Studying Entrepreneurial Learning in a Primary School Setting in Sweden

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Abstract

Questions we care about. In this study we are interested to explore the intersection between entrepreneurial learning (EL) and problem solving in mathematics in a primary school setting in Sweden. EL is part of the Swedish school system curricula where it is about developing entrepreneurial competences such as initiative, responsibility, creativity and ability to collaborate – competences that lay the foundation for an active life and life-long learning. The level of mathematics ability has according to PISA-tests deteriorated in the Swedish school system. Therefore, we wanted to explore if using ideas from EL applied to problem solving in mathematics could be fruitful in both developing mathematical ability and entrepreneurial competences among the students.

Approach. This study uses a participative action research (PAR) approach, implying that we brought in teachers (and to some extent students) as participators in the research project already from the start. While the overall research question (How can EL support problem solving in mathematics and vice versa?) was stated by the researchers, the work to operationalize this in each school setting is done with the teachers. Eight schools in three municipalities participate, comprising students from preschool to grade 6. The overall research guidelines are same for all schools, but the local approach differs based on local contextual factors. The researchers come from two universities some 1300 km from each other, which introduces some coordination challenges.

Results. Working with a PAR approach and involving two universities far away from each other has been a challenge, but we see now positive results in terms of engaged teachers and valuable cross-university exchanges. There seem to be a good fit between EL and problem solving in mathematics based on the first empirical "try-outs". It is too early to draw any conclusions, but the early results support that there is synergetic potential in this mix.

Implications. Based on our initial efforts, the approach (PAR), the setting (Primary schools) and the research focus (interaction between EL and mathematics) provide fruitful results.

Value/Originality. To our knowledge, this is the first attempt to study entrepreneurial learning in relation to mathematics in a primary school setting.

Key Words: Entrepreneurial learning, Problem solving, Mathematics, Primary School, Participatory action research

Background - or why this project became reality.
This project, called ELMA, is a two-year study of possible connections between entrepreneurial learning (EL) and problem solving in mathematics (MA). Entrepreneurial and mathematical competences are two of the key competences the European Community stresses as important in a society where lifelong learning is needed. This since entrepreneurial and mathematical competences are believed to help people be able to cope and act in society, no matter what they will work with (EU, 2007). The phenomenon of entrepreneurial learning being emphasized is part of a discourse that has grown stronger since the 1980s. This discourse stresses the need for people to be entrepreneurial to be able to contribute and flourish in today's society – however, not necessarily in the sense of starting companies. To succeed in today's society people will need entrepreneurial skills, such as creativity, ability to collaborate and to take initiative (Leffler & Svedberg, 2010). It is, however, not entirely clear what EL in a school setting means or if there are possible connections between entrepreneurial learning and mathematics. According to one of the most experienced EL educators in Sweden, Åsa Falk-Lundqvist at Umeå University, mathematics is one of the subjects where EL has had the most difficulties getting traction. *(Ifous*-seminar about EL 12-13th of September 2012).

In 2009, the Swedish government decided that EL was to be integrated in all teaching throughout the Swedish education system (Regeringskansliet, 2009). The curriculum that was launched in 2011 stated that EL should permeate all schooling for children in Sweden (National agency for education, 2011). However, Berglund and Holmgren (2007) claim that EL in primary schools much more depends on individual teachers than overriding structures, which points to potential problems when implementing this curriculum. Several research fields have been studying entrepreneurship including psychology, sociology, social psychology, economics and business administration. All agree that entrepreneurship has to do with action, to actually do something. It can be something revolutionary, but it can also be a small change.

The research on EL in school has so far mostly focused on teachers' views of EL. Mainly the studies have focused on how teachers perceive entrepreneurship and the relation between school development and entrepreneurship. Students have seldom been studied and when students have been included it has been older students (mainly upper secondary school). Since the scope for this study is EL practices in a primary school setting, it involves students in the age of 6 to 12 years. We chose to study them in the context of "problem solving in mathematics" as it provide interesting opportunities. First, problem solving in mathematics and EL, from a theoretical view, seem to have several mutual components as both stress the development of capabilities such as initiative, creativity and collaboration. Second, many students have negative attitudes towards mathematics, attitudes that arise already in primary school (National agency of education, 2003; 2014). These attitudes are also connected to the Swedish negative trend in international comparisons in mathematics (National agency of education, 2014). Maybe a connection between EL and mathematics can increase students' motivation and their attitudes towards mathematics? Based on this, a project was created that had the following aims:

- Investigate if and how EL can support problem solving in mathematics as well if and how problem solving in mathematics can support EL.
- How EL can be part of revitalization of rural areas.
- Identify good examples of integrated EL and mathematics: lectures and projects.
- Spread the results via workshops and lectures to teachers, headmasters, politicians etc in the areas where the research is being done.

