Learning Management Systems Activity Records for Students' Assessment of Generic Skills

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ABSTRACT Students' acquisition of generic skills is a key to their incorporation into the job world. However, teachers encounter several difficulties when measuring their students' performance in generic skills. These difficulties increase in online courses based on learning management systems, where there is no direct contact between teachers and their students. To address this problem, this paper adopts a solution based on the use of activity records from learning management systems as indicators of the students' performance in generic skills. After conducting a survey among teachers of online courses on the suitability of the solution, an artefact was developed and applied within four online courses. Interviews conducted with teachers and the results of a survey for mapping skills and activities provide positive evidence of this solution's potential.

I. INTRODUCTION

University graduates must be competent in generic skills in order to be candidates for companies. As the executive Quinton Studer stated, "All skills are important with some being more vital for some jobs than others. Obviously, some such as communication, teamwork, integrity, etc. are nonnegotiable" [1]. The Tuning Educational Structures in Europe Programme established new approaches to teaching, learning, and assessing generic skills in practice [2], and universities have assumed responsibility by participating in international programs oriented to students' acquisition of generic skills [3].

In the last decade, important shortcomings have been found in the development of generic skills related to the job environment [4]. One challenge for university teachers is to figure out creative ways to involve students in projects that require the skills demanded by employers [5]. In this vein, there are several recent works related to the learning, development, and improvement of students' generic skills in a wide range of areas: Business [6], Computer Science and Engineering [7], Hearth Science [8], Teachers' training [9], and Tourism studies [10], among others. However, the number of papers dealing with the assessment of generic skills is much smaller than those dealing with their improvement. These approaches that address students' assessments in one or several skills have mainly focused on two issues: subjectivity and scalability.

An assessment can be considered subjective when it is based on abstracted or interpreted information provided by an observer [11]. Consequently, students with considerably different performance can have similar grades or, vice-versa, students with similar performance can have grades which are considerably different. Generally, this situation occurs when the assessment of generic skills is delegated to students in peer-assessment processes [12], [13].

Scalability problems mainly appear when teachers cannot make detailed assessments of their students' generic skills. These issues are generally due to one of the following reasons: since it adds to the teachers' daily common tasks, in some cases there is a lack of time. In other cases, it is due simply to the large increase in the number of students [14]–[16].

Learning Management Systems (LMSs) have been adopted by higher education institutions for fostering collaboration between students and teachers and providing greater learning flexibility in numerous learning modules [17]. Previous works used the information stored in LMSs' activity records to measure students' performance in generic skills [18]–[20]. However, there is not a theoretical basis that relates generic

skills and students' activity records. These works use their own interpretation of students' indicators for measuring performance in generic skills. What are the teachers' thoughts regarding this proposal? Do they consider that their students perform generic skills while they interact with the LMS modules? Therefore, the main objective of this research is identifying which students' skills are evaluable from LMSs activity records.

This work was performed at Universidad Internacional de La Rioja (UNIR), an international online university in which the learning-teaching process is carried out completely online. Following Action Research (AR) methodology [21], this research has two fundamental parts. First, teachers of UNIR participated in a survey in which they evaluated the applicability of their students' activity records in the LMS modules to assess their performance in generic skills. Secondly, teachers of four courses at UNIR assessed their students' generic skills following the results collected in the previous survey. They used EvalCourse 4 Sakai, an artefact developed to carry out this research, and were interviewed after the experience.

The rest of this paper is organized as follows: Section 2 describes the literature review; Section 3 describes the material and methods used in this work; Section 4 describes the results; Section 5 discusses the findings of the work; and finally, Section 6 presents the conclusions and an outline of future work in this area.

II. LITERATURE REVIEW
This section reviews the literature and some concepts related to the assessment of generic competences and LMSs.

A. ASSESSMENT OF GENERIC SKILLS
Higher education institutions, supported by the business sector, promote the development of generic skills in order to contribute to graduates' employability [22]. In this context, teachers must assess their students' performance in generic skills. The term assessment is used in this research to refer to the measurement of students' performance in generic skills. To know how well students enrolled in a course perform generic skills, teachers need assessment tools. These tools include rubrics and questionnaires to be used by the teacher and/or the students themselves [23].

In their research, Benlloch-Dualde and Blanc-Clavero used several questionnaires [24]. These teachers defined a series of specific activities to improve their students' generic skills that they later had to assess. Although the experience was positive from the results point of view, it should be noted that the teachers' efforts were excessive and the activities were not repeated in the future. Therefore, scalability is one of the problems that can arise if the teacher is responsible for this assessment. An assessment procedure is said to be affected by scalability problems when the number of assignments grow and the professor is not able to cope with the increase.

