

Students' perception of the effect of formative assessment on their learning

Mercedes Marqués Andrés, José Manuel Badía Contelles, and Gregorio Quintana Ortí

Abstract—In this paper, we analyse students' perception of their formative assessment in a Databases course. Two forms of feedback are analysed: interactive questionnaires during class time and self-assessment of lab practices. Qualitative data gathered with a survey is used to conduct a grounded theory qualitative study. Our aim is to understand those aspects of formative assessment that contribute to our students' learning. The results obtained show that students' perception is positive for both forms of feedback. Responses about what factors of formative assessment contribute to their learning fall into four categories: formative feedback, metacognitive control (reflective learning), relevant learner activity, and social learning. It is also worth mentioning that students' perception of the formative assessment has not been substantially affected by the COVID-19 impact on the learning environment.

Index Terms—Formative assessment, feedback, learning from error, qualitative research, education research.

I. INTRODUCTION

GIBBS and Simpson [1] refer to various research studies, soon to be 50 years old, that highlight the decisive influence of assessment on what and how students learn. Since assessment is key to learning, it is very important to find out those features required to ensure that the strategy followed by students leads them to learn what teachers want them to learn. The goal is to put into practice the famous quote by John Cowan: "I define teaching as the purposeful creation of situations from which motivated learners should not be able to escape, without learning or developing". In the above mentioned work, Gibbs and Simpson defined ten conditions under which assessment supports students' learning. The first three conditions deal with how assessment influences the volume, selection, and quality of learning:

- 1) Provide students with sufficient assessed tasks to capture sufficient study time. If students do not spend enough time on something, they will not learn it.
- 2) Occupy students with assessed tasks that orient them on how to allocate time and effort according to the most important aspects of the course.
- 3) Supply students with productive learning activities of the most appropriate kind (aligned with the learning outcomes).

The remaining conditions tackle the influence of feedback on learning:

- 4) Provide feedback often enough and in enough detail.

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- 5) Focus feedback on students' performance, on their learning, and on actions under their control.
- 6) Give feedback in time so that it is received while it still matters to the students, and in time for them to pay attention to further learning or receive further assistance.
- 7) Feedback should be appropriate to the purpose of the assignment and to its criteria for success. These criteria must be explicit, they need to be understood by the learners, and they need to be evident in the marking.
- 8) Feedback should be appropriate, in relation to students' understanding of what they are supposed to be doing.
- 9) Feedback must be received and attended to by the students.
- 10) Feedback should be acted upon by the students.

In the course on Databases analysed in this article, we employ two types of formative assessment that take into account these ten conditions with the aim to influence in a decisive way the involvement of students in order to improve their learning. The goal of this paper is to analyse the students' perception of how this formative assessment contributes to their learning of the subject.

When it comes to research on practices of high educational value in university teaching, Paricio [2] points out that it is necessary to get to know better about those specific activities that in each concrete subject are capable of generating higher levels of student involvement and that are particularly valuable for the development of subject-related competences. According to this author, each domain or subject will show particular profiles of engagement and, above all, will pose very specific challenges in terms of the processes that can be particularly valuable for their learning. This is why we consider that this analysis will have a relevant contribution to the teaching and learning of Databases.

The research approach used in this work follows the pragmatic paradigm by Dewey [3], focused on understanding, applying, and disseminating what works. He sees "truth" as what works at a given moment in time; absolute truths are not searched for, nor the matching of cause and effect (more usual in positivism and post-positivism, respectively). Here we aim to understand reality as it is interpreted by students, so we work mainly with qualitative data. Therefore, the research question we propose is the following: *How do the two types of formative assessment used in this course contribute to the learning on Databases?* These two types are the following: interactive quizzes during the theory classes and self-assessments of the laboratory practices.

Our article is an extension and update of the one presented at the XXVI edition of the JENUI 2020 Conference on Computer

Science Higher Education [4], which received the award for one of the two best papers of the conference and thus was invited for publication in IEEE-RITA. In this paper, we have extended the data analysis with the data obtained in the 2019-20 academic year. Also, a new section analysing the possible effects of the pandemic on the results obtained has also been added, and the literature review section has been extended.

The article is structured in the following sections. Section II reviews some previous studies related to the one presented here. Section III describes the methodology employed and section IV, the context of this research. Section V presents the results of the survey, which are discussed in Section VI. Section VII discusses the possible effects of the pandemic on the results analysed. Finally, the conclusions are presented in Section VIII.

II. RELATED WORK

Numerous articles tackle formative assessment from different perspectives, e.g. ways of carrying it out, evaluating its effectiveness or analysing its impact on the workload of students or teachers. However, fewer articles analyse students' opinions on formative assessment, methods used to carry it out, or whether it has helped them to improve their learning.

