

Transforming a Course with a Traditional Evaluation into a Competency-Based Assessment Approach: a Practical Experiment

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Abstract—This innovative practice work-in-progress paper presents how a course with a traditional evaluation method has been concretely transformed into one following a competency-based assessment approach. This transformation has been carried out in the context of the COVID-19 pandemic and therefore also included a set-up for remote education.

Transforming a course from one pedagogical device to another one is not easy. This paper explains how the transformation has been carried out, for several aspects: schedule, activities, course material, communication, etc. The transformation mainly aims at improving the quality of students' evaluation and their learning experience, making it more personalised and individualised. It expects to improve students' involvement and offer them a way to better manage their own time and to gain autonomy.

This paper presents the experiment that was carried out and reports on the results from the students' and teachers' perspectives, based on qualitative and quantitative data collected with a survey. It concludes with lessons learned, improvement directions and ideas for future editions of the course, should they be organised on-site, online, or following a hybrid approach.

Index Terms—Competency based assessment, Evaluation, Course transformation

I. INTRODUCTION

Proposing a precise way to evaluate students is not an easy task [1], [2]. Often, the evaluation process is perceived by students as a boring and stressful activity [3], [4]. Teachers see it as an obligation to attribute a numerical mark to their students, determining whether they succeeded the course or not. Evaluations are also often based on generic and unpersonalised tests, since each student gets the same ones. Also, they generally take place at specific time in the semester and lack feedback, the only being the mark [5]. This feedback comes too late and does not allow students to understand what went wrong and improve themselves.

A possible way to improve the evaluation process is by having personalised and individualised assessments, which benefits to both teachers and students. Going from a course with a traditional evaluation approach to one with a competency-based assessment approach is one concrete solution to achieve this [6]–[8]. Using continuous evaluation instead of a single exam may help to reduce students' stress. Also, proposing a set of assessments, from which students can choose the ones they

work on, may make the evaluation process less boring. Finally, targeting acquired competencies instead of grading students with a numerical grade may make the evaluation process more transparent and may offer the opportunity to provide students with better feedback about their progress.

Transforming a course is not an easy task, in particular towards a very different pedagogical approach [9], [10]. This paper focuses on the transformation process to the competency-based approach previously developed by one of the author [6]. It presents how the transformation has been carried out for an IT development course taught to 89 bachelor students during the 2020–2021 academic year. Moreover, given the COVID-19 pandemic situation, the course also had to go from a wholly taught on-site one, into a fully remote one.

The questions which motivated this research is whether the transformation from a traditional evaluation approach with a project and an exam to a competency-based assessments approach improve: (a) teachers' confidence about the evaluation process, (b) what students acquired after having succeeded the course, (c) and students' involvement with the course. The paper brings preliminary pieces of evidence about these questions through a survey carried out at the end of the semester. It also presents the perception of both teachers and students about the transformed course.

The remainder of the paper is as follows. Section II briefly presents the competency-based assessment approach used in this work. Section III then presents how the course has been transformed. Section IV presents the experiment and the results from teachers' and students' perspective. Finally, Section V concludes the paper with future developments.

II. COMPETENCY BASED ASSESSMENT APPROACH

The main goal of competency-based assessment approaches, used in an education context, is to determine whether a person can perform a task and evaluate how well it has been done [11]–[13]. As such approach is quite common in the primary and secondary education, it only reached higher education more recently [11], [14]–[16]. A competency is defined by NPEC as “a combination of skills, abilities and knowledge needed to perform a certain task.” [17]

According to the conceptual learning model defined by the U.S. Department of Education, skills, abilities and knowledge of students are interacting to form learning bundles related to tasks they are working on [12]. Competency-based assessment is therefore a way for students to demonstrate their skills to the teacher. Assessments are integrated in the learning process, changing the focus from teachers collecting data to mark students to students willing to demonstrate what they learned.

