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# The SYNERGY project: Emotional Intelligence to Improve Motivation and Learning

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**Abstract**—For the last decade, our university has experienced a fairly clear decrease in first-year license completion. So, the wish is to be a strong proponent to go towards the experimentation of original devices and students training policy in order to foster success, reduce the failure rate, significantly increase the graduation rate, and ensure a good transition from high school to university. The aim of SYNERGY project is to experiment whether Emotional Intelligence coaching helps to improve students' motivation and learning. In its first stage, the project considers an experiment with twenty students which followed 3 sessions of Emotional Intelligence. The evaluation has been performed through EVA methodology and the results are very conclusive. Indeed, not only does the coaching increase students' motivation and involvement in the work, but students also testify that learning seems more affordable.

**Index Terms**—Emotional Intelligence, Learning, Motivation.

## I. INTRODUCTION

This Innovative practice full paper presents the SYNERGY project whose objective is to evaluate the contribution of Emotional Intelligence for improving motivation and learning of first year undergraduate students. During the 3 years of the Synergy project, several groups of up to 15 students each will be considered. In the present paper we relate an experimentation with 2 groups, each composed of 10 students following electrical engineering and industrial computing curriculum. Each group has followed three sessions in Emotional Intelligence.

The originality of this work is to consider a new paradigm inspired from experimental psychology. We have used an evaluation methodology (EVA) which is also an original evaluation prototype. EVA is based on experimental psychology and makes it possible to analyze objectively the impact of the teaching practice in two ways. First, the use of pre-test, immediate post-test, and deferred post-test questionnaires related to motivation and subject matters related to the training curriculum helps measure student progress over time. Second, the use of a test group and a control group makes it possible to reinforce the impact of the educational innovation. For each

test group, we associate a control group that undergoes an evaluation similar to the test group, but only for modules related to their training (algorithmic and mathematics have been chosen). The assessment of motivational factors is only offered to groups who have attended emotional intelligence sessions. To date, a total of 95 students participate to the project. The first results are very promising. The student satisfaction rate is close to 100%. There is a significant improvement in motivation and self-awareness. Students who had difficulties getting to work, learned to identify the levers to manage their own motivation and stress, and students with greater difficulties were able to become aware of the effect this had on their academic results. The rest of the paper is organized as follows. The next section describes the project and its context. Section III presents the material and the method for conducting the study. In section IV we show the first results that we obtained. At last, we conclude and give some of the next steps and perspectives of the project.

## II. CONTEXT AND MOTIVATION

Since 2009, our university has experienced a fairly clear decrease in the completion of the first year of Bachelor's Degree<sup>1</sup> (27.9% across all sectors). This level is 11.8 points below the national average, which raises many questions. The local context is characterized by the diversity of origins and the frequent unpreparedness of new students. Our university has the will to strongly promote the experimentation of original tools in L1 curriculum and in the students' policy of training. To this end, the "L1 Observatory", composed of teachers, researchers and administrators, is responsible for leading the process by regularly publishing calls for proposals so as to fund innovative pedagogical projects (as it is the case for the Synergy project). The architecture and the observatory's missions were established in spring 2015. The overall objectives are to take into account the diversity of students: fostering success in L1, reduce the failure rate, significantly increase the graduation rate, homogenize the knowledge and relationship

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<sup>1</sup>For the sake of simplicity, we will later denote the first year of Bachelor's Degree as L1.

to the studies of young people, promote the learning of the “student job” and ensure a good transition from high school to university.

The dimensions of self-awareness and personal development have often been neglected in University, creating a divide between academic work and personal work, both of which are necessary to build oneself professionally and personally. Several experiments have been conducted in recent years in France (University of Montpellier, University of Toulon, La Rochelle University).