In an extensive study of student opinion at 17 universities in 51 courses in the field of sport sciences and physical activity, the authors carry out a statistical analysis of the results of a questionnaire [5]. Their conclusions indicate, among other things, that formative assessment systems are perceived positively by students. In the field of engineering, a study that was carried out in four degree programmes at seven universities analyses the students' opinion of how they are assessed and the usefulness they give to each type of assessment used [6]. However, most of the types of assessment studied do not correspond to formative assessment. Their authors note that students frequently value the strategies more often used, such as projects, exams, and reports, although the reason for this consideration is not clear.

In the field of engineering, we found another study that employed a survey to analyse the students' opinions on the teaching and assessment methods used in a course [7]. The most highly rated aspects include those that require greater involvement and interaction with the students, such as continuous assessment. Another study also uses a continuous assessment model that provides fast feedback to students and has a similar cost to traditional assessment [8]. This study shows that 91% of students consider that continuous assessment has helped them to keep up with the course and 81% consider that it has helped them to pass the course. However, the model does not seem to have many formative components and seems to be aimed to help students to keep their work up to date and to avoid the final exam. In a third study, also in the field of engineering, two different assessment methods are used in two groups of students in the same course. In the first one, lab practices are assessed in a more traditional way using weekly laboratory reports prepared by the students, whereas in the second one, they are assessed using online questionnaires with automatic responses that provide immediate feedback [9]. Feedback from students revealed statistically

significant differences in favour of the second method in both academic results and student satisfaction.

In several studies, students were asked about one of the two types of formative assessment used in our course, but we have not found any studies in which students were asked about both at the same time. For example, some studies have found that separating the summative and formative aspects of continuous assessment allows students to keep informed at a reasonable cost to teachers [10]. A system of self- and co-assessment can be used for this purpose. Students indicate in a survey that they perceive the self-assessment as something positive, as it allows them to keep informed in a timely manner.

Like this paper, two other articles surveyed students' opinions on the use of assessment tools such as Kahoot! (kahoot.com), collected through semi-structured interviews [11] and open-ended questionnaires [12]. Both studies conclude that students perceive that the use of these tools improves the quality of learning, especially because it improves the dynamics of class development, their involvement, their motivation, and their learning experience. Whereas the first study highlights its usefulness for creating a gamified teaching environment, the second study uses Kahoot! as a tool for detecting what knowledge needs to be reinforced during the classes.

III. METHODOLOGY

The methodology employed in our research is based on the grounded theory. This theory was one of the first ones to rely on the use of qualitative data in the field of social research [13]. It was defined in a work by Glaser and Strauss in 1967 entitled "The discovery of grounded theory: Strategies for qualitative research". It has since been described as a general methodology for developing theories based on systematically collected and analysed data. Unlike what was usual in educational research, where existing theories were used to analyse the data, within this methodology the theory is generated from the available data.

Our work does not intend to establish universal judgements, but to find out how the practice carried out in this course contributes to the students' learning, for which a survey has been used in order to collect their perception. The data obtained have been coded into categories in order to find out in detail what the students perceive as helping them to learn. To give a more complete meaning to each category, the characteristics that Biggs and Tang attribute to a good learning environment [14] were used: metacognitive control (reflective learning), being active, formative feedback, motivation, interconnected base knowledge, social learning, and quality teaching. Table I shows the four categories identified when coding student responses and their definition based on the characteristics they fit on.

IV. CONTEXT

Two types of formative assessment are used in our course on Databases:

- 1) In the theory sessions, questionnaires are done by using an online interactive response tool.

TABLE I
DEFINITION OF THE CATEGORIES IDENTIFIED.

Category	Characteristic and description
FEED	Formative feedback. It is provided during the learning process to help the students to know how they are doing and what they need to do to achieve the required learning outcomes. Feedback can be given by the teacher, by peers, or by the students themselves. An important part of the feedback is to use mistakes constructively. Mistakes are very important as learning opportunities, so feedback is essential.
GOAL	Metacognitive control (reflective learning). Students should have opportunities to reflect: How am I doing? Am I making mistakes? Is there a pattern on my mistakes? If so, how can I avoid them? Is there a better way to do it than how I am doing it now? It is very important to help the student to learn to reflect.
ACT	Being active. We learn by activating our senses; the more senses are activated, the more effective the learning is since the senses are reinforced. What we learn is stored in three different memory systems: procedural memory (we remember how to do things, we learn actions), episodic memory (we remember where we learnt things, pictures are stored), and semantic memory (we remember statements about things, we learn verbal sentences about knowledge). The contents of the procedural memory is more easily recalled, whereas the contents of the semantic memory is harder to be recalled. For this reason, it is easier to remember what is learnt by doing things, even though if it is a declarative learning.
SOC	Social learning. Promote environments in which students learn from each other. Working with others broadens the view of the subject, helps to see that other peers see things in a different way, which provokes reflection on learning and on the interpretations that are made. Therefore, the view on what is learnt can be broadened as more insights are gained.