This paper uses a practical approach to competency-based assessments from a previous work of one of the author [6]. It can be summarised as follows:

- The objectives of a course are described with a list of basic and advanced competencies. The basic ones are those students must acquire through the course and advanced ones are those for which there is an opportunity for students to work on in the frame of the course.
- A list of assessments is provided to students, each of which being associated to the list of competencies that can be worked on through the assessment.
- For each associated competency, students can earn from one to three competency stars if they succeed the assessment. To validate a competency, students must obtain at least five competency stars.

To succeed a course, students must at least validate all its basic competencies. To do so, they have to take and succeed several assessments, that is, they must prove several times that they master each competency. Students can keep track of their progress on an online platform.

III. COURSE TRANSFORMATION

This section presents the existing IT development course and how it has been transformed.

A. Context

The course is taught to second year bachelor students following a computer technology program. This program aims at training future professionals with technical knowledge ranging from electronics to programming, including telecommunication and computer networks technologies. Students are supposed to have prior basic algorithm design and object oriented notions. The objectives of the course aims at teaching students how to integrate an application development team. It covers several subjects combining project management, advanced programming notions (such as object oriented programming, unit testing and CI/CD) and collaboration tools.

B. Traditional course

The transformed teaching unit has two learning activities: a 2 ECTS theoretical part with lecture sessions and a 3 ECTS practical part. It was spread over twelve weeks with one 75-minute session for the theoretical part and one two hours and a half session for the practical part, each week. At the beginning of the semester, practical sessions consist in programming exercises covering concepts taught during the theoretical sessions. After about one month, students start a project in groups of two consisting in the implementation of a

game or a utility application. Over the semester, the exercise part decreases and, at the end, practical sessions are only devoted to the project. Course materials are made up of online theoretical resources, slides of the lecture sessions, exercises statements and INGINIOUS [18], an online platform with self-graded programming exercises. The evaluation consists in three components: the evaluation of the project, a computer-based practical exam and a paper-based theoretical exam.

C. Transformed course

What motivated the course transformation is a convergence of several factors of change. First, part of the teaching team wanted to switch from Java to Python, to better fit with the profile of the training program. Also, observations from previous years tend to show that some students passed the course without being able to develop. Some succeeded the project by letting their group partner doing all the work and some succeeded with a very good written exam for the theoretical part and a bad project. Some were also lacking several essential competencies considered off-putting (related to the analysis, unit testing and documentation) even if they succeeded the course, performing in other components of the evaluation. Finally, the need to switch to a distance education because of the COVID-19 pandemic was an additional incentive to deeply review how the course was taught. Three main steps have been necessary to transform the course.

1) *First step: Defining the course objectives:* In the first step, the general objectives described in the official course sheet are used to deduce the competencies that should be worked on. From this first list, basic competencies had to be distinguished from advanced ones, based on the following question: “*What competencies must a student who has succeeded the course have acquired?*” The remaining ones are not the main target of the course, but may be worked on by interested students. In the case of the IT development course, basic competencies were easily broken down based on the stages of a development project: analysis, design/modelling, implementation and validation. In addition to these, one competency related to Python programming and one related to the theory of project management were added.

2) *Second step: Planning the course:* In the second step, the table of contents of the course was first examined to identify which competency is worked on in each chapter. The result from this analysis was then transposed into a calendar to identify when each competency is worked on, both in the theoretical and practical parts. With the calendar defined, the preparation of each lecture session was straightforward. In the case of the IT development course, the stages of the project matched the identified basic competencies, which also facilitated the organisation of the project.

3) *Third step: Identifying the assessments:* In the third step, a set of assessments had to be identified for each competency, to ensure that it was possible for a student to obtain at least five stars for the competency. In the case of the IT development course, some of these assessments directly resulted from the stages of the project. The demonstration

of these stages by the pair of students made it possible for them to obtain some competency stars. For the competencies not covered by the project, either asynchronous assessments (quizzes or self-graded codes) or synchronous ones (work with demonstration or interviews) have been identified and proposed to the students as and when.

D. Interactions and remote organisation

Due to the COVID-19 pandemic, the course had to be entirely taught in a remote setting. The theoretical lecture sessions were given with the Microsoft Teams videoconference tool to all the students, with oral or written interactions. The practical sessions were managed with a Discord private server chat tool, using voice and text channels. The solutions to the programming exercises were presented by screen sharing. Finally, the project was also managed with Discord, with one voice and one text channels for each group. The remote setup was eased thanks to the competency-based approach used.