In the present paper we will mainly look at the first aim by first briefly conceptualizing entrepreneurial learning and problem solving in mathematics and then present the methodological strategy (participatory action research) and some details about the method. After this, we highlight some empirical examples and end with a concluding discussion.

Entrepreneurial learning

Entrepreneurship can be seen as a "meta" method to human development - through entrepreneurship the potential that humans have can be achieved (Sarasvathy & Venkataraman, 2011). Linked to this is the notion of "an entrepreneurial mindset" that for a long time has been highlighted as an important basis for working entrepreneurially, which in turn is seen as an important vehicle for the individual to live and work in future society. As mentioned, EL is part of the Swedish curriculum where the National School Agency uses the definition of entrepreneurship that was developed by National Agency for industry some ten years ago when they had responsibility for entrepreneurship in schools (Tillväxtverket, 2015):

> "Entrepreneurship is a dynamic and social process where individuals, alone or in collaboration, identify opportunities and make something with them to transform ideas into practical and goal oriented activities in social, cultural and economic contexts"

This definition is based on key works in the entrepreneurship literature and specifically Shane and Venkataraman's (2000) synthesis in which entrepreneurship has its core in the nexus between individual(s) and opportunities. While Shane with his economics background have pressed hard on that this is a purely economic phenomenon, Venkataraman has opened up to wider arenas (Sarasvathy & Venkataraman, 2011) which is in line with the Swedish school definition.

What an "entrepreneurial mindset" means has been a bit of a "black box". In education, for example, Ellström (2002) highlighted the development-oriented learning as a concept that can match this, but maybe Dweck's (2012) idea of "growth mindset" is closest to what is meant by an entrepreneurial mindset. Dweck argues that we adopt and replicate a mindset that is either developmental or fixed. With a development-oriented mindset, we see others and ourselves as potentials for something more than we are today. Taking it to its extreme a fixed mindset would mean that we see ourselves as fully developed and the possibility for further learning is extremely limited. The very idea of entrepreneurship is strongly related to potential since it is about realizing opportunities.

Based on a review of the literature we here propose six EL competencies: courage (stepping out of the comfort zone), tolerance for ambiguity, ability to collaborate, ability to take responsibility, initiative and creativity. Below, we will define what is meant with these competences and how they can be understood in a school setting. Then, we do an analysis of their origin in relation to the entrepreneurship literature.

Courage *– students dare to be on the verge of their comfort zone, and there do what they (yet) are not fully comfortable with.*

Courage has in entrepreneurship literature a link to "risk taking" that is one of the parts that make up the entrepreneurial orientation construct (Lumpkin & Dess, 1996). This originates from the fact that entrepreneurship was linked to self-employment and thus a greater personal risk. It can be seen as the most original concept linked to entrepreneurship since it was discussed by Cantillon (1734) almost 300 years ago. Risk in business can be about embarking uncharted territory, "mortgage" substantial resources or borrow substantially. The risk may be economic, but also psychological or social. Sarasvathy (2001) highlights in her widely acclaimed theory of "effectuation" that entrepreneurs normally do not see risk as welcome in itself but rather as a price you have to pay to be in an entrepreneurial process where you pursue opportunities. Similarly, the competence courage is a means for the individual to develop their action repertoire and not an end in itself. It is not about liking to be outside your comfort zone, but about being prepared to pay the price for a stronger action ability.