2) In the practice or lab sessions, students' self-assessment is employed.

Next, we describe how the theory and practice sessions are organised to show how both types of formative assessment are used. In addition, we indicate how the conditions set out by Gibbs and Simpson [1], under which assessment supports students' learning (described in Section I), are achieved.

A. Formative assessment in theory sessions

Each week of the semester there is a two-hour theory class session. These sessions are based on a flipped classroom model [15]. Previously to the class, students must acquire the concepts that will later be worked on in the classroom. To do so, they have the course's textbook, videos in which exercises are solved, and an assignment to carry out. The assignment has three sections: objective, what-to-do, and exercises. The first section states the objective by briefly describing the content to be worked on, and the learning outcome to which the assignment contributes. The second section, titled what-to-do, lists the tasks for the students to do, always starting by reading certain sections of the textbook. It also provides the list of concepts to be worked on through the reading, which are the ones the students should try to understand, and provides links to the recommended videos, where exercises are solved using the concepts of the assignment. Finally, the third section contains the exercises to be done. These exercises are aimed to apply the concepts previously studied and serve to check their understanding, so that most of the doubts and questions arise when doing the exercises. This is how conditions 1, 2 and 3 proposed by Gibbs and Simpson are tackled in order to carry out a continuous assessment that contributes to learning [1]. Figure 1 shows one of the assignments carried out before the classes, which follows the structure described above.

As can be seen, the statement of the assignments clearly and concretely defines the objectives, which corresponds to the notion of feed up in Hattie and Timperley's model of effective feedback [16]. This model identifies the properties and circumstances that make feedback effective for learning,



Actividad 2.1. Consultas simples: SELECT, FROM, WHERE

Objetivo

Usar la sentencia SELECT para realizar consultas simples sobre una sola tabla con y sin restricciones. En esta actividad trabajamos el resultado de aprendizaje *Formular consultas de recuperación y actualización de datos en bases de datos relacionales utilizando lenguajes estándar* (competencia IB04).

Qué hacer

Lee en el libro los apartados del 4.4 y 4.5 del capítulo 4. Los conceptos sobre la estructura básica de la sentencia SELECT que aparecen en la lectura, y que vas a trabajar en esta actividad, son:

- en qué **orden** se evalúan las cláusulas en una sentencia simple: **SELECT, FROM, WHERE**
- **qué** se especifica en la cláusula **FROM**
- **qué** se especifica en la cláusula **SELECT**
- qué **expresiones** se pueden incluir en la cláusula **SELECT**
- qué **utilidad** tiene la cláusula **WHERE**
- qué **expresiones** se pueden incluir en la cláusula **WHERE**

Puedes repasar los conceptos que has estudiado en el video *Consultas en SQL: SELECT, FROM, WHERE*. Después realiza los ejercicios que encontrarás a continuación. Los ejercicios trabajan sobre la base de datos del apartado 4.2 del libro. Es importante que te familiarices con las tablas de esta base de datos y que entiendas el significado de los datos que almacenan.

Ejercicios

Los ejercicios que hay a continuación trabajan sobre la base de datos del apartado 4.2 del libro.

- 1 Los **nulos** en las columnas *facturas_iva* y *facturas_afto* de la base de datos no se describe en

Fig. 1: Example of a pre-class assignment.

so that feedback should answer the following three questions: Where am I going? (What are the goals?), How am I doing? (How much progress have I made towards the goal?), and What do I need to do now? (What activities must I do to improve progress?). These three questions correspond to the notions of feed up, feed back and feed forward, respectively.

Students use the online platform, called *aulavirtual*, to submit their answers to the exercises before the class session, so that the teacher can do a quick review and adapt the questionnaire for the class. The questionnaire is developed with a special focus on the errors observed in the submissions, what is known as just-in-time teaching (jitttdl.science.iupui.edu). The aim is to generate opportunities to review the understanding of the concepts worked on and to emphasise the most common difficulties

during the class. For this reason, the answer options presented in each question are worded in such a way as to make them seem acceptable, but are based on typical misunderstandings and mistakes previously made by the students. The teacher's review before the lesson aims to identify these errors. The goal is to enable students to answer the second question of the model of effective feedback mentioned above: How am I doing? (notion of feed back).

The questionnaire is implemented with the online tool Socrative ([socrative.com](https://www.socrative.com)). Nowadays, there are many free tools available that allow the use of interactive questionnaires in the classroom, whose precursors were the clickers, also called ARS (Audience Response Systems). Tools such as Socrative and Kahoot! can be included in this category. It should be noted that the benefits of using these technologies lie in the pedagogy behind the design of the questions and how they are used in the classroom, since they are most effective when they create reflection and discussion among peers, so that constructive and timely feedback is generated [17].

