World Academy of Science, Engineering and Technology
International Journal of Educational and Pedagogical Sciences
Vol:17, No:8, 2023

Skills Development: The Active Learning Model of a French Computer Science Institute

N. Paparisteidi, D. Rodamitou

***Abstract*—**This article focuses on the skills development and path planning of students studying computer science at EPITECH: French private institute of higher education. We examine students' points of view and experience in a blended learning model based on a skills development curriculum. The study is based on the collection of four main categories of data: semi-participant observation, distribution of questionnaires, interviews, and analysis of internal school databases. The findings seem to indicate that a skills-based program on active learning enables students to develop their learning strategies as well as their personal skills and to actively engage in the creation of their career path and contribute to providing additional information to curricula planners and decision-makers about learning design in higher education.

***Keywords*—**Active learning, blended learning, higher education, skills development.

I. Introduction

HAVING most of them with a relatively clear perception of the professional landscape, students are able to implement a curriculum vitae strategy as soon as they enter university [1]. However, even though today's school graduates often enter the labor market with a number of years of studies significantly higher than that of their parents or grandparents, they still have difficulty entering the labor market at the beginning of their professional career. The accumulation of years of study alone is therefore not enough to ensure a smooth transition to a good job [2]. The world of employment has begun to focus more on skills than on credentials and degrees. In England, a full 46% of students plan to enter permanent full-time employment and only 6% say they have no idea what their plans are after graduation. Overall, 71% of students feel that their education improves their career prospects [3]. The situation of universities with respect to pedagogical and digital transformation, although contrasted, is part of a positive overall trend and a promising context. There is a strong awareness of the issues at stake and a real willingness to implement a university ambition driven by blended-learning [4]. Digital literacy is not only knowledge and skills, but also methods that enable the individual to be an actor in the digital society. Anchoring the students in the digital dynamic means inviting them to participate in a culture and an economy based on the exchange of knowledge, on cooperation, on creation [5]. The notion of skills is then likely to underpin in-depth changes in curricula and thus regain its original meaning in the workplace [6]. As demands for citizen and workforce participation increase as a result of technological, economic, and social transformations, and in response to a rapidly changing world and new challenges, many governments have turned to education institutions to provide students with the opportunity to develop the necessary skills to thrive [7]. However, social background continues to be a key influencer of career success. Students from dominated fractions of society have a partial representation of ascension possibilities and tend to underestimate the profitability of extracurricular investments as well as the development of professional networks in the functioning of the labor market [1]. Lambert's study [1]. converges with Schleicher's data [2] on the professional plans of students from low-income and disadvantaged groups. According to Schleicher, disadvantaged students tend to have lower ambitions than what would been expected based on their academic performance [2]. From that moment on, their schooling takes on a hesitant and detrimental character.

According to Fluckiger, the parents of this generation want their children to acquire digital skills because, for them, such skills open the way to a possible upward social mobility [8]. The need for the educational system to ask itself the question of the digital skills necessary for the future citizens is part of the transformation of the cultural role of the school. Fundamental theorists believe in the deterministic role of technologies to society's transformation [9]. Some of them find that the perceptions, theories and learning methods play a decisive and deterministic role in the speed and quality of computer science learning. Students' digital literacy, its tools, its language are built outside their schooling. The question of the relationship between this digital culture of students and the university during COVID-19 pandemic, when blended learning became a necessity, stands at the meeting point of two trends: on the one hand the emergency of this digital literacy and, on the other hand, the institutional, social or commercial pressure that is being exerted so that the school integrates digital technology [7] and prepares the students for the professional world. Notably, this generation has acquired digital skills; a digital capital naturally inherited to students during their childhood and youth. The socialization of students to new technologies, as well as the involvement of teachers-researchers, are among the essential conditions that were implemented. However, students will also have to develop the personal skills to function under conditions

N. Paparisteidi is affiliated to the laboratory of Digital Methods for Human and Social Sciences (MNSHS) of EPITECH - European Institute of Technology, 22 rue Pasteur, Le Kremlin Bicetre, 94300, France and to the University of Paris Cité, in the doctoral school of Frontiers of Innovation on Research and Innovation (ED 474), 8 bis Rue Charles V, 75004 Paris, France (e-mail: n.paparisteidi@gmail.com).

