Managing students' projects in e-learning

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Abstract— This paper's research topic is the improvement of education in the field of student project management through the use of project-based learning. The theoretical basics and concepts of project-based learning are covered in this paper, as well as a review of the concept's practical application in education. The paper aims to suggest a way to improve education in the field of student project management through the use of project-based e-learning. Tools such as Mattermost, OpenProject, and BigBlueButton will be used to communicate, collaborate and organize the work of the teams. The outcomes of the application of this learning concept, as well as a proposal for future work on this topic, will be presented at the end.

Key words— project-based learning, managing projects, e-learning, students' projects

I. INTRODUCTION

The paper's research is on the improvement of education in the field of student project management through the use of project-based learning. The lack of motivation, commitment, and desire for a deeper analysis of the problem being solved is recognized among students. As a result, the main issue that has been identified is how to increase student awareness and engagement so that solving teaching activities is seen as something that will help them in their future development and maturation rather than a duty. When solving any problem, it is critical to inform the participants that their role in the solution is critical, that their opinion is valued, and that it can have a significant impact on the solution's future development. Students get a sense of responsibility for their work as well as the work of other members of the team as a result of project-oriented teaching because the success and results of the entire team are dependent on the performance of each individual. Only then will they be motivated to work hard.

The goal of the Department for e-business at the Faculty of Organizational Sciences was to bring project-based learning closer to the way students work and conduct a simulation of the real environment. In cooperation with professors and associates of the department, a model was designed according to which students from three elective courses will cooperate and form a multidisciplinary team in charge of project implementation and creation of IoT products. Students are tempted to be an independent development team that aims to present a production solution to the problem during one semester, applying the Scrum methodology and learning about its roles. During the implementation of the project, students have at their disposal a group of tools that will help them communicate with each other as efficiently as possible, but also record all the necessary activities and supporting documentation of each part of the project.

II. LITERATURE REVIEW

Mastering Information-Communication Technologies (ICT) is vital since it is the foundational knowledge skill for learners in the twenty-first century. ICT literacy is one element of fundamental knowledge, which includes core content knowledge and cross-disciplinary knowledge. [1] Students' technological understanding is critical, and to achieve ICT literacy, learners might use e-learning. E-learning is anticipated to help trainees understand the newest knowledge and technology while also allowing them to learn without being constrained by place or time. According to the results of a survey on the use of information technology by junior high school science teachers in Indonesia, the usage of ICT in the teaching process is low. As a result, we require a learning approach that enables learners to gain ICT literacy.[2]

Based on the findings of several studies, project-based learning combined with e-learning can provide students with the opportunity to broaden their knowledge and develop skills based on problem-solving and investigation. Learners can search for and share information more widely using e-learning, which supports differentiation and diversity, empowers learners to personalize the learning process, and provides an opportunity for learners to master it.[3]

In recent years, higher education institutions have attempted to provide students with both hard and soft skills, such as cognitive knowledge and professional abilities, such as problem-solving and teamwork. These skill-related objectives, however, are difficult to attain since traditional learning has dominated, with professors acting as "the transmitter of knowledge" and students acting as "the receiver of information." As a result, students may find it difficult to completely engage in instructional processes, resulting in a superficial understanding of discipline knowledge.[4]

Universities place a greater emphasis on developing students' research talents than on professional or transferable skills. As a result, there may be a gap between what students learn at university and what they require in the business. To improve this scenario, students should be allowed to participate in real-world problem-solving and knowledge construction in actual professional settings. Project-based learning is one appealing technique to accomplish this goal.[4]

In project-based learning, students engage in groups to solve real-world, curriculum-based, and frequently interdisciplinary problems. Learners select which activities to pursue and how to tackle an issue. They collect data from many sources, synthesize it, analyze it, and derive knowledge from it. Their education is intrinsically meaningful because it is grounded in reality and encompasses abilities like teamwork and contemplation. Students exhibit their newly gained knowledge at the end and are graded on how much they learned and how well they express it. Rather than directing and managing student work, the teacher's responsibility is to guide and advise them throughout this process.[5]

Project-based learning, as one of the self-organized learning variations, focuses on a project that serves a temporary purpose and allows students to work on a concrete goal while gaining experience. Additionally, students can offer their skills and desires. Last but not least, project-based learning aligns with some key teaching principles:[6]

- Situation relatedness: Contents are arranged according to concrete current or future situations.
- Action relatedness: Contents offer assistance and orientation for concrete actions.
- Science relatedness: Contents are oriented both by the level of knowledge as well as by the topics and methods of the respective scientific discipline.
- By example: Contents were selected so that the wealth of knowledge is depicted by a few typical cases (which are representative of similar issues).
- Structure: Contents transport also structural knowledge such as basic ideas, elements of theories, models, schemes of explanations, etc.