In addition, many scientific studies have shown that the explicit consideration of the psychological dimension in the training courses increases intellectual capacities and increases the success rate. Self-efficacy is defined as an individual’s judgment of his or her ability to perform a task within a specific domain [13]. It has been shown in [12] that many struggling learners will not be able to make the effort needed to master academics and that such students give up or avoid tasks similar to those previously failed. The study in [11] shows the role of students’ motivation in choice of courses of action, and in the intensity and persistence of effort. This experiment tested the notion that the effect of instructor clarity on learning is conditioned upon students motivation. They randomly assigned 128 participants to a video of a clear or an unclear lecture and asked them to report their motivation to deeply process lecture material. The results indicated that even with clear instruction, test scores were not increased when students motivation to process was low. However, when students motivation to process is high, motivation interacted with instructor clarity to increase test scores. Under conditions of high clarity, participants who were highly motivated to think deeply about the lecture scored higher compared with their less motivated counterparts. A level of motivation is reflected in choice of courses of action, and in the intensity and persistence of effort. Self-efficacy beliefs determine how people motivate themselves and behave. Such beliefs produce diverse effects through four major processes that are: cognitive, motivational, affective and selection processes. As it is further shown below the motivational process will be used in SYNERGY project as a lever to help students learning. Another important result is the one in [14] which shows, among other things, that sometimes failures undermine and sometimes they motivate without this being linked to student skills. Indeed, many very skilled students condemned their intelligence when they failed at a task and many of less skilled students never entertained such thoughts. So, the vulnerability is not based on the “reality” of the students’ skills. Rather, it is due to negative emotions, denigration of intelligence that led to deterioration of performances. This reinforces our hypothesis of using Emotional Intelligence to help to improve students’ motivation and learning.

The originality of the SYNERGY project is to “bet” on interaction and synergy at different levels: students, teachers of different specialties, and coaching professionals.

### III. MATERIAL AND METHOD

#### A. EVA methodology

EVA methodology provides an assessment guide for educational transformations and innovation [10]. It has been designed by a collaborative team composed of researchers in developmental psychology and education experts (Villebon-Charpak Institute and Canada)<sup>2</sup>

EVA is a professional tool that provides rigorous, encrypted and easily communicable information on the relevance of a pedagogical transformation. This allows a teacher to respond autonomously and without preconditions to the question: which of my Usual Pedagogical Practice (UPP) or my New Pedagogical Practice (NPP) most favors learning in the short and medium term in my teaching context?

The collected data at the end of the various evaluations can be used to explore more general rules of learning such as: “in which teaching contexts is an educational practice the most relevant?”

EVA comprehends three distinct variants:

- 1) **One lesson, two years, two groups:** it is to apply a UPP to a first year teaching, to evaluate the impact, then to implement and evaluate the impact of its NPP the next year, when we will offer this same teaching to a new group of learners.
- 2) **One lesson, one year, two groups:** the same teaching is given in the same year to two groups of different learners which are equivalent and which do not communicate. The impact of the applied UPP with one group and the impact of the applied NPP with the other group is then assessed. This variant is the simplest and fastest to implement.
- 3) **Two lessons, one year, one group:** UPP and NPP are applied to two different courses with similar difficulty and given to the same group of learners.

Evaluating and comparing two different pedagogical practices on two different lessons requires more effort than evaluating and comparing these pedagogical practices on two different groups of learners. But the third variant is the most appropriate if one wants both practices to benefit the same learners. In the case of the Synergy experimentation project, we adopted the second variant, mainly for its simplicity of implementation. In order to implement an EVA assessment protocol, we need to proceed in the five steps described hereafter. The italic text corresponds to the instantiating of the EVA step in the context of Synergy experimentation project.

- 1) Identify a non optimal parameter we need to improve: *learning programming in C language;*
- 2) Among the various possible causes of this insufficiency, which one should we eliminate? *lack of motivation;*

<sup>2</sup>EVA is an original creation. It has been produced by the Villebon-Charpak Institute (Orsay, France) and the EREST (Equipe de Recherche en Education Scientifique et Technologique) (Montreal, Canada). It is available under the terms of the Creative Commons Attribution Sharing License under the same terms and conditions 4.0 International.

- 3) What is the NPP that will be implemented to try to eliminate this cause? *Coaching sessions in Emotional Intelligence in parallel with the C language courses;*
- 4) What is your UPP? *Learning C language with a conventional approach (courses and supervised work);*
- 5) Write up the pedagogical question, for example, in the form: is my NPP more relevant than my UPP in favoring the “targeted non-optimal parameter” by eliminating “the cause of this targeted inadequacy”? The Synergy question is: *Is it more relevant to follow E.I. coaching sessions, in parallel with the C language course, to improve C language learning, by eliminating the lack of motivation factor?*

The next section describes the implementation of these five steps in the context of the Synergy project.