D. Rodamitou is with the Université Paris Cité, 5 Rue Thomas Mann, 75013 Paris, France (e-mail: dafnirodamitou@hotmail.com).

where, for example, their physical presence will not be mandatory. Learning the tools will be a prerequisite, but at the same time students will be expected to learn to work with each other [10].

II. Methodology

In this study, we wish to investigate skills development and path planning of computer science students, in a French private higher education institution, using active and blended learning methods.

To explore our research question, we studied the experience of two classes of students, respectively in 2019-2020 and 2020-2021; the first one having consequently six months of experimentation with active learning before the transition to blended-learning, which was the case for the second.

This study consists of an investigation based on the triangulation of methods and tools [11]. Our approach combines observations, semi-structured interviews and questionnaires distributed to the entire student population. We also had access to the school's internal databases, which allowed us to cross-reference more massive educational data. The study conducted has the characteristics of a monography, as we chose a specific field in order to empirically verify the research hypotheses [12].

The observations initially took place, for a total of 410 hours, on the premises of several of the EPITECH's campuses between June 2019 and October 2022.

Ethnography is based on an empirical approach that involves the immersion of the researchers in order to study in detail institutions, communities, situations, interactions, and individual and collective behaviors [13]. However, during the pandemic, we were confronted with the need to make the observations virtual. We thus had access to both dense and varied data (comments, chats) and this over the long term. Consequently, the *Teams* and *Discord* channels were designed from this perspective as a set of social microcosms, miniature replicas of the campuses we were invited to explore [14]. Our virtual involvement allowed us to understand the context of the programs, to see elements that might otherwise be unconsciously missed, that participants might not speak freely about in interview situations [11].

In addition to these observations, we conducted 88 semi-structured interviews: 39 with first-year students (E), 26 with teaching assistants (P) and 20 with members of the educational administration. They also submitted a questionnaire to all first-year students at the school, for which they received 519 responses (28.08% of all of the students).

III. Results

A. Developed Skills

The development of skills-based curricula has become a rule in recent years in France. EPITECH has been working for a long time on a curriculum that will allow students to develop technically, professionally and personally.

EPITECH is trying to implement an academic program that enables students to grow professionally and personally, to develop complementary skills in order to better understand other disciplines, communicate and work together [15]. Communication can be defined as the process of exchanging information, ideas, or attitudes between a sender and receiver *through a common system of signals, symbols, or behaviors* [16]. Through communication, people transmit emotions. Communication as inevitable, since non-communication also conveys a message [17].

Fig. 1 Non-violent Communication Course (Discord Channel)

Today, the specific requirements to be covered are well identified thanks to the different tests that could be undertaken [15].

During the admission interviews, candidates take tests (*They found an online test that can detect these kinds of skills in the student*, 26.11.2019) that will evaluate their skills. Reasoning questions (*during the recruitment of students*, 25.11.2019) and team spirit are fundamental criteria for the students who apply.

EPITECH's pedagogical program also relies on the development of students' soft skills. That is to say, non-technical, inter- and intra-personal skills, complementary to hard skills (technical skills; know-how). Soft skills are defined as "intra- and inter-personal (socio-emotional) competencies that are essential for personal development, social participation and success at work (...)"[18].

The team in charge of the curriculum design ensures that curriculum activities enhance students' soft skills.

> "So I give them a mind map - network - it's telecommunication; once they're prepared, they take the quiz and then they get to do the pitch on an innovation

topic. It's not that they're happy, but you have to have relays at all levels, to continue to say that if we bother you with a pitch, it's to tell you that a quiz is not enough for you to improve your skills" D13.

The skills developed through the EPITECH program correspond to skills that range from the more general, such as time management (*I learned to manage my time differently*, E13), to more specific skills, such as team management (*they train us to be good managers rather than developers*, E5). As the students tell us, there are other skills they were able to develop, such as concentration (E38), determination and organization (E30, E37, E39).