To avoid scalability issues, researchers often make use of peer and self-assessment procedures [7], [25], [26].

Through group work practices, students can assess their performance as a team. Garcia-Martin *et al.* [7] applied the Team Work Behaviour Questionnaire (TWBQ) in two steps: first, students assessed their own performance and second, they assessed the performance of their mates. However, previous works have shown that peer and self-assessment procedures can bring subjective issues, since students performing similarly sometimes have different grades. Carreras-Marín *et al.* [12] showed several discrepancies when assessing the same submission between the average grade given by teachers and the average grade given by students in peer-assessment for each assignment. As researchers are knowledgeable of this issue, they try to devise methods to avoid it. Staubitz *et al.* [25] designed a grading rubric to avoid subjectivity and established several peer-assessments per assignment in order to increase the probability that the average grade of students' tasks was close to the grade a teacher would assign. Chan and King [26] improved the accuracy of their peer-assessment process by leveraging students' social information. Based on the idea that students' grading bias could be affected by their friends, three probabilistic models for peer-assessment were proposed by including social connections.

B. GENERIC SKILLS PERFORMANCE ON LEARNING MANAGEMENT SYSTEMS
A LMS is a software application for the administration, documentation, tracking, reporting, and delivery of educational courses [27]. At this point, it will be difficult to find an educational institution that does not have an e-learning platform of this type for the management of its courses. Some of the benefits of using LMS for students are organization of content, access at anytime and anywhere with a computer, communication with other students or teachers, and easy tracking of their progress. LMSs are composed of modules such as wikis, exams, tasks, forums, and workshops, among others. Teachers configure and adapt these modules for their courses and students interact with these modules during their academic life.

Several articles can be found in the literature in which teachers confirm that their students perform generic skills when working on LMS modules. For instance, there is a correlation between students' activity in online forums and the grades they achieve [28]. They stated that in programming courses where forum participation is not assessed, students only posted when they needed help solving problems. In other research, Fidalgo-Blanco *et al.* used learning analytics to assess their students' performance in teamwork through their interactions in forums [19].

Learning analytics is the use of intelligent data, learner-produced data, and analysis models to discover information and social connections and to predict and advise on learning [29] Rayon Jerez *et al.* [18] proposed a solution based on learning analytics to assess several generic skills from students' activity in LMS, Google Apps for Education, and MediaWiki. Interpersonal communication, analytics

thinking, and writing skills were assessed through both students' participation in forums and comments posted in their Google Doc. Balderas et al. developed an artefact based on learning analytics techniques to retrieve evidence from a LMS to assess students' performance in leadership, self-critical, and interpersonal skills. Evidence was collected from the forum and workshop modules [20].

Can we claim that students' activity in forums is suitable to assess students' performance in the ability of problem solving and teamwork? Unfortunately, the answer to this or other questions is not found in the literature. Each work addresses the assessment of one or several generic skills, but there are no studies that specifically link the performance in generic skills and the activity performed in LMS modules by students. The main objective of this research is precisely to identify this relationship between generic skills and the work performed in LMSs.

III. MATERIALS AND METHODS

Once the literature review has been presented, two main parts remain to be discussed in this AR process. First, it is necessary to know which generic skills teachers consider to be evaluable from students' activity recorded in the LMS. Second, a tool for obtaining indicators from Sakai records was developed and applied in four online courses. Their corresponding teachers were interviewed regarding the applicability of the indicators obtained by the tool for assessing the generic skills of their students. Following Oates description [21], the features of the AR are:

- Concentration on practical issues: teachers working in their online courses based on a LMS.
- An iterative cycle of plan-act-reflect: this research can be repeated in order to refine the proposal.
- An emphasis on change: improve the assessment of generic skills.
- Collaboration with practitioners: teachers.
- Multiple data generation methods: quantitative data via survey and qualitative data via interviews.
- Action outcomes plus research outcomes.

A. SURVEY FOR MAPPING LMS RECORDS AND GENERIC SKILLS

Subjectivity is one of the main problem when assessing generic skills. When assessing for one specific skill, two different teachers can consider an activity performed by a student in a LMS quite differently.