Tolerance for Ambiguity *- students are able to solve tasks even though the situation is ambiguous and not fully understood.*

Tolerance for Ambiguity has been studied in psychology for a long time. In the entrepreneurship field it came to be used in the 1980s (e.g. Begley & Boyd, 1987) and has since been a trait that often has been included when entrepreneur's characteristics has been the focus (e.g. Westerberg, Singh & Häckner, 1997). According to Budner (1962), ambiguity can come from novelty, complexity, or situations without an unequivocal solution. He defines tolerance for ambiguity as a tendency to like situations that have these traits and the opposite (intolerance for ambiguity) as a tendency to view such situations as threatening. Tolerance for ambiguity is therefore crucial to be able to act on opportunities, which normally means a hefty dose of novelty, complexity and lack of clarity. In the school context the student meets similar situations (new types of tasks that hold complexity and have no clear answer) but on a more basic level. This could mean that with a more developed tolerance for ambiguity you can better understand the task and easier find strategies that can lead toward a solution.

Ability to collaborate *– students are able to both give (share thoughts and knowledge) and take (absorb other's thoughts and knowledge) and can based on this work together with others to carry out tasks and solve problems.*

Ability to collaborate is not an entrepreneurial ability linked to the entrepreneurial orientation construct (such as risk taking) and it is not linked to the characteristics of the entrepreneur (such as tolerance for ambiguity), but is still undoubtedly a key competence to be able to act in our future society (which may already be here). Already in the early 1980s Miller (1983) showed that communication and an ability to work with others was important for companies acting in dynamic markets. In recent years the concept of "open innovation" is highlighted as central for success. Working with open innovation implies that firms interact more deeply in the whole innovation process. Parida, Westerberg & Frishammar (2012) showed that many aspects of the interaction (both with customers, suppliers and partners in the industry) were central for the company's innovation performance. This pattern also fits with Sarasvathy's (2001) idea of "resource quilting" which means that entrepreneurs primarily see other actors in the industry as partners rather than as competitors. Key aspects for obtaining good collaboration lies in creating a balanced exchange (see e.g. Wincent, 2008) and building a strong network capability (see e.g. Parida & Westerberg, 2009). Network capability consists of the ability to communicate internally, knowing your partners, establish and maintain relationships and build concrete collaborative projects. These aspects also seem central to interact in a school environment. An important basis for this is to know oneself, one's own competences and abilities, which in turn is the basis for building self-confidence.

Ability to take responsibility *– students take responsibility for both own and peers' learning by being a driving force that possess patience and do not give up despite setbacks.*

Also this dimension originates from the entrepreneurial orientation construct, but there it is known as autonomy. It is defined in Lumpkin & Dess (1996, p. 140) as "the independent action of an individual or a team in bringing forth an idea or a vision and carrying it through to completion". It is thus about to be self-driven when embarking on opportunities and not let organizational structures become hinders. A central idea of intrapreneurship (Pinchot, 1985) is to create opportunities for employees to take responsibility and thus be able to act as a more independent actor despite being within an organizational structure where the frames are given. Similar to this, responsibility in a school context would mean that the student becomes an independent actor in relation to his or her own learning. The goals are pre-given, but the student takes an active part in deciding how to achieve them.

Initiative *– students can be proactive and act without a teacher telling and are thus not dependent on a leader / teacher that sets the agenda.*

Initiative is linked to "proactiveness" which also is part of the entrepreneurial orientation construct. Proactiveness is defined as actions to anticipate future problems, needs and changes. In the entrepreneurship literature, it is very much about being early with novelties related to the business and to always be open to exploring and implementing new (business) opportunities. Initiative was highlighted already by Schumpeter (1934) as central in the entrepreneurial process. By having a vision of the future the entrepreneur can become the creator of the future. This can be related to Sarasvathy's (2001) "pilot-in-the-plane" principle, where the entrepreneur by taking the initiative becomes master of his fate rather than the prisoner of circumstance. Similarly, by taking more initiative, the student can become more active and thus less dependent on teacher.

***Creativity** – students are able to contribute to finding new solutions that are not trivial/ conventional for them.*

Creativity is related to "innovation" and is the fourth component that is taken from the entrepreneurial orientation construct. Innovation is perhaps the most central aspect of the entrepreneurial orientation construct and is about to engage in and support new ideas, experimentation and creative processes (Lumpkin & Dess, 1996). Schumpeter (1934) stated long ago that creativity is central to the renewal of businesses and industries. By "new combinations" of resources new products and production methods are created that better solves the needs of the market. The market has now been extended to society by the introduction of social innovations (and social entrepreneurship). In these situations creativity is used to solve social needs in society. At school, it is probably more interesting to work with the challenges facing society. Developing creativity does not require solving societal challenges, but may take place in most subjects by taking advantage of and developing the ideas that emerge from the students.