In addition, in the pedagogical program there are compulsory modules (*Are obliged to do TEPITECH*[3], D5) to be followed such as English and professional writing. The pedagogical teams want the students to be able to face the professional reality at the end of their studies (professional integration) as well as during their studies (internship), without forgetting that the acquisition of a foreign language is a necessary tool for the international mobility of the students. In addition, project presentations that are taking place in English receive a bonus (*they get one more point if they do the presentations in English*, 13.09.2019). During the professional development, students also learn how to do promotion (*to sell a product*, P2, *customer relations*, E36), send professional emails and organize meetings (*to send a professional email with very precise indications and also add an agenda*, 26.11.2019). Here are some student testimonials:

"There are oral workshops that allow us to focus on speaking, there are the pro writing courses that allow us to practice professional skills: emails, letters [...] and I personally practice the whole communication part, the social part" E2.

The interviews carried out revealed that students tend to be grateful for the learning model adopted by EPITECH. Indeed, the latter allows them to develop not only computer skills but also what is called soft skills, i.e., behavioral abilities relating to transferable know-how and interpersonal skills, going far beyond the field of computer science, for example, speaking in public, writing a letter or an email to a colleague or a client (E1, E7). The list of soft skills includes the following: work ethic, courtesy, teamwork, self-discipline, self-confidence, compliance with standards and language skills [19]. Students did not hesitate to compare EPITECH to other schools (*I have much more technical skills than them*, E4) and rejected traditional teaching practices (*I can't see myself going back to lectures*, E6).

"As a result, as soft skills, we have to learn to vulgarize our expertise so that everyone understands. In fact, for soft skills, there is teamwork, mutual aid, soft skills like that, which we can acquire if we want to. We can develop them ourselves" E1.

"I couldn't see myself finishing my studies in a traditional university, because in the amphitheater, we listened for hours to what they told us, and we had to go home and learn it by heart and then take midterms. But here we do this all year long" E10.

Through the activities proposed by their curriculum, students also work on other skills such as speaking, presentations, storytelling, decision making, and analytical and inculcation skills (*now I understand much faster and I can reproduce*, E16) and recognize their usefulness for the future (E8).

"Your problem statement should be written clearly from the first slide. For me this is very important in the presentation. You start with storytelling. On the pitch you will definitely gain points" 04.09.2019.

One of the pedagogical directors tells us that the main objective to be reached during the first year of study is more related to the development of skills than to the development of techniques (D5). The goal is to acquire personal skills that will set the stage for students to acquire technical skills later on. More specifically, the first year at EPITECH allows students to communicate their knowledge and explore their learning mechanisms.

The technical progress of the students is a parameter to be looked at in the long run. More specifically, students will focus on learning the C language, which begins with the pool (E31, E39, D13):

"I know how to develop in C language and in Python" E31.

In addition, the skills that will allow students to enter the professional world are also of interest to EPITECH's pedagogical departments. The project-based learning (PBL) which is a pillar of EPITECH's pedagogy, allows students to develop learning strategies, to actively engage in the creation of a product, to use their knowledge and previous experiences and to explore the professional reality to which they aspire [20]. Among the students we also see a recognition of the need to acquire soft skills to insert themselves into the professional world but also to initiate themselves to the search for a job (E1, E5, E7) starting with searching for an internship (E2). For some of the students, programming itself is seen as the primary tool that will ensure them a job, which is reinforced by their perception of EPITECH as a school with a good reputation:

"The fact that we come 40 hours a week and especially at hours around 9 am etc. already adapts us to the rhythms of work because I think it is quite common to come at 9 am and leave at 6 pm in companies" E5.

"We do CVs, we do sales, we do code, but we also do a little bit of everything that connects us to the company, everything that will be useful to us" E39.

During the observations we were also able to distinguish moments during which the management team invited students to be trained in a skill or to apply for a student job as for example at EPITECH Marseille (6/4/2021) where we see that the director invites students to join the team of EPITECH Regional Assistants, and thus occupy a position where they will mentor younger students. At the same time, Career Days (7/04/2021) are proposed to students in order to connect them with the corporate world. These activities are also proposed remotely given the sanitary context related to the COVID-19 pandemic.