Unlike the analysis carried out in the 2018/19 academic year [4], in the 2019/20 academic year, whose analysis is presented in this paper, the first seven weeks were carried out face-to-face and, after the confinement was decreed in Spain in March, the remaining eight weeks were carried out fully online.

In the face-to-face sessions, the students spent the first hour of class answering the questionnaire in the classroom using their mobile phones, tablets, or laptops. Discussion among students was encouraged before answering each question in order to put peer instruction into practice [18]. When all the students answered a question, the result was displayed and discussed in order to solve doubts, as well as explaining those concepts in which there were still misunderstandings. For this reason, although the questionnaire was short (an average of 10 questions), approximately half of the theory class session was spent on it.

The online sessions were carried out synchronously through the Google Meet platform. The correction was also carried out by using the questionnaire. However, debating before answering the questionnaire was not possible for obvious reasons. After showing the result, the dynamic was the same, as doubts were raised and explanations were given. It must be said that the students regarded very positively the way in which this teaching model adapts to online learning.

Since the questionnaire is prepared on the basis of the errors identified in the students' deliveries, they have timely and detailed feedback on their performance, putting into practice conditions 4 to 9 established by Gibbs and Simpson [1]. As for condition 10, in the case of the face-to-face teaching, there is no follow-up to check whether the students have taken any action based on the feedback, something that was incorporated into the online teaching, inviting the students to reflect on the mistakes made in the activity carried out before the class. Although this self-assessment was done on a voluntary basis, students who carried it out also rated it positively.

The second hour of the face-to-face theory classes were set up as a problem-solving session. Students solved more complex exercises in small groups, which were corrected on

the blackboard. The teacher answered groups' questions during the exercises, and also in the correction that was carried out for the whole class based on the solutions provided by the students themselves. Therefore, this part of the class also provides feedback (conditions 1 to 9) and helps to address the third question of the effective feedback model, related to feed forward: What should I do now? In the case of the online sessions, this second part was not carried out synchronously for two reasons. The first reason is that the time devoted to correcting the previous activity took up more than half of the session, as the pace of the interventions is slower: The teacher and the students must read the chat to be able to answer, organise the turn of those who intervene with a microphone, wait for the screen to be shared to show something, etc. The second reason was that by not being in the classroom, the possibility of interaction between the students and the teacher was greatly slowed down, so the students were asked to do the activity as personal work and later the solutions were provided so that they could check them.

B. Formative assessment in the practicals

Ten practical sessions are carried out in computer labs and are devoted to solving exercises on the computer that put into practice what has been worked on in the theory sessions. Previously to the class, students must answer a questionnaire to help them prepare for the practice. For example, if the practice involves queries on a part of the database that the students are not yet familiar with, or involves SQL functions that have not yet been used, the questionnaire includes questions that require the students to search information about these tables, or these functions, so that they are aware of them during the class. At the beginning of the session, the teacher reviews the answers to the questionnaire to explain possible mistakes and then the students work individually solving the exercises, although they may interact with the teacher and classmates to solve doubts. The exercises in the pre-assignment and the practical exercises allow conditions 1, 2 and 3 to be fulfilled [1].

Once the practical session is over and the deadline to deliver it has passed (usually set for the next day), the solutions are published so that students can self-assess. To this end, they are asked to compare their solutions with those published and to comment, in writing, on the significant differences found. For each difference they must tell whether it is an error or not, since the solutions are not unique and there may be differences due to alternative solutions. In case of errors, they are asked to reflect on why they have made them and why they will not make them again. Self-assessment must always be carried out within a maximum of one week after the practice (i.e. before the next session).

The self-assessment is written by the students in a shared individual document created by the teaching staff in which a pre-established template is included. Once the self-assessments have been completed, teachers review them and help students who have not identified their mistakes or who, even though they have done so, have not correctly identified the cause of their errors. To this end, they make the relevant annotations in the shared documents. Both the self-assessment and the

subsequent review by the teacher are intended to provide feedback to the learner.

Learning to correctly self-assess is not easy, so an example of self-assessment is provided. In addition, in the first two practices students are allowed to redo the self-assessment if the teacher considers that they have not done it correctly. An example of a wrong self-assessment is when the student writes: “In exercise 6, I should have used LEFT JOIN to get the correct result, and not just JOIN”. This reflection is not considered correct because the student does not show that he understands why he should have used LEFT JOIN; he has identified a difference between his solution and the official solution (a difference that is obvious), but for learning to take place he must be able to explain why his solution is not correct and what to pay attention to in the future to avoid the same mistake (for example: “I should have used LEFT JOIN because the foreign key accepts nulls. From now on I will consult the description of the tables to check if the foreign keys accept nulls and I will also look at the statement to check if the rows with nulls should be in the solution or not”).