LMSs have several modules with which students interact during their academic life. A survey was created with the purpose of determining the relationship between the activity carried out by students in these modules and the generic skills performed. This survey was planned and designed following Oates' guidelines [30] comprising six activities:

1) Data requirements. The data needed for responses to the following questions:
   - What module activity records are valid to measure students' performance in generic skills?
   - Which specific generic skills can be measured with the previously obtained module activity records?
2) Data generation method. A questionnaire was chosen as the survey method. The most suitable requirements for this option are:
   - It is required to obtain data from a large number of teachers.
   - It is required to obtain standardized data: identical questions and a range of answers.
3) Sampling frame. Population likely to be included in the survey: in this case, the list of teachers from UNIR. This is a probability sampling, i.e., the respondents are representative of the overall population being studied: teachers who supervise virtual courses.
4) Sampling technique. It is required to decide how the selection of people out of the sampling frame should be made. The chosen technique is random sampling. The questionnaire was randomly sent to 413 teachers from this university (a population of 700).
5) Response rate. 144 teachers answered the questionnaire (35%).
6) Sample size. 144 teachers represent 20% of the population. The accuracy range of this sample is $+/- 7.5\%$, with a confidence level of 95%.

The design of the questionnaire comprised two parts: a list of generic skills and a list of the LMS modules. The list of generic skills was taken from the Tuning Education Structures in Europe Project [2]. These skills are used by Spanish educational institutions when defining their syllabus. The list is shown below:

- Ability to communicate in a second language
- Capacity to learn and stay up-to-date with learning
- Ability to communicate both orally and through the written word in first language
- Ability to be critical and self-critical
- Ability to plan and manage time
- Ability to show awareness of equal opportunities and gender issues
- Capacity to generate new ideas (creativity)
- Ability to search for, process, and analyse information from a variety of sources
- Commitment to safety
- Ability to identify, pose, and resolve problems
- Ability to apply knowledge in practical situations
- Ability to make reasoned decisions
- Ability to undertake research at an appropriate level
- Ability to work in a team
- Knowledge and understanding of the subject area and understanding of the profession
- Ability to work in an international context
- Ability to act on the basis of ethical reasoning
- Ability to communicate with non-experts of one's field
- Ability for abstract thinking, analysis, and synthesis
- Spirit of enterprise, ability to take initiative
- Interpersonal and interaction skills
- Ability to design and manage projects

- Ability to act with social responsibility and civic awareness
- Determination and perseverance in the tasks given and responsibilities taken
- Appreciation of and respect for diversity and multiculturality
- Ability to work autonomously
- Skills in the use of information and communications technologies
- Commitment to the conservation of the environment
- Ability to adapt to and act in new situations
- Ability to evaluate and maintain the quality of work produced
- Ability to motivate people and move toward common goals

For each LMS module and generic skill pair, each teacher selected an option in a 5-point Likert scale regarding usability to measure students' performance in the given skill to the activity recorded in this module. The list of the LMS modules was taken from the modules available in Sakai. These modules are listed below:

- Forum
- Videoconference
- Resources and content
- Assignments
- Calendar
- Exams
- Private messages

B. PROPOSAL IMPLEMENTATION

This section is divided into two parts. First, the section presents a technological artefact specifically developed to implement the proposal. Second, it describes its application to the assessment of generic skills in a series of online courses.

1) EVALCOURSE FOR SAKAI

As indicated in the introduction, this research was performed at UNIR, an international online university that uses Sakai as its educational platform. Sakai [31] is a LMS written in Java and distributed under the Educational Community License (a type of open source license). Although Sakai provides several reports on students' activity, they are not customizable and teachers cannot propose their own indicators.

Consequently, a technological artefact for obtaining information from the LMS activity records was required to carry out this study. At first, the authors of this paper were going to use EvalCourse. EvalCourse is a software that run queries written in SASQL, a domain-specific language (DSL) intended to customize online learning assessments based on students' activity records on Moodle [32]. However, although SASQL has simple syntax and was created so that non-technical teachers could use it, its authors regretted that its complexity was one of the issues most reported by teachers who used the tool.

This led to the implementation of EvalCourse 4 Sakai (E4S). First, E4S brings a web application that replaces the
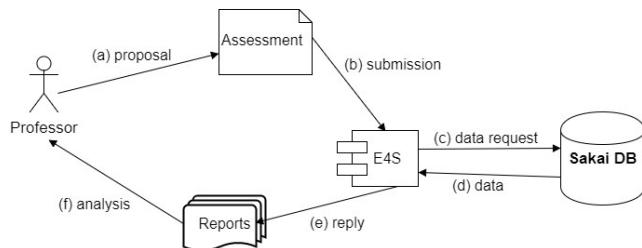

FIGURE 1. E4S use scheme.