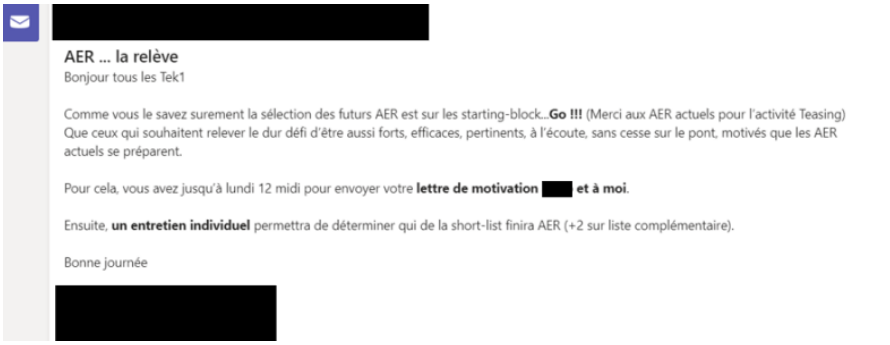

Fig. 2 Call for assistant applications (Microsoft Teams channel)

Fig. 3 Career Days Post (Microsoft Teams platform)

Fig. 4 Business game (Microsoft Teams platform)

Further on, we see that the pedagogical direction of Toulouse invites the students to immerse themselves in the world of *virtual enterprise creation* (12/05/21) and to develop their skills in management, decision making, conflict management, finance, human resources management, etc.

Afterwards, we also received a testimony from a pedagogical

director where we see that the director has organized days dedicated to teaching students to adopt a correct body posture, to choose the right ophthalmic equipment and, at the end, to use tools that will help them avoid back problems, a problem most often linked to the jobs of people using computers on a daily basis:

"A physiotherapist at the school during the first week of school, [...] an ophthalmologist, we are training people who will work for 30 years on computers sitting on desks [...] because the biggest health problem of the century is back pain.

The physiotherapist tells you or makes you work on the gym ball [...] so you can work your deep muscles, especially the abdominal and lumbar muscles, which will allow you to support your back and have a better posture" D20.

The quantitative data also give us a chance to study the topic of skill development before and after COVID-19 in depth. In the questionnaire, we asked students about the skills they had developed during this time. For each of the following five skills*: Creativity and Innovation, Initiative Taking and Leadership, Abilities to Integrate into the Learning Program, Mastery of Study Objectives, Analytical and Synthesis Skills*, they were asked whether or not they agree that they have acquired the skills in question.

In 2019, 83.8% of students had developed their creativity and innovation versus 85.8% in 2020. Regarding initiative and leadership, 89.2% agreed in 2019 had developed it versus 87.1% in 2020.

Intuitively, WE can say that there has been no significant evolution during these years. This is confirmed by the p-values we calculated to measure the independence between the acquisition of skills and the year of study. All p-values are above 40% and therefore very high. We decide not to reject the hypothesis of independence and therefore conclude that the results have remained stable between the years.

IV. Professionalization

A. Future Perspectives

The percentage of young adults between the ages of 18 and 25 years who have a concrete professional goal in mind when choosing their career path in France is 57% according to a 2018 study [21]. Students mention that their choice of discipline was a result of both available job opportunities (*they are people who are fully committed to their studies, and this is reflected in their careers*, D20) and the job opportunities that EPITECH can provide them because of its good reputation (*EPITECH's reputation is too important if I really want to find a job 100%,* E39). Searching for an internship and also the importance that EPITECH gives to internships and companies (*the fact that there were many companies also attracted me*, E37), is also an element that appears in the interviews:

We observed in our interviews that EPITECH's degree is important both for the students and for the school's staff (E1, E4, E5, E8, E34, P2, D5). More specifically, one tutor (P2) mentions that 80% of EPITECH interns at the end of their studies are recruited by the companies where they do their internship and that the school competes with the remuneration received by students from the major engineering schools in France (*the other universities don't like it because an EPITECH student ends up earning the same money as the students who studied to be an engineer*). This positioning is reinforced by the testimony of the D5 director, during which he states that his students are "in a strong position in the job market" and that they are in most cases "recruited after their third year". The recognition of the school is also omnipresent from the moment students search for internships (E4, E8):

"There are companies that ask for students only from EPITECH, that specify the school" E4.

"So for the internship and also for recognition, the school's reputation is essential" E8.

The last word from an internship manager also confirms the students' testimonies regarding the willingness of companies to recruit EPITECH students:

"We would be delighted to receive other EPITECH students" (company internship manager) 25.06.2019

It is being emphasized that the skills acquired at EPITECH are helping most of the students to project themselves towards the international scene (E8, E26, E29).