Online lab sessions were also carried out synchronously via Google Meet. The teaching staff and students remained connected to a room for group-cast communication, and the students used its chat to ask questions. If students needed to talk to the teacher or share a screen, they were directed to another virtual room set up for individual questions.

V. RESULTS

Since this course was first taught, an anonymous survey has been conducted just after the first final exam. At that moment, students have just finished taking the final exam and have a complete view about the influence on their learning of the strategies used in the course (flipped classroom and two types of formative assessment).

The survey is usually handed out on paper. However, for the 2019/20 academic year, due to the confinement caused by the COVID-19 pandemic, both the exam and the survey were conducted online. In particular, a link to a form with the anonymous and voluntary survey was added at the end of the exam. Although we keep the survey data for every year, in this paper we only analyse the data from last year’s survey (2019/20), as the results from previous years are similar. Of the 54 students enrolled, 48 took the exam and 39 (72.2% of the students who took the exam) answered the survey.

The survey consists of a combination of multiple-choice and open-ended questions. The open-ended questions ask for justification of the choice made in the multiple-choice questions, and sometimes offer the possibility to make suggestions. Figure 2 shows the part of a student’s survey with answers related to questionnaires and self-assessment.

Since the goal of this paper is to analyse students’ perception of the influence on their learning of the types of formative assessment that are applied, we will only refer to the survey questions related to this topic. These questions are stated below.

Question 5 is related to the theory class, it has four sections:
5.1 How do you rate the use of Socrative questionnaires during the class? Possible answers are: Positive/Negative.

PRÁCTICAS

4. ¿Crees que haciendo las autoevaluaciones de las prácticas has aprendido peor, mejor o igual que si las prácticas hubieran sido corregidas por el profesorado? *

mejor
 igual
 peor

Por favor, justifica tu respuesta. *

Yo creo que es una buena idea hacer la autoevaluaciones, ya que no invierte mucho tiempo y además hay cosas que al escribirías se entienden más fácilmente

USO DE LOS CUESTIONARIOS (SOCRATIVE) EN CLASE

5.1 ¿Qué valoración haces del uso de los cuestionarios de Socrative en clase? *

positiva
 negativa

5.2 ¿Para qué te han servido los cuestionarios?

Para poder descubrir nuevos métodos de solucionar los mismos problemas y sobre todo, para pillar las trampas y cosas que en ocasiones parece que hacen lo mismo pero en realidad no.

5.3 ¿Has notado diferencia, en cuanto a tu aprendizaje, entre usar cuestionarios y no hacerlo? *

Yo creo que si no hubiera hecho cuestionarios, habría necesitado más ejercicios prácticos para darme cuenta de lo mismo. Por lo tanto, sí

Fig. 2: Example of a part of a survey answered by a student.

5.2 What did you find it useful for?

5.3 Have you noticed any difference, in terms of your learning, between using quizzes and not using them?

5.4 Do you have any suggestions for improving the use of quizzes in the class?

Question 4 is related to the lab classes and has two sections:

4.1 Do you think that the self-assessment of the lab practicals have helped you to learn worse than/better than/same as if the lab practicals had been assessed by the teacher? Possible answers are: Better/Same/Worse.

4.2 Please justify your answer.

In the online survey, all questions but 5.2 and 5.4 have been marked as compulsory. The following sections include the results of the analysis of the survey responses.

A. Perception of the use of questionnaires in theory classes

All students who answered the survey gave a positive assessment of the use of questionnaires in class. Of these, 35 answered the question “What did you find the questionnaires useful for?”. The answers provided were broken down into thematic units later classified into the four categories shown in Table I. Some answers were broken down into several thematic units as they contained multiple arguments belonging to different categories.

The categories identified are as follows:

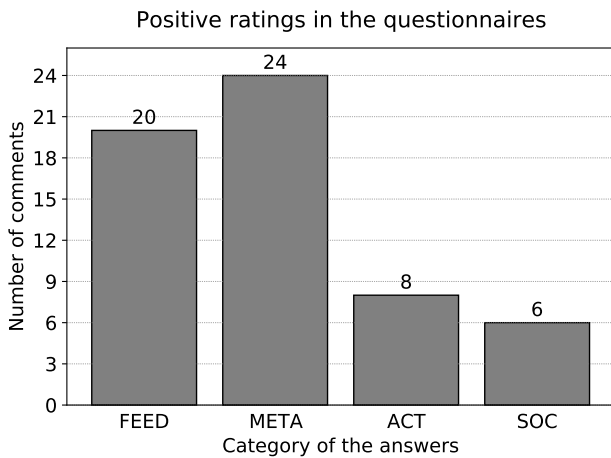


Fig. 3: Ranking of the 58 thematic units in the comments provided in 39 surveys positively assessing the use of quizzes in theory classes.