DSL query and, second, it adapts the internal Moodle queries, turning them into internal Sakai queries. Figure 1 shows the use scheme of E4S. Teachers propose the assessment of a skill from the LMS records (a). Then, they complete and submit the form (b). E4S collects the data required from the Sakai DB (c & d). Then, E4S replies with reports that contain the information requested by teachers. Finally, it is the teachers' duty to analyse whether the information can be used as indicators of the skill under assessment.

After logging in, E4S provides teachers with a web form. In this form, the teacher must select firstly a course (since teachers may teach several courses and E4S is linked to Sakai, all their courses can be chosen). Then, the teacher must select an event. An event is an activity related to a Sakai module. For instance, a forum has several selectable activities, i.e., new messages, read messages, or deleted messages. Finally, the date range of events may also be indicated.

Upon submission of the form, a general report is provided (figure 2). In its upper area, a bar diagram displays a representation of the performance of each student in the corresponding event. In the lower area, the list of students with their numeric data representing their performance is shown, along with a button to retrieve the individual analysis of each student.
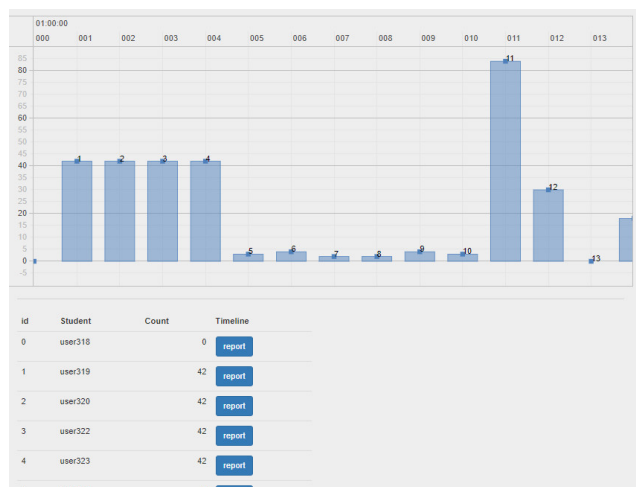

FIGURE 2. E4S report and students' activity links.

2) IMPLEMENTATION IN FOUR COURSES

The experience was carried out to evaluate the suitability of the assessment proposal obtained from the survey results. For teachers to put the proposal into practice and assess students'

generic skills, they needed to be able to obtain the activity records. For this purpose, E4S was specifically developed and applied within four online courses. The teachers who coordinated the courses were requested to use the LMS activity indicators that were best considered in the survey in order to assess their students' generic skills. Later, these teachers were interviewed.

IV. RESULTS

The results of this research are presented in two parts. First, the results of the survey for mapping LMS module records and skills are displayed. Second, the results of both the four case studies and the interviews conducted with the teachers are shown.

A. SURVEY FOR MAPPING THE LMS MODULE RECORDS AND SKILLS

144 teachers from UNIR participated in the survey. The results show positive evidence concerning the use of LMS module records to assess students' performance in generic skills.

Questions in the survey were optional because some generic skills were not very common. In order to facilitate teachers' participation, they were allowed to leave blank those skills with which they were not familiar or of which they saw no relation with a given module. Each generic skill and LMS module pair was checked with a value ranging between 1 and 5 (5-point Likert scale). Appendix presents the summary of the survey. Its highlights are the following:

- The most voted generic skill and LMS module pair was [ability to work autonomously, task], with an average of 4.67 out of 5 points and with the votes of 125 teachers. More information in table 7 (Appendix).
- 26 out of 31 generic skills were considered, to a greater or lesser degree, evaluable from the students' activity records in LMS (their averages were above 3). More information in table 8 (Appendix).
- For 19 skills, the mode was between the strongly agree or agree values, and only for 3 skills was the mode between the disagree or in the strongly disagree values. More information in table 9 (Appendix).
- The activity records of 6 out of 7 modules consulted were considered useful for the assessment of students' generic skills (averages between 3.36 and 3.81) More information in table 10 (Appendix).
- In the former 6 modules, the mode was between the strongly agree and agree values. More information in table 11 (Appendix).
- The task (3.81 out of 5.00) was the best module for use in the assessment of generic skills from its activity records. More information in table 10 (Appendix).
- The ability to work autonomously (4.18 out of 5.00) was the most evaluable skill based on all modules' activity records. More information in table 8 (Appendix).
- The independence of the responses provided by teachers based on their branch of knowledge was studied.

Fisher's exact test was used. In 211 of the 217 possible combinations of skill and module, the significance threshold was above 0.05, the null hypothesis was not rejected, and the independence of the responses with respect to the branch was accepted.

