is confident and doesn't care if she is wrong. She used to get very frustrated before.

Results – Mastery experiences

Interviewer: And, do you remember a specific episode in which she was successful?

ST: For example, we were solving a multiplication problem and nobody knew the answer, and she raised her hand, and gave the answer. And seeing her expression of satisfaction was priceless, I mean, she was the only one who knew the answer. Imagine, of the whole class, she was the only one that knew the answer. I mean, an answer that she thought of and that she said, and that was correct.

~

Interviewer: Things have changed in comparison to how she used to be?

ST: She can say now: "No, let's do it this way" things like that.

Results - Vicarious experience

Vicarious experiences can affect self-efficacy when observing someone else succeed at a task — especially someone perceived as similar.

For Cristina, her diagnosis meant she may feel a vicarious connection to students who struggle with mathematics and/or expressive language.

However, we were unable to find any clear examples where Cristina underwent a vicarious experience. Two possible reasons for this:

1. No opportunities to see other child succeed.

2. May not have perceived any similarities between herself and the other child.

Results - Social persuasion

Prior to ARPA, much of the feedback Cristina received directly from her peers and indirectly from her teachers would have served to undermine her self-efficacy.

Describing the class as ***"very problematic class in terms of social relations between classmates"***, the classroom teacher recounted that the students were quite vocal in their insistence that Cristina's participation delayed the whole group:

ST: Of course, she noticed it. Because they **[the girls]** ***expressed it; they said, "Ah, we don't want to work with her."***

Results - Social persuasion

Her teachers well-intentioned practice of removing Cristina from the classroom to work on an individualized program, would have reinforced for her that she was incapable of doing the work of her peers.

Additionally, it would have reinforced her peers' notion that she was incapable, creating a loop wherein Cristina lived up to the low expectations of those around her.

Results - Social persuasion

This changed with the introduction of ARPA.

All the students, including Cristina, were now expected to work collaboratively on non-routine problems.

Visibly random grouping eased the transition as the students were excited to be in groups that changed regularly.

Results - Social persuasion

Although her teachers were initially skeptical that Cristina would be able to participate and be accepted by her peers, they persevered.

They set high expectations for social behaviour and encouraged positive peer support.

This was effective, with the special education teacher noting:

ST: Working in groups is like a second-nature to her now and she can work in any group. She participates, she gives her opinion, and she can even be bossy… a little bit.

~

Interviewer: And what was the group's opinion on working with Cristina?

CT: It was good, they'd say, "Well done, Cristina, continue". They see her as one of them.

Results - Social persuasion

CT: **[When working one-on-one]** ***I'd try to ask her: Why did you do that? So she would explain it to me and then I would encourage her: Very good! Amazing! You're the best! and she would look at me and laugh nervously.***

~

CT: When talking to her I say, "You know that I am deaf" […]. Then she speaks to me in a choppy way, but I understand it. For example, she says to me, "Add …. number …. result". Then I say to the classmates that Cristina said, "Oh Miss, what happens is that...". I create a whole story, then she feels good because the others look at her saying, "Wow, Cristina, that's good".

Results - Social persuasion

This kind of verbal support would impact Cristina's self-efficacy in two ways.

1. The classroom teacher is positioning Cristina as someone who has a mathematical contribution that is worth sharing; the reinforcement that Cristina receives is that she is mathematically capable.
2. The positioning also evokes a positive response from Cristina's peers, which will have an impact on her self-efficacy.

CT: What I think is most remarkable now, is that she is not afraid to talk.

~

Cristina: I felt like… different, because, if a classmate works with me, she is as happy as I am.

Results - Emotional/Physiological State

When asked how she initially felt about math, Cristina offers that she ***"didn't know a thing about math"*** and that she felt ***"shy, very shy"***.

Shyness is an emotion often associated with feelings of self-consciousness and insecurity and can interfere with engagement in classroom activities in general (Hughes & Coplan, 2010).