### B. Emotional Intelligence sessions

Emotional Intelligence (EI) has been defined by Daniel Goleman [4] as the ability to recognize our own feelings and those of others, to motivate ourselves, and to handle our emotions well to have the best for ourselves and for our relationships. EI describes capacities different from, but supplementary to, academic intelligence. Daniel Goleman compiles these capacities into five clusters: Self Awareness, Self-Regulation, Motivation, Empathy, and Social Skills. It has been showed in [5] that the use of EI skills is a determining factor to innovate and develop one’s performances.

In this paper, we have explored this idea for the first year undergraduate students in order to study how these skills can help them to improve motivation and learning programming in C language. The course of C language runs throughout the first semester and the coaching sessions take place over three days in the middle of the same semester. The concept of collective intelligence, which is associated to mirror concept [8], has also a strong impact on the synergy among the students and the teachers. Cooperation and interaction are at the heart of learning.

In the present experimentation, the students followed 3 successive coaching sessions, whose duration is respectively, 6, 6 and 4 hours. It is important that each group does not exceed fifteen members. As shown in Figure 1, the spatial arrangement in a circle allows students to see each other.

Our experimentation involves behavioral exploration through collective, thematic, experiential and interactive sessions. We give below some examples of themes worked during the sessions. The choice was made in consultation according to the objectives of the members of the group. However, the first session is always dedicated to the concept of commitment.

- Assessment of social skills
- Codes and fundamentals of Emotional Intelligence
- Assertiveness and leadership
- Self control
- Crisis management and loss of sens
- Oral exam preparation
- Stress management
- To learn for a know-how



Fig. 1. Circular spatial arrangement

- To develop for a knowledge to become

### C. Implementation and results

To measure the relevance of a pedagogical transformation, we compared the learning achieved with the UPP and those made with the NPP. It is assumed that, as a professional in the assessment of knowledge and skills targeted in his/her teaching context, the teacher is the most appropriate person to prepare assessment tests of learning. This step is therefore only intended to provide the indications and recommendations necessary for the structuring and rigor of the approach proposed in EVA. We measure the evolution of knowledge and skills in the short term (between the beginning and the end of the education), but also in the medium term (between the beginning of the teaching and a few days or weeks after the end of the teaching). For this, it is necessary to test the knowledge and/or skills targeted by the teaching at three points in time:

- A pre-test is realized before the beginning of the course. It has been proposed at the beginning of the first session.
- An immediate post-test is realized immediately after the sessions. At best, it is carried out at the end of the last session, failing this, as soon as possible in the days following the end of the course. In our case this has been performed at the of the third session.
- A delayed post-test is realized sometime later. It can be performed between a few days and several decades after the immediate post-test. A delay of one week has been considered in our case.

The three tests are prepared before the beginning of the sessions both for UPP and NPP. EVA gives some helpful recommendations, the most important being:

- These tests are specific to EVA and should not be included in formal assessments of knowledge and skills. This precaution makes it possible to reduce the stress of the learners and to increase the homogeneity of the tests. Indeed, the pre-test can not be evaluated formally since it is given before teaching. The use of a scale prepared upstream must allow each test to be assigned an objective

and quantified score. This scale must be common to all six tests to ensure comparison of the scores.

- Tests of ten to fifteen minutes are usually a good compromise between the time taken on the course and the quality of the measurement collected. It is necessary to ensure that there are enough evaluation criteria for each test so that they are representative of the state of learners' knowledge and/or skills. The duration of the tests can be shortened or lengthened if necessary or desired. In any case, the time allowed for the six tests must be respected so as not to introduce any bias in the results.
- In order to improve the statistical quality of the measurements, one can draw randomly whenever one needs to choose elements among a set or in which order to present elements. For example, one can randomly draw the knowledge and/or skills that are evaluated from those targeted in the courses and the order in which the six tests prepared will be proposed.
- The six tests must be equivalent in terms of structure and difficulty.