B. PROPOSAL IMPLEMENTATION AND INTERVIEWS

In order to evaluate the suitability of the proposal used in the assessment of generic skills, it was applied within four courses at UNIR. Table 1 summarizes the information of these courses.

TABLE 1. Summary of subjects.

ID	Subject	Teacher	Students
SubA	Artificial Intelligence Techniques	Teacher A	55
SubB	Web Security	Teacher B	7
SubC	Software Security	Teacher C	82
SubD	Data Analysis and Interpretation	Teacher D	28

For each LMS module, teachers extracted indicators from their courses using E4S. They were encouraged to assess their students' generic skills in each module by using the indicators best considered in the previous survey. The results collected for the 5 modules most used by teachers are summarized below: forums, videoconferences, contents and resources, tasks, and exams.

1) FORUM

The forum module is an activity where students and teachers can exchange ideas by posting comments. All teachers had forums in their courses and encouraged their students to use them. The forum reports provided by E4S gave teachers information pertaining to the number of messages, the number of answers and the number of message readings made by each student. Additionally, time stamps are provided so teachers can identify when each student carried out these previous actions. Table 2 summarizes the teachers' considerations for assessing each generic skill by using the records in this module. Most teachers considered that the information provided by E4S could be used to assess their students' capacity to learn and stay up-to-date with learning, their interpersonal and interaction skills, and their ability to communicate both orally and through the written word in first language. Only Teacher D considered that she was not able to assess students' performance in capacity to learn and stay up-to-date with learning, because the assessment required a text analysis of

TABLE 2. Answers for forum records.

Generic skill	Yes	No
Capacity to learn and stay up-to-date with learning	3	1
Interpersonal and interaction skills	4	0
Ability to be critical and self-critical	1	3
Ability to communicate both orally and through the written word in first language	3	1
Ability for abstract thinking, analysis, and synthesis	2	2

the comments made by students. Besides, Teacher A considered that even though the information provided by E4S could be used as an indicator of the fact that students are performing their ability to communicate through the written word in their first language, in order to assess the generic skill, it was necessary to know the content written by the student.

There were discrepancies regarding the use of indicators provided by E4S to assess the ability to be critical and self-critical and the ability for abstract thinking, analysis, and synthesis. Only Teacher D said that she could assess students' abilities to be critical and self-critical with the quantitative indicators provided by E4S, while the other teachers considered that the assessment of this skill required qualitative analysis. Regarding the ability for abstract thinking, analysis, and synthesis, two teachers considered that they could use forum records to assess their students' performance in that skill, while two teachers considered they could not be used without a qualitative report supporting the quantitative one.

2) VIDEOCONFERENCE

Videoconference is a module where a teacher usually teaches a class that students attend virtually. Students have an area where they can write comments and even speak using their microphone if the teacher gives them permission. Table 3 summarizes teachers' considerations for assessing each generic skill by using the records in this module.

TABLE 3. Answers for videoconference records.

Generic skill	Yes	No
Capacity to learn and stay up-to-date with learning	3	1
Ability to plan and manage time	4	0
Ability to work autonomously	3	1
Skills in the use of information and communications technologies	2	2
Ability to apply knowledge in practical situations	2	2

The information provided by E4S related to this module allowed teachers to know whether students were attending their classes. Additionally, the reports gave them information concerning not only the students that attended their classes, but also the students who later saw the recordings of the classes. They mainly considered that this information could be an indicator of good performance in their capacity to learn and stay up-to-date with learning, their ability to plan and manage time, and their ability to work autonomously.

Regarding their students' skills in the use of information and communications technologies, two teachers considered that the fact that students are having a videoconference is indicative of them having good skills with ICT, since it is not easy to install the plugins required to attend the lessons. The other teachers considered that with a quantitative report, it is not possible to know whether students are good in this skill. Teachers' responses regarding their students' ability to apply knowledge in practical situations were similar. Teacher A stated that it is difficult to assess this skill without qualitative data, but she specified that quantitative reports can be more

useful if the teacher designs the activity in a way that foments performance in the skill.

3) CONTENTS AND RESOURCES

Contents and resources refer to the material, documents, and links uploaded to the virtual course by the teacher. E4S provides information that reflects when and how many times students have downloaded contents and resources.

As seen in table 4 below, most teachers agreed to use this information to assess their students' performance in those generic skills. For the last one, ability for abstract thinking, analysis, and synthesis, two teachers stated it was difficult to assess with just quantitative information. In particular, Teacher D concluded that she would need students' feedback to actually know if they had the ability for abstract thinking, analysis, and synthesis.