Problem solving in mathematics

In the Swedish syllabus for primary school, mathematics is described as a “creative, reflective, problem-solving activity” (National Agency for Education, 2011, p. 62). When working with mathematics the students are to develop their ability to formulate and solve problems, and also to reflect over and evaluate their selected strategies and methods, models and results (National Agency for Education, 2011). The emphasis on problem solving in the Swedish syllabus is not new and the same emphasis can be found in several other countries. However, in many of these countries problem solving in mathematics is not integrated into mathematics teaching but is instead taught separately (Cai, 2010; English & Sriraman, 2010). Problem solving being emphasized, both nationally and internationally, is based on the intention of teaching for the future where competences as critical thinking, flexibility and ability to cooperate are stressed as important to develop (Evans, 2012).

Although the emphasis on problem solving in mathematics is not new, the arguments regarding how and why students are to be taught problem solving has changed over the years. The arguments has shifted slowly, from a view where students first need to learn mathematics in order to become problem solvers, to a view where problem solving is to be taught as content itself. Today’s view is that students will develop important mathematical ideas and competences through working with problem-solving tasks (Wyndhamn, Riesbeck & Schoultz, 2000). Problem solving then is described as both an aim (problem solving as a strategy for acquiring new mathematical knowledge) and as a content (together with number and number use, algebra, geometry, probability and statistics) in the syllabus. This implies that students, for example, are supposed to learn content, such as probability and statistics, through working with problem solving.

Even though there is “no universal agreement about what teaching mathematics through problem solving should really look like” (Cai, 2010, p. 255), there are common features. A *mathematics problem-solving task* is a challenge to deal with where the method or methods for solving it are not known beforehand. The students have to form a ***new mathematical idea***. A mathematics task becomes a problem-solving task when the ”problem solver” has to develop for him/her new strategies, methods and/or models. As such, if a task concerns a problem solving task or not depends on the relation between the task and the previous experiences and knowledge of the problem solver. If a task is possible to solve with ***different strategies*** and is possible to adapt regarding ***depth and breadth*** it is more possible that it will work as a problem-solving task for a whole class of students. This since the teacher can adapt the task in relation to the experiences and knowledge of each student. For example the students can work with the "same" problem-solving task but with different numbers and with different amounts of questions to be answered. Another way to adapt a task in relation to the experiences and knowledge of each student is to vary the requested number and level of abstraction of the strategies used. Examples of problem solving strategies are to draw, search for patterns, work backwards, make lists, charts and/or tables, dramatize, guess and try, use manipulatives and/or to simplify the task (Lesh & Zawojewski, 2007).

In this study we have chosen to focus on the potential of the lectures and projects to make it possible for students to develop *mathematical ideas, to solve task with different strategies* and the possibility to vary the tasks regarding their *depth and breath*.

The Empirical Study – methodological strategy and how we work in practice

Nine researchers from two universities and teachers and students from eight primary schools participate in this two-year long study. Also Professor Bengt Johannisson participate in the project as an evaluator. The participation of the schools is based on the interest of the teachers to be involved in the study. Since the participating schools are of different size and since the project is voluntary for the teachers the number of the participating teachers vary between schools. All the children's guardians were informed in writing about the study and approved their children's participation in line with the ethical guidelines provided by the Swedish Research Council (2002).

Some of the schools have traditional pedagogical axioms while others are striving towards EL. Five of the schools are located in the south of Sweden and three schools in the north. Since we in the project also study how schools, through EL can be part of revitalization processes in the surrounding communities four of these schools can be classified as belonging to rural areas.

