

Problem Solving in Patagonia

Universidad de Magallenes
Punta Arenas, Chile
Nov 28 - Dec 1, 2017

Examining Sources of Self-Efficacy in Whole Class Problem-Solving

Patricio Felmer, Peter Liljedahl, **Cristián Reyes**,
Annette Rouleau, Natalia Ruiz, and Robert Sidley



UNIVERSIDAD DE CHILE

Opportunity knocks

- International collaboration
- ARPA
- The public lesson

Cristina

- 11-year-old, fifth-grade student in the Chilean public school system in a small town outside the metropolitan region.
- 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 “*shy, very shy*”. Mentioned disliking math and feeling weak in the subject “*I didn’t know a thing about math*”.
- Strong parental support, perhaps too much so “*So the mom supports her a lot, but sometimes she was pressuring her very much*”. (CT)

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. Heighten and sustain their efforts in the face of failure.
4. Recover quickly from setback or failure.
5. Attribute failure to insufficient effort or deficient knowledge and skills which are acquirable.
6. Approach threatening situations with assurance that they can exercise control over them.

(Bandura, 1994)

Low self-efficacy

1. Shy away from difficult tasks which they view as personal threats.
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 persuasions
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
 - weakened through repeated failures, especially if these failures occur before a sense of efficacy is firmly established
- 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.

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 persuasions

- 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?

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.

Class

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)

<http://www.arpamat.cl/>

- 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 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.

Results - 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: 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.

Results - Mastery

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 give 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

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

1. Short interview
2. Few problem-solving experiences

Results - Social persuasion

**ST: In the beginning they said, “ah, also, we don’t want to work with her”
But we explained to them that those are the rules.**



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

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.



Interviewer: Imagine you have a math lesson tomorrow with Miss L. (CT), and Miss J. (ST), and you were in a random group where you have to work with any class mate, how would you feel if you had to work in group?

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

Results - Emotional/Physiological State

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.

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.

Conclusion - Cristina Now

- *“Cristina is the most complicated, but she has improved a lot so, for us, she is just like the rest.” (CT)*
- *She is confident. That is the last thing we have seen. And, since she learned to solve the problems, she always participates. I think it helped her to face problematic situations with confidence. The confidence she gained, and that she obtained from the fun lessons, from problems that made sense to her, like, familiar topics. CT*
- *Mother: I think she likes it [math] much more than in the previous years [...] This year math hasn't been so hard for her, compared to previous years. I think that's because of the method [ARPA] the teachers are using.*

Conclusion

ARPA's model of random groups and non-routine problems provided Cristina with multiple opportunities to improve her self-efficacy through:

1. Individual sources
2. Relative sources

Conclusion

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.

Interview questions

- i) What was math like for X at the beginning of the school year?
- ii) What is math like for X now?
- iii) What caused the difference? (will that bring it back around to random groups?)
- iv) Does X like math now? Why?
- v) Think about X in a random group tomorrow. What will it look like?
- vi) Tell a story about when X was successful.
- vii) How did you think X would do in random groups when it first started?
- viii) What surprised you about X this year?
- ix) What surprised you about X this year the first time you did random groups?