#### IV. RESULTS AND DISCUSSION

##### A. General context

For each of the groups of the study, tests have been conducted as explained earlier using the EVA evaluation methodology. A pre-test has been realized before the beginning of the coaching session, with 20 respondents, and a post-test has been realized immediately after the end of the coaching session, with 17 respondents. A delayed post-test has also been realized but with too few respondents to be significant, so we won't comment about the corresponding results. One of the first things to be noticed is that the students were quite ambivalent about the coaching session they were about to begin. They had both high expectations, with 90% of the students hoping that it would help them in their studies (see Fig. 2), while having low confidence that it would indeed be useful, with very mixed feelings about the potential interest of the experiment (see Fig. 3). One possible explanation for this distrust is that the participation in the coaching was not a real choice for most of them, but rather a default choice, or at best the result of curiosity (see Fig. 4).

##### B. Expectation about the coaching session

A series of questions was designed so as to evaluate the expectations of the students with respect to the way the coaching may help them. The questions were formulated as "I wish that this coaching..." and the different propositions were the following (in parenthesis, the label used for the proposition in tables I and II):

- "helps me in my studies" (*studies*)
- "helps me in my personal life" (*personal life*)
- "brings me self confidence" (*self confidence*)
- "brings me a clearer study project" (*clear study project*)
- "brings me a better handling of my emotions" (*emotions handling*)

**I wish that this workshop helps me in my studies**

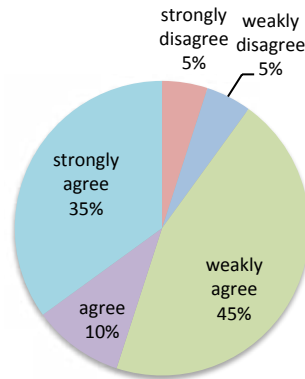


Fig. 2. Initial expectation for the AA group

**I don't see the interest of this workshop**

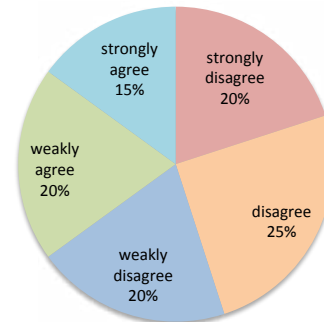


Fig. 3. Pre-test evaluation of the interest for the AA group

**I signed up for the workshop**

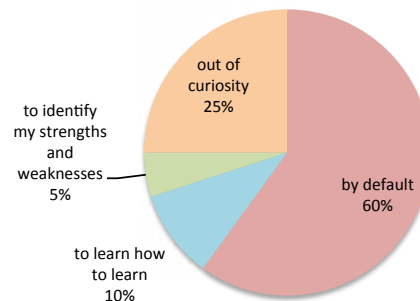


Fig. 4. Reasons for signing up in the coaching session

- “brings me a better handling of my stress” (*stress handling*)
- “the assertion of my personality” (*personality assertion*)

The students were asked to express their feeling using the following scale: *strongly disagree*, *disagree*, *weakly disagree*, *weakly agree*, *agree*, *strongly agree*. Table I synthesizes the results obtained. To simplify the analysis, we grouped the answers into only four categories: *strongly disagree (SD)*, *disagree (D)*, by grouping *disagree* and *weakly disagree*, *agree (A)*, by grouping *weakly agree* and *agree*, *strongly agree (SA)*. The various propositions are ordered in the table by decreasing positive valuation (*SA + A*), than decreasing strong agreement (*SA*).

Interestingly, the students have the perception that the coaching may be of interest mainly in the context of their personal life (100% of agreement) but not as much in the context of their studies (still 90% of agreement, with more or less conviction). Except for the assertion of their personality, which is rated lower, all the other expectations are given 90% rate of agreement, with a varying rate of *strong agreement*. The students are highly confident that the coaching may generally enhance their self confidence (40% of *SA*) but a little bit less that the coaching will give them tools or techniques for a better handling of their emotions (30% of *SA*) and stress (25% of *SA*). Finally, most of them have the hope that it will help them clarify their study project, which may not be the main goal of the coaching.