- Formative feedback (FEED category in Figure 3). This category was assigned when the students stated that the questionnaires helped them to make progress. They employed verbs such as the following: learn, improve, reinforce, understand, solve (doubts), correct (mistakes).
- Metacognitive control (category META in Figure 3). This category was assigned when the students answered that the questionnaires helped them to reflect, to be aware of what one knows and where one fails, as well as to be aware that there are different ways of solving the exercises. The answers used verbs such as the following: see (other options, mistakes), notice, realize, pay attention, compare, test yourself.
- Being active (ACT category in Figure 3). This category was assigned when the answers expressed that the quizzes made the class more enjoyable and attention was better maintained. The ACT category was also assigned when the comments were that the quizzes caused the commission of common mistakes.
- Social learning (SOC category in Figure 3). This category was given when the answers stated that the quizzes were used for discussion with peers.

An example of a response that contains multiple thematic units is the following: “They have helped me to reason with my classmates about the doubts found in each previous assignment, even if they were not mine, and they have also helped me to reinforce concepts that I was clear about but that other classmates were not so clear about”. This answer has been broken down into three thematic units:

- The part “They have helped me to reason” was classified in the category of metacognitive control (META in Figure 3).
- The part “reason with my classmates about the doubts found” was classified in the category of social learning (SOC in Figure 3).
- The part “also helped me to reinforce concepts that” was classified in the formative feedback category (FEED in

Figure 3).

A total of 58 thematic units have been identified and classified from the 35 surveys in which question 5.2 was answered.

In question 5.3, on whether they have noticed any difference in learning by using questionnaires, the answers are: 26 yes (66.7%), 7 a little (17.9%), 3 don’t know (7.7%) and 3 no (7.7%). When asked if they have suggestions for improvement (question 5.4), 13 students answered that they did not (33.3%), 19 did not answer (48.7%), and 7 answered with suggestions (17.9%). In the latter, 3 proposed adding a touch of competitiveness (knowing who is the best, competing in teams), 2 proposed spending a few minutes beforehand to remember the previous task because they may have done it several days before the class, another one alluded to the formulation of the questions and their possible answers (“Sometimes you do not know how to match your answer to the ones that come up.”), and the last one proposed being more interactive (“No, I mean maybe a little more interactivity, but that’s my opinion, not the opinion of the whole class”).

B. Perception of the use of self-assessment in the lab practicals

In response to the multiple-choice question “Do you think that the self-assessments of the lab practicals have helped you to learn worse than/better than/same as if the lab practicals had been assessed by the teacher?”, the following result was obtained: 18 better (46.2%), 17 the same (43.6%), and 4 worse (10.3%).

Among those who stated that they learnt better with self-assessment (46.2%), the following categories (defined in Table I) were identified from the thematic units that appear in the justification:

- Formative feedback (FEED category in Figure 4). This category is assigned to two types of arguments:
 - When the students stated that self-assessment helped them to understand mistakes and learn from them, i.e. to make progress. They use expressions such as: “by detecting your mistakes you assimilate better what not to do”, “we force ourselves to understand what our mistakes are and why we have made them”, “they help you to realise how to solve your mistakes”.
 - When the students pointed out that if the correction is done by teachers, they do not pay as much attention to it or it does not help them. They use expressions such as: “if you have the teacher’s correction at first, you say ‘I got it right or wrong’, but you don’t redo the practice without mistakes, and this way you do”, “many times, when other teachers correct our practices or other assignments, sometimes we just look over it thinking that this way we will see the mistakes we have made, but we don’t look at them in depth”, “most teacher’s gradings are limited to giving a mark instead of justifying mistakes and helping students learn”.
- Metacognitive control (META category in Figure 4). This category is assigned when the students state that self-assessment involves a moment of reflection. They

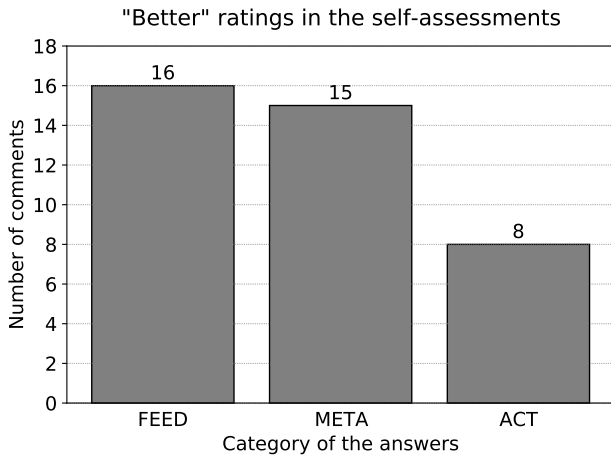


Fig. 4: Classification of the 39 thematic units identified in the comments provided in the 18 surveys that considered to have learnt better by using the self-assessment of the labs.