TABLE 4. Answers for resources and content records.

Generic skill	Yes	No
Capacity to learn and stay up-to-date with learning	3	1
Ability to plan and manage time	4	0
Ability to work autonomously	4	0
Ability to search for, process, and analyse information from a variety of sources	3	1
Ability for abstract thinking, analysis, and synthesis	2	2

4) TASKS

Tasks are assignments that students should complete before a deadline established by the teacher. The reports provided by E4S gave teachers information pertaining to the number of tasks that students should complete, the number of tasks they completed, and when they did them.

Table 5 shows that all teachers accepted the use of the indicators for the assessment of their students' performance in their ability to work autonomously and their ability to plan and manage time.

TABLE 5. Answers for tasks records.

Generic skill	Yes	No
Ability to work autonomously	4	0
Capacity to learn and stay up-to-date with learning	3	1
Ability to plan and manage time	4	0
Ability to apply knowledge in practical situations	2	2
Ability to communicate both orally and through the written word in first language	2	2

The teachers that disagreed with the use of this information as indicators for any other skills said that it was necessary to include the grades that students received in the assignments to complete the assessment of these generic skills.

5) EXAMS

An exam is a test that students who are enrolled in a course should complete after finishing a lesson. E4S provides information referring to when and how many exams were taken by each student.

TABLE 6. Answers for exams records.

Generic skill	Yes	No
Ability to work autonomously	4	0
Capacity to learn and stay up-to-date with learning	4	0
Ability to identify, pose, and resolve problems	3	1
Ability for abstract thinking, analysis, and synthesis	3	1
Knowledge and understanding of the subject area and understanding of the profession	3	1

Table 6 shows that teachers mostly accepted the information provided by E4S as indicators of their students' performance in these generic skills. Only Teacher D disagreed in the last three skills, arguing again that it was necessary to include the grades that students received in the exams to complete the assessment of these generic skills.

V. DISCUSSION

In the literature review, the weaknesses of the previous works were discussed. This section contrasts the findings of this research with those weaknesses.

Previous research showed scalability issues when the number of assignments grew and the teachers were not able to cope with the increase [24]. By using the assessment method proposed in this work, teachers do not have to create specific tasks that require further assessment for each skill. They must plan tasks that favour their students' performance in one or several generic skills. Students' activity while performing the tasks is recorded in the virtual course. Then, they can collect the generated data for use as indicators of those generic skills using E4S.

To avoid scalability issues and improve the assessment experience in online courses, researchers often make use of peer-assessment procedures [25], [26]. However, delegating the assessment task to students sometimes generates problems of subjectivity, resulting in differences between the assessments given by teachers and the assessments given by students for the same performance. In this research, the assessments came from the LMS records. They were objective data stored on system databases collected during students' participation in activities. Thus, two or more students that have similar numbers in a given module activity had similar assessments in the performance of a generic skill.

Previous work presented computer-based solutions to obtain indicators that might be used to assess one or several generic skills in their particular experiences [18]–[20]. However, they did not define a specific relationship between their indicators and generic skills. This research identified this relationship from teachers' points of view. For instance, it was confirmed that teachers mostly consider that by using students' activity in a forum, generic skills such as *capacity to learn and stay up-to-date with learning, interpersonal and interaction skills, ability to be critical and self-critical, ability to communicate both orally and through the written word in first language, ability for abstract thinking* and *analysis and synthesis* can be assessed. Two participant teachers in the

experience considered that by using *E4S* they could measure their students' performance in those generic skills through forum activity. Though the other two teachers agreed, they showed certain nuances. They agreed that the information provided by *E4S* is valuable to support the assessment of those skills, but it would be more valuable if they planned students' activity ahead of time, added qualitative information to quantitative reports, or contrasted the quantitative reports with the forum itself. Finally, teachers who participated in the experience stated by knowing they will be able to use *E4S* in future courses, they can design their activities to favour students' performance in generic skills.