TABLE I  
EXPECTATIONS OF THE STUDENTS IN THE PRE-TEST

Expectation	SD <sup>a</sup>	D <sup>b</sup>	A <sup>c</sup>	SA <sup>d</sup>
personal life	0%	0%	70%	30%
self confidence	10%	0%	50%	40%
studies	5%	5%	55%	35%
emotions handling	5%	5%	60%	30%
clear study project	5%	5%	65%	25%
stress handling	5%	5%	65%	25%
personality assertion	10%	15%	55%	20%

<sup>a</sup>strongly disagree      <sup>c</sup>agree or weakly agree  
<sup>b</sup>disagree or weakly disagree      <sup>d</sup>strongly agree

The post-test evaluation enables to assess whether the coaching session has fulfilled its promises or on the contrary has been deceptive (see Table II, with the propositions being ordered with the same criterion as previously). In this respect, the main teaching is that, while holding its promises in the context of the personal life, the coaching has also succeeded in convincing the students of its usefulness in the context of their studies (+10% of positive assessment and +12.1% of strong agreement), and in the handling of their emotions (+9.7%). Comparatively, it may have been a little bit deceptive with respect to the handling of stress (-7.1%) and the enhancement of self confidence (-5.3%). The following testimony from a student illustrates this result.

“One of the themes I appreciated was the Emotional Intelligence that allowed me to better manage my emotions between anger and joy for example. Because when I got angry, I

stayed all day and I could not change mood and move on. Now thanks to this theme I know how to master myself. This module allowed me to progress in my learning and especially in achieving my goals. Now to validate my degree’s first year, I read my classes more regularly (something I did not do before), I look for my mistakes and I try to read the part of the course that concerns my mistake. This module allowed me to challenge myself and take stock of my failures and to understand what was the cause. The confidence we had in the group allowed me to become an open person and feel better. I will never forget this module because thanks to that, I became a new person.”

TABLE II  
EVALUATION OF THE STUDENTS IN THE POST-TEST

Evaluation	SD <sup>a</sup>	D <sup>b</sup>	A <sup>c</sup>	SA <sup>d</sup>
personal life	0%	0%	47.1%	52.9%
studies	0%	0%	52.9%	47.1%
emotions handling	5.9%	5.9%	35.3%	52.9%
self confidence	5.9%	5.9%	41.1%	47.1%
stress handling	11.8%	0%	52.9%	35.3%
personality assertion	5.9%	11.8%	47%	35.3%
clear study project	0%	17.7%	52.9%	29.4%

<sup>a</sup>strongly disagree      <sup>c</sup>agree or weakly agree  
<sup>b</sup>disagree or weakly disagree      <sup>d</sup>strongly agree

If we look globally, as compared to the pre-test where the students were very doubtful about the usefulness of the coaching (Fig. 3), it appears very clear that the students have recognized the coaching for being interesting in the end (Fig. 5).

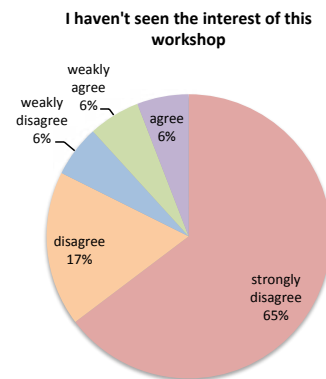


Fig. 5. Post-test evaluation of the interest for the AA group

### C. Perception about a specific course

For the second part of the evaluation, students were asked to think about a course that is quite important in their curriculum (*C Language programming*) and to express their feeling about the following propositions using the same grading scale as previously (in parenthesis, the label used for the proposition in tables III and IV):

- “I am curious to know more about this theme” (*curious to know more*)

- “This course will be useful later” (*useful course for later*)
- “What I learn is in keeping with my values” (*in keeping with values*)
- “I oppose those who want to impose me this course” (*oppose if imposed*)
- “I don’t see the point in this course” (*don’t see the point*)
- “to follow this course is a chore that I can not escape” (*inescapable chore*)
- “I absolutely have to validate this course” (*have to validate*)
- “It annoys me that this course is imposed” (*annoyed because imposed*)
- “I want to do better than the others” (*want to do better*)
- “I am obliged to undergo this course” (*obliged to undergo*)
- “I’m afraid we’ll laugh at me if I fail” (*afraid of laughs if failing*)
- “I like that others recognize my abilities” (*like to have recognized abilities*)
- “I find pleasure in learning this subject” (*pleasure in learning*)
- “I look forward to not having to take this course” (*look forward to end*)
- “This course is a waste of time” (*waste of time*)
- “I am anxious about not validating this course” (*anxious about failing*)
- “the ideas presented in this course have the power to improve society” (*power to improve society*)
- “I would feel ill at ease if I had insufficient grades in this course” (*ill at ease with low grades*)
- “It is important to me to have good grades in this course” (*important to have good grades*)
- “This course helps me to give the best of myself” (*helps me to give the best*)
- “I avoid this course as soon as I can” (*avoid the course*)
- “I would feel ashamed that others think I am not able to validate this course” (*ashamed if not able*)