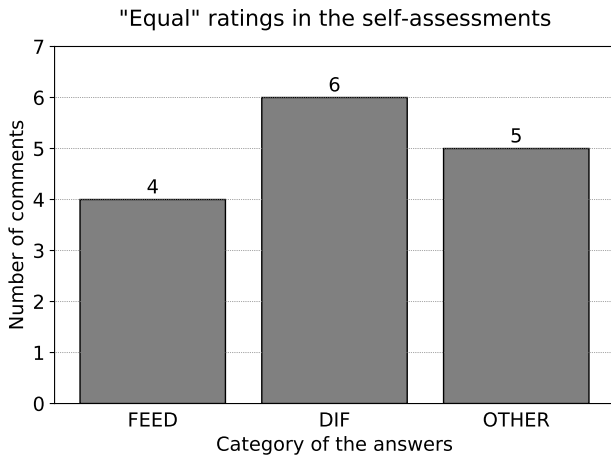


Fig. 5: Classification of the 15 thematic units identified in the comments provided in the 17 surveys that considered to have learnt the same by using the self-assessment of the labs.

employed expressions such as the following: “you force yourself to find your own mistakes”, “you reflect more and give more thought to the problem”, “analyzing your answers is a good way to focus on the mistakes”, “they help a lot to be self-critical”.

- Being active (ACT category in Figure 4). This category is assigned when the students consider it a better way of learning because more time is devoted to it or because action is emphasized. They use expressions such as: “by correcting your own mistakes, you realize much quicker why you did it wrong”, “there are things that are easier to understand when you write them down”, “it’s a good method that helps you to spend a little more time looking at the differences”.

No thematic units corresponding to the SOC category were identified since self-assessment is an individual activity.

Among those students who claim to have learnt the same with self-assessment (43.6%), the following categories were

identified in their answers:

- Formative feedback (FEED category in Figure 5). This category is assigned when the answer tells that the teacher’s explanations do not help when something is not understood (here they mean the teacher’s subsequent revision of the self-assessments), or that the errors detected were not important.
- Category DIF is assigned when there is no difference in learning (Figure 5).
- Category OTHER (Figure 5). Five comments that could not be classified in the previous categories have been included in this category: Four of them refer to the time required (for example, “I was a bit too lazy”, “a waste of time”), and the fifth (“Unfortunately, I am not the best person to answer”) corresponds to a student who did not attend the practical classes (he did not do the exercises, so he did not do any self-assessment either).

Of the 17 answers that stated that they have learnt the same, one does not include any justification and another one is incomplete (the sentence is not complete), so the justifications of 15 answers have been categorised, resulting in 15 thematic units.

As for the answers of the four students who said that they learnt worse (10.3%), the categorization is the following:

- Two of them are related to formative feedback, in terms of needing help from the teacher.
- One is related to the way of their marking and their deadlines: “This is what I forgot to do the most, and the truth is that if I have done it and then I don’t remember to do my self-assessment, I look at the solutions and I learn anyway, but it doesn’t count for my mark, I think it’s something that everyone should do for themselves”.
- One is relative to the difficulty of the self-assessment: “On many occasions the solutions were so different, either in certain parts or completely, that it was really difficult to know if they were 100% correct or not”.

VI. DISCUSSION

We now return to the focus of our research: How do the two types of formative assessment, interactive questionnaires and self-assessment, contribute to learning in our course on Databases?

The results obtained in the surveys after the final exam confirm that both types of assessment have a positive influence on learning according to students’ perception. When it comes to the interactive questionnaires during the theory classes, all the students who took the survey rated them positively. In the justifications provided by the students we discovered two of the characteristics of a good learning environment that are related to formative assessment [14]: They mainly indicate they were useful for receiving formative feedback that allows them to learn from their mistakes and to reflect on their learning process (Figure 3). In the justifications analysed, 75.9% correspond to one of these two characteristics. When it comes to self-assessment of practices, among those who say they have learnt better (46.2%), we again find these two

characteristics, in this case accounting for a total of 79.5% of the justifications given (Figure 4).

Another positive feature identified in both types of assessment is that they allow them to be active, both inside the classroom, which makes the class more enjoyable, and outside, dedicating time each week to their self-assessment.

In the case of self-assessment, about 44% of the students wrote that they learnt the same as if they had been corrected by the teacher, which shows that this type of formative assessment is positive for 90% of the students who answered the survey.