In the study we work according to participatory action research, which can be seen as a branching-out of the term action research originally coined by Lewin (1946; 1948). One way to distinguish between action research and participatory action research is through the formulation by Ghaye et al. (2008) of some key questions. In action research the question asked is ”What is the practical problem I need to address in my work?" (p. 364) while in participatory action research the question asked is "What can we do together to change the situation here?" (p. 364). In our study researchers and participating pedagogues under democratic forms are to produce practical knowledge. Through this practical knowledge we wish to achieve lasting development in the form of good exemplars, such as new approaches, new ways and means of working, and systematic and critical reflection on pedagogic and didactic issues. According to Reason & Bradbury (2008) there is in this approach to research an opening-up of new forums for conversation, reflection and joint knowledge creation. At the eight schools different forums have been established in the shape of meetings, research circles, workshops, interaction amidst the classroom chalk dust or the researcher's participation in day-to-day talks in the staffroom. Reason & Bradbury (ibid, p. 17), further note that "researching with people means that they are engaged as full persons, and the exploration is based directly on their understanding of their own actions and experience, rather than filtered through an outsider's perspective". Taken together, the ambition of the study is to attempt to change the existing practices *together* with the participants, rather than a wish to try to change them.

The first six months of the two-year project have been focused on finding possible connections between EL and mathematics theoretically, collecting empirical examples of former projects, and also getting to know the schools. Six of the researchers have spent time every week at the schools (as observing participants and participating observants) and all teachers and their students have been interviewed. This implies interviews with 45 teachers and several hundred students. The focus of the interviews was on how the teachers and students perceive EL and problem solving in mathematics before getting involved in the development of lectures and projects within the study. In December 2014 teachers at involved ELMA-schools were invited to a workshop to socialize, get a glimpse of the two theoretical fields (entrepreneurial learning and problem solving in mathematics) and to explore how these fields can be integrated. In addition to this meeting, we have conducted training days and research circles with teachers. During spring semester 2015, the teachers are asked to try out different "tools" for entrepreneurial learning that were briefly introduced in theory sessions. At a follow-up workshop in June teachers will be able to exchange experiences from their attempts to work with entrepreneurial learning in their classes.

Focus in the following 12 months of ELMA will be on design of lectures and projects that make it possible for the students to work with and develop EL and mathematical competences further. Before these lectures or projects are launched, we will discuss with the teachers and the students what we want to achieve. During the implementation, the researchers are active in the classrooms observing and interacting with the students. Before a lecture the researcher or teacher tell the students about the task and the students mark with thumbs up, thumbs down or neutral thumb what they think about it. After every lecture the students, the teachers and the researcher make evaluations, both individual and together. We believe that the students' evaluations are very important in relation to the previous mentioned motivation and attitudes. Approximately once a month a meeting with all participating teachers at each school is held where we discuss the work just done and the next to be launched. Parallel to the implementation of these lectures and projects at the schools the researchers meet to compare, evaluate and further develop the theoretical aspects of the study. The researchers meet both in real life and using distance-spanning technology. The last six months of the project will be spent writing and spreading the findings. The findings, lectures and projects will be implemented (not only at participating schools) before the project's end. The results are to be spread through lectures and workshops aimed at teachers but also headmasters, politicians, etc.

Regarding quality criteria the study is inspired by Guba & Lincoln (1994), implying that we will work with the umbrella terms *trustworthiness* and *authenticity*. Trustworthiness encompasses the criteria for credibility, which correspond to internal validity; transferability which corresponds to external validity; dependability which corresponds to reliability; and confirmability, which corresponds to objectivity (Guba, 1981; Lincoln & Guba, 1985). The second umbrella term, *authenticity*, encompasses the criteria for fairness, ontological authenticity, educative authenticity, catalytic authenticity and tactical authenticity (Guba & Lincoln, 1989).

Empirical notes from the initial process and from the initial try-outs

Since the project is in its first year we are far from ready with collecting empirical material and building results. However, next we will first present some reflections on the overall research process and then three examples from the work to try out new ideas in the classroom.

Our initial process – passion and stumbles

As the project team met for the first time in August 2014, many didn't know each other, and we came from two distinct fields, mathematics education and entrepreneurship. However, all were eager to work together and the passion for developing better education was evident among all. During the first six months, we have only met physically twice and at both times, the time was not sufficient to fully iron out the issues we discussed (e.g. how to practically work with participatory action research, how the conceptual framework should be used, etc), which led to that part of this had to be done using e-mail, e-conference facilities and other distance spanning techniques. This has led to some misunderstandings and to some degree a split in the project, where each university runs their part of the project independent of the other. As integration between the universities is paramount for final product success, we will now have more physical meetings the next months to remedy this and make sure we are able to profit from being two universities.