Table III and table IV synthesize the results obtained respectively for the pre- and post-test. The presentation is the same as in the first two tables.

What appears in the pre-test is that the students are convinced that this course is indeed important in their curriculum: they mostly agree or strongly agree (at more than 90%) that they have to validate it, that it will be useful for later and that it is important to have good grades. Consequently, this perception also generates stress: three out of four are anxious about failing to validate the course or having insufficient grades. Also they are 90% to be curious to know more, and 70% to want to perform better than others, which indicates a good motivation in attending the course. However, this last point is mitigated by the fact that one out of two considers the course as an inescapable chore and looks forward to get rid of it. Finally, students are quite evenly distributed with respect to the concern about the others’ perception (*ashamed if not able*, *afraid of laughs if failing*).

If we now look at the post-test, and compare it with the

TABLE III  
APPRECIATION ABOUT THE C LANGUAGE COURSE IN THE PRE-TEST

Appreciation	SD <sup>a</sup>	D <sup>b</sup>	A <sup>c</sup>	SA <sup>d</sup>
have to validate	5%	5%	40%	50%
useful course for later	0%	5%	55%	40%
important to have good grades	0%	10%	50%	40%
curious to know more	0%	10%	55%	35%
anxious about failing	5%	20%	40%	35%
ill at ease with low grades	5%	20%	40%	35%
want to do better	15%	15%	40%	30%
like to have recognized abilities	0%	10%	65%	25%
ashamed if not able	35%	15%	30%	20%
in keeping with values	5%	10%	70%	15%
helps me to give the best	5%	30%	50%	15%
afraid of laughs if failing	30%	30%	25%	15%
power to improve society	5%	25%	60%	10%
pleasure in learning	10%	30%	50%	10%
obliged to undergo	10%	35%	45%	10%
look forward to end	10%	45%	35%	10%
waste of time	35%	35%	20%	10%
avoid the course	40%	35%	15%	10%
inescapable chore	20%	30%	45%	5%
oppose if imposed	20%	40%	35%	5%
annoyed because imposed	30%	35%	30%	5%
don’t see the point	30%	60%	10%	0%

<sup>a</sup>strongly disagree

<sup>b</sup>disagree or weakly disagree

<sup>c</sup>agree or weakly agree

<sup>d</sup>strongly agree

pre-test, we can try to identify what was most impacted by the coaching on Emotional Intelligence. In terms of *strong agreement*, what has increased most significantly is the perception that this is a useful course for later (+30.5%) and that it may have the power to improve society (+31.1%). For the usefulness criterion, it is a simple transfer from a simple *agreement* to a *strong agreement* whereas for the society improvement criterion, it also comes with a decrease in the *disagreement*. The proportion of students strongly agreeing that they are eager to perform better than the others also raised by 17%. At the other end of the scale, the criterion for which the *strong agreement* decreased the most is the fact of being anxious about not validating the course (-23.3%).

If we look on the criteria for the “global” agreement (*SA + A*), the one that increased the most is, by far, the criterion stating that they had pleasure in learning this subject (raising from 60% to 82.4%). In the meantime, other criteria strongly decreased, confirming the better perception of the course: the perception that it was an inescapable chore decreased by 32.3%, the perception that they were obliged to undergo the course decreased by 31.5%, the fact that they looked forward to not having to take this course decreased by 21.5%, the consideration that it was a waste of time decreased by 12.3%. Some of these criteria were also among the ones for which the *strongly disagree* rating increased the most: 25.3% more students strongly disagreeing that they looked forward to not having to undergo the course, 21.2% more that they would oppose those who would try to impose the course, 19.4% more that they felt obliged to undergo, 17.1% more that they didn’t see the point in the course.