The real-world focus of Project-based learning (PBL) activities is central to the process. Students are driven to work hard when they understand that their effort is ultimately meant as a solution to a real problem or a project that will have an impact on others.[5] When students propose projects, their motivation is high. A group of students at the University of Applied Sciences - Technikum Wien has been working on a sophisticated system of robots playing soccer for several years. The initiative is one of the university's most intriguing PBL projects. Students from a variety of academic programs are involved. The project's outcomes are outstanding. Three years in a row, the squad reached the RoboCup quarterfinals in the F180 league. [6]

PBL is a student-centered method of instruction founded on three constructivist principles: learning is context-specific, learners participate actively in the learning process, and they attain their objectives through social interactions and knowledge and understanding sharing. [7] Because students can document the entire process and quickly share their products in a digital format, modern digital technology is a big enabler for students to comfortably engage with the process of planning and developing their projects.[8] In the PBL context, effective use of technology as an integrated part of instructional processes has been found to assist both weakly and strongly performing students develop knowledge.[9]

According to John Larmer and John R. Mergendoller, seven essentials for project-based learning are:[10]

1. A Need to Know - Teachers can effectively stimulate students' desire to learn content by starting a project with an "entrance event" that captures the attention their attention and prompts them to ask questions.
2. A Driving Question - A excellent driving question expresses the project's essence in simple, compelling language, giving students a sense of purpose and challenge.
3. Student Voice and Choice - In terms of making a project feel meaningful to students, the more voice and choice, the better.
4. 21st Century Skills - Collaboration, communication, critical thinking, and the use of technology
5. Inquiry and Innovation - Students find project work more interesting when they do true investigation, which does not entail gathering information from books or the Internet and pasting it onto a poster.
6. Feedback and Revision - Formalizing a process for feedback and revision during a project makes learning meaningful because it emphasizes that creating high-quality products and performances is an important purpose of the endeavor.
7. A Publicly Presented Product – Presenting a product to a real audience makes students care more about its quality.

The impacts of project-based learning and direct instruction by teachers on students' educational achievements in elementary, secondary, and tertiary education were compared in one of the reviews. In this study, PBL refers to a learning approach in which students are involved in real-world projects and product development. PBL had a more favorable influence on students' academic progress than direct instruction, according to the findings. However, only 20% (6 out of 30) of the studies assessed were undertaken in higher education.[4]

Reis et al. [11] conducted a review of PBL in engineering education studies using bibliometrics (e.g., keyword analysis) and categorizing research techniques. The top three keywords used, according to bibliometric statistics, were project-based learning, engineering education, and problem-based learning. The classification results revealed that over 70% of studies focused on undergraduates, with case studies being the most popular research method.

III. AN APPROACH TO MANAGING STUDENTS' PROJECTS

In the cooperation between professors and associates of the Department for e-business at the Faculty of Organizational Sciences, a model of project-based e-learning was designed in which students from three elective courses will have the opportunity to develop software products in multidisciplinary teams. In the first part of the teaching activities, students have the opportunity to get acquainted with the theoretical foundations and concepts of both project-based learning and Scrum methodology. After getting acquainted with the necessary theoretical work, students have the opportunity to apply what they have learned in mutual discussions to work with professors and associates to well determine the concepts of Scrum methodology and product development techniques previously heard in class. The next step is to choose topics. Everyone has the opportunity to choose between the offered topic or to make a proposal for a new topic that can be processed following the objectives of the courses.

Students from the elective courses E-business risk management, Internet Marketing, and Internet of things are participating in the realization of the project. Depending on which course students attend, they will have different roles by Scrum during the implementation of the project. Each team consists of the following roles:

1. Product owner - Represents a person who defines the requirements of the project, accepts or rejects the results of work, and performs a time estimate for the required activities. This role during the realization of the project was given to either a professor or an associate of the department.
2. Scrum master - represents the person who leads the project, manages and assists the development team, and enables cooperation between all roles and functions in the organization. This role during the implementation of the project was given to a student from the elective course E-business risk management.
3. Member of the development team - The person responsible for the implementation of specific activities. This role during the realization of the project is given to the student from the elective course Internet Marketing and/or Internet of things

After choosing the topic and forming the team, the Scrum Master is obliged to arrange a kick-off meeting with the Product Owner, where the presence of all team members is mandatory. At the kick-off meeting, it is necessary to define the goals that the team wants to achieve with their product and get all the necessary information from their Product Owner which will be important to them for further realization. After the initial meeting, the Scrum Master, together with the development team, plans sprints and further distributes activities to members. The development team is not obliged to fully comply with Scrum's daily meetings due to other obligations they have at the faculty, but the proposed number of meetings for one week is two.