The participatory action research strategy was an important part of the project already from project conception. To have the teachers as participants and not merely study objects was seen as crucial for getting long-term impact. However, getting teachers to become participants takes a lot of work – more than we anticipated. It is about spending enough time at the schools and building trust, but also about negotiating roles. The teachers tended to see the researchers too much as authorities to begin with and it took time to get to a climate where there is a more free exchange. But now after about six months we have created a climate that hopefully will lead to good results as teachers engage in "try-outs" on a more regular basis.

Classroom example one – produce tasks for a given answer

The first example is from a school where teachers from all grades are involved in the project. The example shows how quite small changes in a mathematical task can make it possible for students to practice entrepreneurial competences and at the same time learn mathematics. The example is from a grade five (eleven-year-olds) but all grades at the school worked with the same task, however adapted to the age of the students.

In grade five the students, in pairs, were to produce tasks for a given answer. (The “normal” in mathematics education is the opposite; the students produce answers to given tasks.) This was the first time these students were to produce own tasks in this way. They could choose to work with the answer 45 or 96. The students were to produce one word-task for each rule of arithmetic. Doing this, they struggled a lot, especially with multiplication and division since they had to think reverse to be able to construct their tasks. To produce a division-task they had to think multiplication or addition and vice versa. In the end of the lesson, the students presented their tasks in a whole class session. Together they evaluated if the tasks were suitable for each rule of arithmetic.

When evaluating this lesson in relation to the mathematical and entrepreneurial parts focused on in the study the preliminary results indicate the following. The task involved clear *mathematical ideas* and the students struggled with using their previous mathematical knowledge in, for them, a new setting. As such the task made it possible for them to learn mathematics. The task also made it possible for the students to use *different strategies* and to work on mathematics with different *depth and breadth*. The students needed both *courage* and *tolerance for ambiguity* to be able to work with a task outside their comfort zone and to present and evaluate the tasks in the whole class session. Since they worked in pairs they practiced their *ability to collaborate* which can be extra difficult when working outside your comfort zone. Since the task was to be presented and evaluated in the class the students had to take *responsibility* for both their own and for their peers’ learning. While working with the task the students were allowed to, and sometimes took own *initiatives.* For example some students started to use calculators to check the correctness of their tasks before presenting them in the whole class session. Finally, the students had to be *creative* to produce their tasks since it was not a routine situation for them. To sum up, this became a task that looked quite narrow at the first glimpse but in the process of working with it, the task offered the students opportunities to develop a wide range of both mathematical and entrepreneurial competences. Some of these opportunities can be related directly to the task (mathematical idea, different strategies, depth and breath, courage, tolerance for ambiguity, creativity) while others can be referred to the context, here the arrangement of the classroom (collaborate, responsibility, initiative).

Classroom example two – produce problems for other students to solve

Another example of activities within the project was conducted with four-graders (i.e. students around 10 years old). These students had at this time been working to develop their problem-solving abilities for a few months. We had noticed that the students had difficulties in relating different problems to each other and to the mathematical idea and strategy behind it. This activity was focused on developing their ability to detect and create problems in environments outside school, in order to learn more about problems, problem-solving and the transferability of problems. The students could choose an environment, a product or a happening that they found interesting. This resulted in a variety of contexts and products, for example, one of the students chose a car, another chose balls and a third chose a horse race. Their assignment was then to develop problems related to this context, product or happening for the other students to solve. The problem should include a clear *mathematical idea* and be able to *solve problems in a variety of ways*, that is, use different strategies. The pupils were very engaged and motivated to find different mathematical problems for their fellow students to solve, which contributed to *creative* solutions and made them *take initiative* to try to develop them further. When the students later were to solve their classmates' problems, this created a fruitful discussion and reflections about what constitutes a problem or not, *the depths and width of a problem*, what facts that are needed to solve a problem and how to use different mathematical techniques to solve the same problem. This discussion, in turn, contributed to the students' ability to *collaborate* and to help each other understand and learn, both about solving the actual problems but also problem-solving as a whole. What we could see from the assignment was that the students did develop their ability to create problems where the solution and method to solve were not known beforehand. They also learned about what facts that are needed to solve different problems. The biggest challenge, however, was to focus on the mathematical idea and strategies and to be able to transfer them. This insight, in turn made the next lecture to be more focused on transferability and different examples of the same mathematical idea and strategy, albeit in a different context.