Students were not very active during the lecture sessions and remained silent during the practical sessions, even if they were connected. However, increasingly constructive interactions between teachers and students took place over the course of the project, especially for the evaluations. Few interactions, at least visible to the teachers, between groups of students took place.

IV. THE EXPERIMENT

The transformed course has been tested this year for the first time. There were 89 students registered to the course, 14 of whom are taking it for the second time. The teaching team consists of three people: one in charge of the theoretical course and the supervision of one of the three groups for the practical sessions, the two others each in charge of one of the two remaining groups for the practical sessions.

A. Course schedule

During the introductory session, the pedagogical device used for the course has been presented to the students. They were then asked to register on the online platform used to track the mastery levels of their competencies. Finally, they were asked to start doing quizzes and self-graded exercises. After a month, students only made a little progress and were not involved with the pedagogical device. The online platform was not yet fully functional resulting in the fact that students were not able to notice their (non-)progress. The project was then launched but students found it very difficult to get involved in the early stages because there were no formal deadlines.

After six to seven weeks, the online platform was fully functional and many assessments were made available. Students started to get involved in the project, but mostly “good” students were active. Also, students do not take much advantage of the scheduled practical sessions to present their work on assessments. Three to four weeks before the end of the semester, faced with the observation of the lack of involvement and proaction, the teacher teams asked to every student to complete a work planning for the presentation of the assessments they plan to work on before the end of

TABLE I
THE RESULTS OF ELEVEN AFFIRMATIONS THAT STUDENTS HAD TO EVALUATE ON A 5-LEVEL LIKERT SCALE SHOWS THAT THEY ARE GLOBALLY SATISFIED WITH THE TRANSFORMED COURSE.

A1	I appreciated the competency based assessment approach.	
B1	I have the feeling that I better assimilated/understood the course material.	
B2	I have the feeling that I have had a better control over my learning.	
C1	I have the feeling that I spent more time working (during the year, the revision break and the exam session).	
C2	I appreciated being able to progress at my own pace.	
D1	I have the feeling that the evaluations made with this device are more fair, leaving less room for chance.	
D2	I appreciated being able to choose the assessments to work on to prove the competencies I needed to acquire for this course.	
E1	I have the feeling that I have been better supported in my learning.	
E2	I have the feeling that this device is suitable for a 100% online course situation like the one I have been experiencing since the Covid-19 pandemy.	
F1	I regularly checked my progress on the platform to find out where I was.	
F2	I have the feeling that the platform is suitable for monitoring the evaluations	

the semester and the exam. This shocked a good part of the students and additional sessions were planned for the evaluations, in a “*run for your life*” rush mode.

B. Students’ results

At the end of the semester, seven students got all or nearly all the basic competencies (90 to 100 % of them), 28 students obtained between 50 and 90% of the basic competencies stars and 54 students got less than half of them. For the final “*exam*”, a 15-minute session with each students and a 30-minute session for each group were scheduled. After this exam, the number of students who succeeded the course reached 26 out of 89, eight students were very close and 14 of them barely started to acquire competency stars. Last year, about 37% succeeded the course after the exam.

C. Students’ perspective

To have some insights about students’ perception on the pedagogical device used, a short survey has been conducted at the end of the first semester. Table I shows the results of the 21 students who took the survey for the eleven Likert-scale questions related to the competency-based assessment approach. Since only 24% of the classroom answered the survey, it only gives a partial view of students’ opinions.

The results shows that the proposed competency-based assessment approach was globally appreciated (A1). A majority

of the students also highlighted that they had the feeling to have better assimilated the course material while having had a better control over their learning (B1 and B2). Regarding the time management, they appreciated to be able to progress at their own pace but they felt to have spent more time working compared to a traditional approach (C1 and C2). Students also appreciated the possibility to choose the assessments to work on and found that this way to evaluate is more fair (D1 and D2). According to students' perception, the transformed course was suitable for a remote setting and better supported students during their learning (E1 and E2). Finally, the support offered by the platform to monitor their progress was appreciated as students regularly checked their progress on it (F1 and F2).