VI. CONCLUSIONS

Effectively performing in generic skills is fundamental for future graduates to be valuable to companies. In the educational context, teachers must have tools that support the assessment of students' performance in generic skills. This work presents a proposal for the assessment of students' generic skills in online environments by using LMS activity records. It was developed in an online university where teachers do not have direct personal contact with students, which was the ideal environment for the research. Two tasks were carried out under an action research process. First, a sample of teachers from this university was consulted to know which activities from which Sakai modules they considered usable to assess the performance of their students in generic skills. Second, a tool was developed to obtain activity records from Sakai, which was then applied within four courses of this university. After its use, the teachers were interviewed to evaluate the suitability of both the use of the records and the tool to assess generic skills. Positive evidence was found with the results. In general, teachers considered that they can use activity records as indicators of their students' performance in generic skills. However, it is necessary to encourage students to participate in modules. Additionally, another interesting contribution of this work is a list that maps generic skills and the activity of which LMS module it can be measured with. This is an interesting guide for teachers, as they can consult it when they prepare activities in which their students must perform generic skills. This study sets the groundwork for future work. Its findings could be supported by the application of the method and the tool in different environments. The assessment of generic skills linked to activity records could be used in professional contexts. For instance, when seeking candidates to be promoted in a company, the one with the best rating in a given skill according to their activity records in a platform could be selected.

APPENDIX
SUMMARY OF THE SURVEY FOR MAPPING LMS RECORDS AND GENERIC SKILLS

Each participant had to select the evaluability of each generic skill with each of the LMS modules using a 5-points Likert scale. Since the teachers might not understand all descriptions of some generic skills, they could leave some of them blank.

Therefore, not all options had the same number of votes. Table 7 displays the 25 best graded pairs of generic skills and LMS modules. For instance, the first line means that the pair [*ability to work autonomously, tasks*] was graded by 125 teachers and had an average grade of 4.67 out of 5 (considering that the minimum grade is 1).

A. EVALUABILITY OF GENERIC COMPETENCES

This subsection summarizes the results from the point of view of generic skills, i.e., the suitability of each generic skill to be assessed by an activity in the LMS modules.

TABLE 7. 25 best graded pairs of generic skill and module LMS in the survey.

Generic skill	LMS Module	Average	Votes
Ability to work autonomously	Tasks	4.67	125
Capacity to learn and stay up-to-date with learning	Tasks	4.55	125
Ability to work autonomously	Resources and contents	4.52	126
Capacity to learn and stay up-to-date with learning	Resources and contents	4.44	126
Ability to plan and manage time	Calendar	4.42	98
Ability to plan and manage time	Tasks	4.38	125
Ability to apply knowledge in practical situations	Tasks	4.38	90
Capacity to learn and stay up-to-date with learning	Exams	4.36	99
Ability to work autonomously	Exams	4.34	99
Ability to communicate both orally and through the written word in first language	Tasks	4.33	125
Capacity to learn and stay up-to-date with learning	External tools	4.27	129
Ability for abstract thinking, analysis, and synthesis	Tasks	4.25	88
Ability to make reasoned decisions	Tasks	4.25	88
Ability to search for, process, and analyse information from a variety of sources	Resources and contents	4.23	93
Ability to identify, pose, and resolve problems	Tasks	4.22	90
Ability to search for, process, and analyse information from a variety of sources	Tasks	4.22	90
Ability to work autonomously	External tools	4.22	129
Determination and perseverance in the tasks given and responsibilities taken	Tasks	4.20	87
Ability to plan and manage time	Resources and contents	4.14	126
Ability to identify, pose, and resolve problems	Exams	4.14	78
Knowledge and understanding of the subject area and understanding of the profession	Tasks	4.10	88
Ability to evaluate and maintain the quality of work produced	Tasks	4.09	91
Skills in the use of information and communications technologies	External tools	4.09	91
Ability to work autonomously	Calendar	4.08	98

Table 8 displays the average grades and the votes received for each generic skill considering all LMS modules.

TABLE 8. Average grade obtained by each competence (average) and the number of grades received (votes).

Generic skill	Average	Votes
Ability to work autonomously	4.18	818
Capacity to learn and stay up-to-date with learning	4.14	818
Ability to plan and manage time	3.87	818
Ability to apply knowledge in practical situations	3.75	635
Ability for abstract thinking, analysis, and synthesis	3.73	622
Skills in the use of information and communications technologies	3.73	611
Ability to identify, pose, and resolve problems	3.73	622
Ability to communicate both orally and through the written word in first language	3.71	818
Determination and perseverance in the tasks given and responsibilities taken	3.71	604
Ability to make reasoned decisions	3.71	617
Ability to search for, process, and analyse information from a variety of sources	3.69	623
Knowledge and understanding of the subject area and understanding of the profession	3.68	615
Ability to be critical and self-critical	3.67	627
Ability to evaluate and maintain the quality of work produced	3.56	618
Ability to adapt to and act in new situations	3.53	611
Capacity to generate new ideas (creativity)	3.47	611
Interpersonal and interaction skills	3.42	818
Ability to undertake research at an appropriate level	3.40	619
Spirit of enterprise, ability to take initiative	3.29	599
Ability to act on the basis of ethical reasoning	3.29	608
Ability to act with social responsibility and civic awareness	3.18	620
Appreciation of and respect for diversity and multiculturality	3.18	612
Ability to design and manage projects	3.15	597
Ability to work in an international context	3.13	597
Ability to motivate people and move toward common goals	3.07	818
Ability to work in a team	3.06	818
Ability to communicate with non-experts of one's field	2.87	597
Ability to communicate in a second language	2.82	591
Ability to show awareness of equal opportunities and gender issues	2.77	597
Commitment to safety	2.59	597
Commitment to the conservation of the environment	2.54	599