Classroom example three – open task and no given answers

The third example is from a school where pre-school, first and second grade students participated in the project. The task was adapted somewhat to the age of the students, but they all did the basic which was solving how many snowballs will be needed for a party. The only information given was:

1) You are going to build snowball lanterns for a party. The party will take place in the middle of the summer.
2) How many balls will we need when making one lantern if the base is X, and we need one less ball for every ring (the x varied depending on how old the children where). In second grade we used the base 10 and in pre-school 5.

The students started out by discussing the problem of snow and warm weather in groups. The came up with many solutions of how to make snow last! One student came up with the idea: does it has to be snow!? They discussed different materials that could be used and when they had decided they started to calculate the number of balls that would be needed. First, they worked individually. Then they worked two and two, discussing the individual solutions with each other. They used knowledge they already had in mathematics, that is addition, but it became clear they had to use the knowledge in different ways than they were used to. Some of them actually said "But this is not mathematics, this is preparing for a party!" At the end of the lecture the students said that they wanted to make a party for the class with lanterns. If the lecture had been changed into a project, the students would have practiced responsibility as well – by organizing a party. But during the lecture they did use many *different strategies* solving how many snowballs would be needed for one lantern. The students showed *creativity* and *courage* while experienced *tolerance of ambiguity* since they came up with many different solutions and had to discuss them with the other students. A few children went and got some materials to work with. They build the lanterns and then counted. Others drew circles on small white boards, representing the different layers, while others wrote the numbers under the rings and added them. Others wrote only numbers. After the students had worked alone, we paired them together based on how they had solved the problem. They also visited several other students to discuss their way of solving the problem. That is, they *collaborated* and got an understanding of *several strategies* that solved the problem. They also made the problem even bigger (*depth and breadth*) when they decided that one lantern was not enough for the party. All of a sudden they had entered a whole *new mathematical idea*: multiplication. In the end when summarizing the lecture in class students presented the different ways they had solved the problem and we told them that they had done multiplication. The children were very surprised.

Discussion and conclusions

As indicated, the project is only in its first phase and results are only starting to build up. Still, there are some aspects that we would like to discuss on the basis of what we have learnt so far.

First, it seems to be a rather good fit between problem solving in mathematics (MA) and entrepreneurial learning EL). As the preliminary results from the classroom examples show, we can tick many of the boxes for both what constitutes a good problem from a mathematical and entrepreneurial learning standpoint. It is thus promising to continue finding ways to work in mathematical problem solving that not only sharpen the mathematical ability, but also develop entrepreneurial competences. However, we still lack some conceptual development where we merge the two fields and explore what happen in the intersection between them. As we have three MA constructs and six EL constructs, there are 18 intersections in the matrix. The work to explore this conceptually and then empirically has just started, and we hope to be able to contribute both theoretically and practically with this work.

Second, to be able to merge problem solving in mathematics and EL it is important to have a good task, a good structure but also a supporting culture/context. As the classroom examples show, a good task can tick many of the dimensions in EL and MA. This could also be enhanced with the help of a supporting structure during the lessons/the projects. We have seen that if the structure is too loose, students lose themselves in the task. The imposing of "rules" linked to the general way to work with the problems helps students to focus on the essential aspects of the problems. However, finding the right balance between rules and freedom of rules must be a constant consideration for the teacher. As students become more accustomed in a given rule setting, rules may be loosened to allow for more creativity. And if the teacher sees that a student is unable to come up with solutions, a more structured situation can be created for the student. Still, all this activity needs to be done in a culture/context that emphasizes a growth mindset (Dweck, 2012). Without a culture where students and teachers alike have a focus on the development of our competences built on a belief that all can learn, the best constructed tasks and the optimal structure in place will still not result in developed abilities in MA and developed competences in EL.

Third, and related to our own process, it is important to understand that development is a process and that we as researchers need to be patient at the same time as we are passionate about what we want to achieve. It is easy to "hijack" the process from the teachers and they may even like it as we take control and make things happen. However, for the teachers to be able to implement the results and to carry on after project end, joint ownership of the process is a key component.

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