The survey also contains two open questions asking for the perceived strengths and weaknesses of the competency-based assessment approach in the transformed course. The identified strengths are mainly related to the autonomy and possibility for students to work at their own pace, removing useless stress due to hard deadlines and a final exam that can be only presented once. They also highlighted the possibility to choose or to propose an assessment as a big advantage of the approach, making the evaluation more personal. The main weaknesses highlighted by students are related to the risk of procrastination leading to an accumulation of delays. Another issue raised is the fact that some students favoured this course over other from the programme. Finally, several students also mentioned that it was difficult to identify the assessments to work on when they were just missing a few competency stars.

D. Teachers' perspective

The teachers' perspectives cover four main aspects and have been identified informally by the teachers' team.

Concerning the workload, it is difficult to draw any conclusions because since it was the first edition, a lot of new material had to be prepared and the process was not optimised yet. Except that, the workload was globally quite light at the beginning of the semester since students were not asking to take assessments. From two thirds of the semester, the workload increased a lot. If one 10-minute interview session is granted per student, 300 minutes have to be planned for each group of 30 students. In addition to these five hours, interviews related to the project have also to be carried out during the practical sessions. The workload exam was not too heavy and there were no grading afterwards.

Interactions between teachers and students are interesting to analyse. They were rich and fruitful with good students because of their proactivity. These students explored new things, went further than what was requested and took the opportunity to present their external contributions. For average and hard-working students, regular exchanges made it possible for teachers to have an individual follow-up, with tailored explanations. They better understood what was expected and worked in ways to improve themselves efficiently. For non-regular students, it was difficult for them to hang up at the last minute. Teachers do not have a lot of time to develop these students' competencies, based on their work done in a

hurry and often sloppy. Finally, it is difficult for weak students to hang up if they do not start on time. However, if they try to start from the beginning, they have more opportunities to get specific feedback and to develop basic competencies, focusing on the essential.

The remote setting has had some impact on the course. The use of Discord for the asynchronous interactions related to the project eased the communication, especially the informal one. However, the interactions were less rich since students were less daring to ask questions. Classroom dynamics are less present and there were less emulation between students.

Finally, the overall quality of the evaluation seemed to be better with the transformed course. Each student having been evaluated on each competency, with a certain number of direct interactions with the teacher, the final grade better reflects the acquisition of knowledge and competencies. The pass rate is not excellent, but at least successful students are competent. For the other students, their advancement available on the platform is a clear indication of their progress. Even if they have not succeeded, they know where they are and what they have to do to succeed.

V. CONCLUSION AND FUTURE WORK

To conclude, this paper shows how a course with a traditional evaluation approach has been transformed to follow a competency-based approach. The transformed course has been tested and a preliminary evaluation shows that it has been globally accepted by the students. Also, it managed to solve the concern raised by teachers about the quality of the evaluations. However, what was difficult for the transformation is the number of assessments to provide. It is important to think ahead and identify, in advance, which assessments can be automated and which ones require an oral interview or a manual correction. Also, the transformed course involves a lot of exchanges with students, which is a good way to individualise their learning experience. It is however important to have a frame and rules to be sure that all the students play the game and are indeed working. Future ideas include improving the platform with a tool to help students planning their work and providing students with hints on what to do for those having less autonomy.

Finally, the transformed course worked pretty well in a remote setting. Quizzes and automated evaluations helped students to make progress easily at the beginning, motivating them with the first acquired competency stars. Using Discord also helps students by offering them opportunities to meet with the teachers when it suited them. However, informal interactions outside of the evaluations were not fostered by the remote setting and proactivity was difficult.

Future research direction will include further analysis of the proposed approach, in particular with the next run of the course that should be on-site, or at least hybrid. Further research will also be carried out to precisely evaluate the impacts of the approach on the evaluation quality, on students' performances and on their motivation and involvement with the course. This will be realised within a rigorous experimental setup.

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