"Being able to move, live in Canada, become a citizen and therefore have Canadian nationality and work in IT there" E2.6

"A reputation on the international scene" E29.

The spirit of freedom and autonomy that the students develop through the active learning process is also reflected in their desire to follow a professional path that will allow them to contribute to this perspective by working remotely, by traveling (*working while traveling, working abroad, changing countries regularly*, E35) and by working as digital nomads (*that is to say, a person who travels, who works just from everywhere*, E2). The students underline the desire to choose a professional path in accordance with the EPITECH learning approach (*the flexibility of time - the job I would choose is a bit like school*, E32). That is, independent and flexible work. They also consider self-entrepreneurship for reasons of independence and economic benefits as well as starting their own business (*my goal would be to create something, to have a nice business that works well and is operational* E8, E38). Many students choose to start their careers as students. They often start as early as the third year at EPITECH (*Several choose to be Freelancers*, D5). On the other hand, other testimonies go in the opposite direction of how EPITECH's learning model works. These students are thinking of having a job as an employee in a company (E36, E32) because it would bring them stability and because they would not feel sufficiently secure as a self-employed person. Stability, the reputation of the company, the possibility to save money and to live in good conditions are the elements mentioned in the following interviews:

"The stability of the thing- then the notoriety of the company" E30.

"You have to have a job, to be able to live well and have some money on the side" E6.

The participants mention different professions as the goal of

their professional project: management (E7), web and application development (E1), video game developer (E2, E16, E33, E34), software developer (E10), cybersecurity (E30, E31, E39), robotics (E4), and artificial intelligence (E29). One student would have commented that the work of a developer requires little effort (A good developer is lazy fenian, 09.12.2019). This raises questions about some students' choice of professionalization for the effort-reward pay-off. One student says that he will choose a job he enjoys (E1):

> "I prefer to find a job that I like, where I will really enjoy going to work, rather than finding a job, which pays better with a better position. Being happy at work, I think that's the most important thing" E1.

Currently, students are starting to prepare their resume presentation with online tools such as LinkedIn to facilitate their job search. Students sometimes make the following kind of comments about their life or profession:

> "The students in the next group are talking about LinkedIn. They have created accounts and are adding each other. Students are interested in developing their online profile in order to find an internship/start their professional life" 11/26/2019.

B. Internships

All students complete internships during their studies. The internship is part of the EPITECH curriculum:

> "They do a technical internship at the beginning of the second year. During the first year, they only did C and then it is difficult to find an internship" D5.

Technical experiences provide them with new skills needed in the professional field and help them reach a certain professional maturity (*they leave, they are kids, they come back, they are adults*, P11). During the following extract, we observe a member of the pedagogical direction encouraging and advising the students in their research of internship by encouraging them to remain optimistic. Another member of the pedagogical team also mentions his positive position in the students' internship search (*it went well because we found internships*, D19):

> "If you are an intern, it's normal not to have basic skills and the guy hiring you knows it. Just shows that you are able to learn to do stuff. They want to know if you are motivated. Don't be naive, they are not looking to nail you down. It's also interesting to learn how to do things you don't know how to do" 24.07.2019

V. Conclusions

In active learning, knowledge is built by the student, through the actions he or she performs on the objects. PBL proposes the development of critical thinking, projection and anticipation skills. It is considered as the harmonious marriage between theory and practice, as it sets up conditions for emancipation and creativity, which are generally rewarding for students [20]. Finally, students believe that their learning experience at EPITECH, and the title of the school they will obtain, will help them acquire the necessary skills to access the job market and to accomplish their dream. We observe that students are aware of the hard and soft skills that the job market requires today.

Students' discouragement is often due to daily problems related to their efforts to meet the demands of their studies as best as they can. Students' interest in computer science is very present as highlighted by our quantitative data analysis. During this analysis we have seen that the problems of the students derive also from their will to assure a level that will allow them to insert themselves professionally. In this phase, the students are in search of their path as individuals and citizens. The support of their school is an important factor in the construction of their identity and their ability to meet the demands of their studies.

The students feel confident and optimistic about their professional integration as they value the EPITECH degree and consider that the school has offered them a plethora of soft and hard skills at the same time, skills that they will be able to mobilize in the future.