In addition, criteria corresponding to a lack of confidence

also strongly decreased: 16.5% of the students ceased to be afraid of laughs if failing, 14.7% ceased to feel ashamed if others thought they were not able to validate the course, 10.3% ceased to be anxious about failing, demonstrating that students clearly gained in self-confidence. Symmetrically, they were 28.8% more strongly disagreeing that they were afraid of laughs, and 18.5% more strongly disagreeing that they were anxious about failing.

TABLE IV

APPRECIATION ABOUT THE C LANGUAGE COURSE IN THE POST-TEST

Appreciation	SD <sup>a</sup>	D <sup>b</sup>	A <sup>c</sup>	SA <sup>d</sup>
useful course for later	5.9%	0%	23.6%	70.5%
have to validate	0.0%	5.9%	41.1%	53%
want to do better	11.8%	11.8%	29.4%	47.0%
important to have good grades	0.0%	0%	58.8%	41.2%
power to improve society	5.9%	11.8%	41.2%	41.1%
curious to know more	5.9%	11.8%	47%	35.3%
like to have recognized abilities	5.9%	0.0%	64.7%	29.4%
ill at ease with low grades	17.6%	11.8%	41.2%	29.4%
pleasure in learning	0.0%	17.7%	64.6%	17.7%
helps me to give the best	11.8%	29.4%	41.1%	17.7%
in keeping with values	5.9%	0.0%	82.3%	11.8%
anxious about failing	23.5%	11.8%	52.9%	11.8%
avoid the course	47.1%	23.5%	17.6%	11.8%
oppose if imposed	41.2%	11.8%	41.1%	5.9%
ashamed if not able	35.3%	29.4%	29.4%	5.9%
annoyed because imposed	29.4%	41.1%	23.6%	5.9%
obliged to undergo	29.4%	47.1%	17.7%	5.8%
look forward to end	35.3%	41.2%	17.7%	5.8%
afraid of laughs if failing	58.8%	17.7%	17.7%	5.8%
inescapable chore	23.50%	58.8%	11.8%	5.9%
waste of time	35.3%	47%	11.8%	5.9%
don't see the point	47.1%	35.3%	17.6%	0.0%

<sup>a</sup>strongly disagree

<sup>c</sup>agree or weakly agree

<sup>b</sup>disagree or weakly disagree

<sup>d</sup>strongly agree

#### D. Results obtained in the C language course

The results described above are encouraging since students, after attending the coaching session, are globally more positive about their main disciplinary course (C language), take more pleasure in attending it, and are more confident about their own capacities. But is it enough to improve the results in the corresponding course? First, it has to be underlined that the 19 students that participated in the coaching and passed the final exam had a mean grade of 8.91, whereas the students that didn't participate had a mean grade of 10.41, which can be explained by the fact that the coaching attracted students with some methodological and personal difficulties.

Table V shows the mean grades obtained by the students at the final examination for the C language course, depending on whether they agreed or disagreed with some of the assertions in the post-test. The scale goes from 0 to 20, the higher the grade, the better. We chose to group the students into only two different groups (agree vs. disagree) because they were not numerous enough so that multiple groups are significant.

Two major lessons can be learned from this experiment. The first one is that students who are curious to learn about a subject and who take pleasure in learning get better grades. On the contrary, those who consider that the course is a waste of

TABLE V

MEAN RESULTS OBTAINED IN THE C LANGUAGE EVALUATION DEPENDING ON THE PERCEPTION ON SOME CRITERIA IN THE POST-TEST

Appreciation	D <sup>a</sup>	A <sup>b</sup>
curious to know more	6.1	10.3
pleasure in learning	6.1	10.3
waste of time	10	7.4
want to do better	8.1	10.0
afraid of laughs if failing	10.1	7.7
ashamed if not able	10.1	8.5

<sup>a</sup>disagree

<sup>b</sup>agree

time get lower grades in the end. Not surprisingly, motivation appears to be a key factor in learning. The second lesson is that self confidence is also key to success. Students who are eager to perform better than the others indeed perform better. On the contrary, those who are anxious about others' look (because they are afraid of laughs if they fail or because they would feel ashamed if others think they are not able) perform worse.