Slightly more than 10% of the students stated that they had learnt less with self-assessment, either because they felt they needed help from the teacher, or because of the difficulty involved in carrying it out. There is only one case disagreeing that not doing the self-assessment within the time limit results in a loss of marks. It should be noted here that for a practice to be awarded a mark (0.2 points of the final grade), students must correctly complete the self-assessment within the deadline. The ten practices allow 2 points for the continuous assessment, which the syllabus sets at 50% of the final grade.

VII. EFFECTS OF THE PANDEMIC

As previously stated, the results of the surveys of the different courses were similar. However, it is worth analysing the possible effect of the main changes in teaching and assessment due to the 2020 spring confinement. This affected slightly to more than half of the course sessions during the 2019/20 academic year, as well as to the way the final assessment was carried out. However, the use of questionnaires during the theory sessions did not change, nor did the self-assessment of the labs, nor the feedback received by the students. Therefore, the contents and methodology did not change, and only the circumstances did.

To assess the effects of the pandemic, we are going to compare the results of the 2018/19 academic year [4] with those of 2019/20. The total number of surveys answered by the students was very similar, including in both years a very high percentage of students attending the first final exam: 42 in 2018/19 and 39 in 2019/20.

The positive ratings of the use of the questionnaires during the classes were equally high in both years: 92.9% in 2018/19 and 100% in 2019/20. More than 70% of ratings in both years found the questionnaires useful for learning, whereas around 10% did not find them useful. Since the survey analysed in this paper was carried out using an electronic form (and not on paper, as in previous years), the responses have been substantially longer, which has led to the definition of a greater number of thematic units classified in the different categories. For example, the 39 justifications in the positive assessments to the questionnaire in 2018/19 resulted in 48 units, whereas the 35 justifications in 2019/20 resulted in 58 units.

Confinement has not influenced the students' perception of the value of the questionnaires. The vast majority of the thematic units (around 70%) have been classified in both courses in the FEED or META categories. Interestingly, the number of units classified in the SOC category has doubled in the course affected by the confinement (from 4.2% to 10.3%),

which seems to indicate that the social distance increased the usefulness of the questionnaires as a tool for interaction, as it gave rise to interventions by the students at the level of the whole group.

There were some changes in the students' ratings of the self-assessments of the labs between the two courses. The percentage of those who consider to have learnt better than with teacher's correction dropped by about 20 percentage points, whereas those who consider to have learnt the same have increased by the same amount. Comparing the surveys of both years to find out an explanation for this drop, we find that in the 2019/20 academic year the justifications given in the group of 'others' refer to issues that did not appear in the 2018/19 academic year: Four of them complained about the time or effort required, and another one corresponds to a person who did not do the self-assessments (12.8%). On the other hand, in the comments of those who found no difference, there was an increase in those who point out to be good learners, those who spontaneously already did this self-assessment exercise, rising from two students in the 2018/19 academic year to four students in 2019/20. However, those who prefer teacher correction remain at 10%.

These differences are also reflected in their perception of the usefulness of self-assessments and feedback in their learning. Among the students who consider self-assessment to be more useful than teacher' correction, the number of students who attribute this to metacognitive control (META) has dropped by 15.6 percentage points, which is compensated by a rise of 8.6 points in those who attribute it to formative feedback (FEED) and 7 points to being active (ACT). On the other hand, among those who think that they would have learnt the same as with teacher correction, the differences between one year and the next have always varied by less than 10 percentage points.

We can see that in nearly all cases the differences between the opinions of the face-to-face course and the partially online course are usually small. It is difficult to attribute these differences to a single cause, although the significant change in the teaching context may be one of the most important and obvious reasons. However, it may also be indirectly due to the fact that students gave significantly longer feedback by answering the survey via an electronic form at the end of the exam and without time constraints, rather than by writing it down on paper at the end of the exam in the classroom. The opinions of the 2019/20 academic year are more complete and more nuanced, which has made it possible to attribute their comments to more categories, modifying the effect of the data analysis.

VIII. CONCLUSIONS

The analysis of the surveys carried out in this work reinforces the conclusions of the work presented in the XXVI edition of the JENUI in 2020 [4], allowing a deep understanding of the contribution to student learning of the two types of formative assessment implemented in our course on Databases.

We can conclude that both types of assessment are well implemented since most of the students perceive that they help them to be aware of their learning, while also having formative feedback that allows them to progress.

The research methodology used in this work has allowed us to find out to what extent formative assessment contributes to creating a good learning environment, as the characteristics have emerged from the analysis of the justifications provided by the students in the survey carried out.

Finally, we have been able to confirm that the self-assessment and feedback methods that have been analysed are robust in the face of major changes in the teaching context, such as the change to online learning. The fact of having to suddenly adapt to an online environment has not substantially affected the positive opinions expressed by the students about the usefulness of the methods analysed in their learning. They can be applied in a face-to-face, hybrid, or entirely online environment.

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