Acknowledgment

The authors gratefully acknowledge the financial aid of the Doctoral school 474 Frontiers of Innovation on Research and Education, Université Paris Cité and EPITECH – European Institute of Technology.

References

[1] Lambert, A. (2010). Le comblement inachevé des écarts sociaux. Actes de la recherche en sciences sociales, pp. 106-124
[2] Schleicher, A. (2019). PISA 2018 Insights and Interpretations. OECD. p. 41
[3] Payne, L., & Watkins, N. (2008). NUS Student Experience Report. GFK.
[4] Dulbecco et al., 2018, p. 71 Dulbecco, P. C.-G. (2018). Les innovations pédagogiques numériques et la transformation des établissements d'enseignement supérieur. IGAENR.
[5] Pène, et al., 2014 Payne, L., & Watkins, N. (2008). NUS Student Experience Report. GFK.
[6] Audigier, F., & Tutiaux-Guillon, N. (2008). Compétences et contenus. Les curriculums en questions. De Boeck
[7] Reimers, F. M. (2020). In Search of a Compass to Chart an Education Path During and After the COVID-19 Pandemic.
[8] Fluckiger, C. (2015). Cordier Anne. Grandir connectés. Les adolescents et la recherche d'information. Revue Française de Pédagogie, pp. 107-108.
[9] Nawaz, A. &. (2010). Digital literacy: An analysis of the contemporary paradigm. Journal of Science and Technology Education Research, 19-29.
[10] Garcia, S. (2003). Croyance pédagogique et innovation technologique. Le marché de la formation à distance au service de la « démocratisation » de l'enseignement supérieur.
[11] Cohen, L. M. (2008). Research methods in education. London and New York: Routledge.
[12] Albarello, L. (2011). Choisir l'étude de cas comme méthode de recherche. De Boeck. Récupéré sur http://hdl.handle.net/2078.1/140043
[13] Jouët , J., & Caroff, C. (2013). Chapitre 7 - L'observation ethnographique en ligne. Dans C. Barats, Manuel d'analyse du web en Sciences Humaines et Sociales (pp. 147-165). Armand Colin.
[14] Berry, V. (2012). Ethnographie sur Internet: rendre compte du « virtuel ». Les Sciences de l'éducation - Pour l'Ère nouvelle, 35 - 58. Récupéré sur https://www.cairn.info/revue-les-sciences-de-l-education-pour-l-ere-nouvelle-2012-4-page-35.html
[15] Da Cruz, A., Leroux, M., Tran, L., VanoIi, L., Bret, C., & Glikmann, A. (2020, Juillet 28). Comment Epitech a aidé des TPE-PME pendant le confinement.
[16] Babiniotis, G. (2002). Dictionary of the Modern Greek Language. Athens: Centre for Lexicology. p. 650
[17] Kantas, A. (1999). Organizational-Industrial Psychology. Part 3, Team Processes-Conflict-Development and Change-Culture-Professional Stress. Athens: Ellinika Grammata.

[18] Kechagias, K. (Ed.) (2011). Teaching and assessing soft skills. Neapolis: 1st Second Chance School of Thessaloniki.
[19] John, J. Study on the Nature of Impact of Soft Skills Training Program on the Soft Skills Development of Management Students (September 17, 2009). Pacific Business Review, pp. 19-27.
[20] Menard, L., & Saint-Pierre, L. (2014). Se former à la pédagogie de l'enseignement supérieur. Collection Performa.

Nefeli Paparisteidi is a PhD researcher in Sociology and Education science at the laboratory of Digital Methods for Human and Social Sciences (MNSHS) of EPITECH in France and she is affiliated to the University of Paris Cité, in the doctoral school of Frontiers of Innovation on Research and Innovation (ED 474). In the past few years, she has been conducting research on the sociology of education and managing education and training projects. Her areas of interest are: blended learning, ICT, student experience, active pedagogy, teacher training, and education policy.

Dafni Rodamitou is an education coordinator at the Université Paris Cité in France with professional background as a Montessori teacher-pedagogue and academic background in Education Sciences, Philosophy and Education Leadership & Management (M.Sc). Scientific areas of interest: philosophy of education, politics of education, lifelong learning, active pedagogies, soft skills development and leading change.