In particular, Hannula (2012) suggests that the emotions one experiences around mathematics influences the likelihood of success.

Results - Emotional/Physiological State

Interviewer: And, you like math now? Why?

Cristina: Because it's very fun. It's fun for everyone, even those who don't know much about it.

~

We suggest that the change in her emotional state occurred for two reasons - her participation in:

1. visibly random grouping
2. non-routine problems

Results - Emotional/Physiological State

Situations in which students choose their own partners or are assigned by the teacher are particularly difficult for shy children and working individually in or out of the classroom only reinforces the shyness.

The affordances of visibly random grouping include increased peer tolerance and the elimination of social barriers, both which serve to level the negative emotions associated with the social dynamic.

We see this in Cristina's reply to a question of how she now feels about being asked to work in a group with any classmate:

~

Cristina: Very happy, because if everyone is in group, and I'm in a group, I feel happy.

Results - Emotional/Physiological State

Prior to the ARPA implementation, problem solving of any kind was seldom assigned and Cristina's mathematical experiences were limited to heavily scaffolded lessons of the lock-step variety.

Non-routine problems provide opportunities to meet student needs of autonomy, competence, and belonging, all of which contribute to their emotional well-being (Hannula, 2006).

The special education teacher shares:

CT: The thing I've noticed the most and what satisfies me is the she is happy being in the class and she feels at ease. She is one of the first to raise her hand and give an answer… She faces it **[problem solving]** ***happily.***

Emergent theme - Individual mastery

Interviewer: Do you remember a moment this year when you had done well in math?

Cristina: The test. I did well, because I always study.

Results - Individual mastery

Interviewer: Do you remember a moment this year when you had done well in math?

Cristina: The test. I did well, because I always study.

~

Interviewer: And, do you remember a specific episode in which she was successful?

ST: For example, we were solving a multiplication problem and nobody knew the answer, and she raised her hand, and gave the answer. And seeing her expression of satisfaction was priceless, I mean, she was the only one who knew the answer. Imagine, of the whole class, she was the only one that knew the answer. I mean, an answer that she thought of and that she said, and that was correct.

Emergent theme - Individual social persuasion

Although, by its very nature, social persuasion as a source of self-efficacy suggests a scope that is larger than the individual, we argue that it is necessary to distinguish instances that occurred privately between Cristina and one other individual, and public instances that occurred when Cristina was with a larger group.

For example, we suggest that Cristina's classroom teacher praising her mathematical explanation as ***"very good!"***, is an example of an instance of individual social persuasion.

It was a private moment shared between Cristina and her teacher that served to improve her self-efficacy.

Results – Public social persuasion

An instance of public social persuasion occurred with the classroom teacher's revoicing of Cristina's problem-solving strategy ***"Add …. number …. result"***.

This valuing of her strategy had the dual effect of positioning Cristina as a "doer and thinker" of mathematics and doing so in the presence of her peers which, according to Bandura (1997) makes it a strong source of self-efficacy.

Implications of individual vs public sources of self-efficacy

Our conjecture is that public instances may have a greater effect on improving self-efficacy than individual, at least for Cristina.

Prior to the ARPA implementation Cristina would have experienced moments which would have impacted her self-efficacy, but either they were too few or too private.

It was not until she was placed in a randomly selected group with her classmates and expected to work collaboratively on non-routine problems, did her teachers note any change.

We suggest that creating conditions that allow for public sources of self-efficacy to occur is an effective method of developing self-efficacy.

Conclusion

Improvement in Cristina's self-efficacy was due to a change in the social dynamics and in the type of activities proposed in the classroom.

1. Visibly random groupings – promoted integration and decreased marginalization

2. Non-routine problems – promoted opportunities for all students to undergo mastery experiences

Interviewer: In fact, she told us…

CT: What?

Interviewer: ... that math was fun for her.

CT: Yes? Think about it, the fact that a girl is telling you that. One feels satisfied. Everything else doesn't matter, we feel already paid.