In the end, students who are both motivated by the course and self-confident about their capacities perform quite as well as the students who didn't participate in the EI coaching, which indicates that they have overcome their initial difficulties. Since the coaching help students in getting involved and motivated on the one hand, and in getting self-confident on the other hand, it is a good indication that the coaching probably helped these students in getting better grades than if they hadn't participated.

## V. DISCUSSION

There has been an extensive literature in the recent years about teaching how to program, especially to beginners [6], [9]. Lots of authors insist on the fact that learning how to program is a difficult task, with no simple nor single solution to it, and there is a general agreement that it takes approximately ten years to turn a novice into an expert programmer. [9] explains that "learning to program involves acquiring complex new knowledge and related strategies and practical skills" and that "an observation that recurs with depressing regularity (...), is that the average student does not make much progress in an introductory programming course". But despite the fact that it is a difficult task, some student still are effective. To understand what makes the difference between effective and ineffective students, "the range of potentially relevant factors includes motivation, confidence or emotional responses, and aspects of general or specific knowledge, strategies, or mental models. (...) Given that knowledge is (assumed to be) uniformly low, it is their preexisting strategies that initially distinguish effective and ineffective novices."

Said differently, one aspect that may be crucial to explain success in learning how to program may lie in the attitude with respect to learning. [2] and [3] have conducted phenomenographic studies so as to categorize students depending on their motivations in learning, what [2] call the "outcome



space”. What they found is that the less involved students are only motivated by obtaining the module, concentrating on assignments where marks are to be gained. Others concentrate on learning the syntax of the programming language in order to write programs, often by copy-pasting existing pieces of code, but with no real understanding of what they are doing. A third category tries to understand and integrate the concepts underlying the programming language, while a fourth category sees programming as a problem solving method of thinking. A fifth category finally sees programming with respect to what it is to think like a programmer.

One may think that the less motivated and the less self-confident the student, the more he/she will adopt a “surface” and pragmatic strategy, which may be efficient as long as things remain very simple, but become inefficient as soon as things become a little bit more complicated since there is no understanding of what is done. Computer science is seen, for these students, as something that is totally different from the way of thinking they are used to, and sometimes with a kind of magic character. On the contrary, if students are more confident that they can succeed, they may also be more willing to try to understand the logic of “programming thinking”, thus engaging in a deeper understanding process. Working on emotional intelligence to restore self-confidence and motivation may also enable students to shift from surface learning strategies to deep understanding strategies, thus improving their results.

Others like [7] classify students as stoppers and movers. Stoppers, when confronted to a difficulty, think that they won’t be able to find the solution by themselves and stop. Movers on the contrary will try to correct their errors by using the feedback from the computer and will keep experimenting and modifying their program until finding a solution. As [9] put it, “students’ attitudes to mistakes/errors are important. Those who are frustrated by or have a negative emotional reaction to errors are likely to become stopper”. Again the key difference between movers and stoppers, between effective and ineffective students will lie in self-confidence and the ability to control their emotions efficiently, arguing in favor of emotional intelligence coaching.

## VI. CONCLUSION

We have presented an experiment performed during the first step of the SYNERGY project which consists in studying whether Emotional Intelligence coaching improves motivation and learning for the first year students. To conduct the experiments, we have used the EVA methodology which is based on a new paradigm inspired from experimental psychology. The results show that not only the coaching improves motivation but also they positively impact the students’ perception about a specific course (programming in C language in the case of the presented experiment).

Other similar experiments with a larger student population are in progress. The results will be available within a month. If the first results are confirmed in the following experiments, it is planned to integrate the EI coaching into the training packages,

so that all students can benefit from them.

The perspectives of this work are numerous. New experiments are in progress with the same evaluation protocol. For the future experiments, the questionnaires are being prepared with the involvement of sociologists to refine the questions. We also plan to develop motivational activities to overcome some technical or academic obstacles of the courses most feared by the students. In the longer term, researchers will be able to aggregate data collected in bulk to perform meta-analyses. This will enable to identify new important reasons of students’ failures. Then, it will be possible to have another target than *motivation*. Classification algorithm could also be helpful.

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