Table 9 shows the distribution of these votes among the Likert scale options. Since participants graded the activity performed in a module for more than one generic skill, the number of votes received by each generic skill was higher than the number of participants. As was previously introduced, they could leave some of them blank. The numerical header in table 9 represents the five-likert leves:

(1) Strongly disagree
(2) Disagree
(3) Neither agree nor disagree
(4) Agree
(5) Strongly agree

B. EVALUABILITY OF LMS MODULES

This subsection summarizes the results from the point of view of the LMS, i.e., the suitability of the activity in each module LMS for use in the assessment of generic skills.

TABLE 9. Number of grading obtained on the Likert scale for each generic skill in all LMS modules.

Generic skill	(1)	(2)	(3)	(4)	(5)
Ability to work autonomously	401	250	103	41	23
Capacity to learn and stay up-to-date with learning	374	268	117	34	25
Ability to plan and manage time	320	242	137	64	55
Ability to apply knowledge in practical situations	210	203	127	45	50
Ability for abstract thinking, analysis, and synthesis	214	194	106	50	58
Skills in the use of information and communications technologies	209	175	132	44	51
Ability to identify, pose, and resolve problems	202	204	110	56	50
Ability to communicate both orally and through the written word in first language	261	257	172	58	70
Determination and perseverance in the tasks given and responsibilities taken	186	199	120	54	45
Ability to make reasoned decisions	192	195	136	45	49
Ability to search for, process, and analyse information from a variety of sources	207	188	119	47	62
Knowledge and understanding of the subject area and understanding of the profession	215	168	115	57	60
Ability to be critical and self-critical	183	207	134	51	52
Ability to evaluate and maintain the quality of work produced	163	199	133	66	57
Ability to adapt to and act in new situations	162	184	143	61	61
Capacity to generate new ideas (creativity)	155	186	129	72	69
Interpersonal and interaction skills	195	235	196	99	93
Ability to undertake research at an appropriate level	135	192	150	72	70
Spirit of enterprise, ability to take initiative	148	145	135	76	95
Ability to act on the basis of ethical reasoning	134	158	158	67	91
Ability to act with social responsibility and civic awareness	127	130	189	77	97
Appreciation of and respect for diversity and multiculturality	129	135	163	86	99
Ability to design and manage projects	120	142	138	99	98
Ability to work in an international context	128	118	159	88	104
Ability to motivate people and move toward common goals	128	206	221	121	142
Ability to work in a team	132	192	230	122	142
Ability to communicate with non-experts of one's field	87	119	157	99	135
Ability to communicate in a	87	113	147	96	148

TABLE 9. *(Continued.)* Number of grading obtained on the Likert scale for each generic skill in all LMS modules.

	(1)	(2)	(3)	(4)	(5)
second language					
Ability to show awareness of equal opportunities and gender issues	80	102	163	102	150
Commitment to safety	73	79	150	119	176
Commitment to the conservation of the environment	75	71	146	118	189

Table 10 displays the average grades and the votes received for each module LMS considering all the generic skills, and Table 11 shows the distribution of these votes among the Likert scale options.

TABLE 10. Average grade obtained by each module LMS (average) and the number of grades received (votes).

LMS module	Average	Votes
Tasks	3.81	2952
Resources and contents	3.51	3045
External tools	3.48	3100
Forums	3.44	3900
Exams	3.41	2495
Private messages	3.36	2424
Calendars	2.85	2459

TABLE 11. Number of grading obtained on the Likert scale for each module LMS in all generic skills.

LMS module	(1)	(2)	(3)	(4)	(5)
Calendars	459	395	599	340	666
Exams	753	603	444	309	386
Forums	906	1174	949	489	382
External tools	774	949	720	307	350
Private messages	605	643	546	269	361
Resources and contents	860	808	724	343	310
Tasks	1075	884	553	229	211

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