During the implementation of the project, students have at their disposal various tools that will help them communicate with each other as efficiently as possible, but also record all the necessary activities and supporting documentation of each part of the project. The tools available for use are Mattermost, OpenProject, and BigBlueButton. These are channels for a formal form of communication. Each team is free to use, in addition to the mentioned benefits, any other channels for informal communication that it considers suitable and efficient during development.

A. Mattermost

Mattermost is an open-source platform for secure communication, collaboration, and orchestration of teamwork and tools. Mattermost is made especially for software development and engineering use cases. Each student receives their account on the mentioned platform and has access to their team and appropriate channels within it. By applying this tool, we want to bring students closer to what communication looks like in a real business environment. It is necessary that the team members record within the appropriate channels all the necessary information that may mean to other members, but also in this way document their work on the project. In addition to the basic functionalities, the Mattermost Boards option is also used, which is a tool for recording and distributing activities to members, as well as setting deadlines and prioritizing tasks.

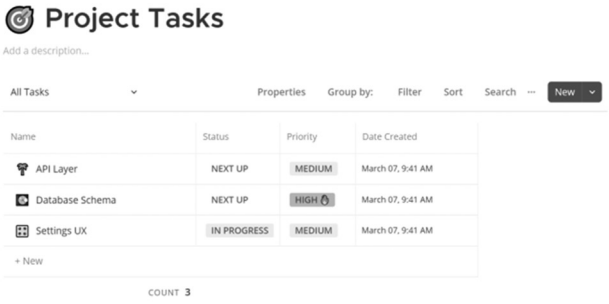

Fig. 1. Mattermost Board

B. BigBlueButton

BigBlueButton is a tool integrated within the Mattermost platform and used by the team as a tool for online meetings so that they can communicate as easily and quickly as possible due to problems, but also for conducting daily activities.

C. OpenProject

OpenProject is an open-source platform used for efficient project management and administration. Within the project on the platform, participants have the opportunity to see the plan of future work, what activities are assigned to them, what is the deadline for their implementation, the Gantt chart, and milestones that need to be achieved. In addition to all the options related to the individual, this tool

provides the opportunity to organize a meeting, conduct various discussions on the project, record the necessary documentation, estimate costs, etc.

Fig. 2 OpenProject Work packages board

IV. ANALYSIS OF RESULTS

In the previous two years, over 40 projects were successfully implemented, in which more than 100 students from the courses E-business risk management and Internet of Things collaborated. Students completed their activities and passed the course during the current school year. After the realized projects, in the conversation with the students, we managed to collect praise for the innovative way of working, as well as their criticism, but also space for improvement. What stood out the most in the conversation with the students was that this was a real opportunity for them to experience what it is like to work in a team, use tools that are used in the development of real projects, and participate in creating software products in today's fastest-growing industry.

The third year of project-based learning within the elective courses of the Department for e-business is underway. The new year brought with it an expansion of the number of students on projects because we recognized that there is interest in the same, but also an increased motivation among students when they participate in creating something practical instead of preparing only a theoretical exam.

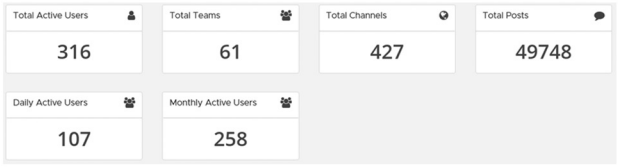

Fig. 3. Mattermost System Statistics

As can be seen in the picture above, there are over 300 active users who are assigned to multidisciplinary teams that also represent the number of active projects. Currently, the teams are actively working on over 60 projects that can be internal, involving professors and associates of departments, and external, projects that students implement as part of teaching activities in accordance with the project-based learning model. Within teams, students and other participants are allowed to create channels that cover a particular topic for discussion when developing a particular product. So there are a total of 427 channels created within the project. Also, based on the daily and monthly number of active users, it can be concluded that each team on a daily or monthly level meets the necessary number of users to adequately monitor the current state of the project.

The total number of posts on the system is currently almost 50,000, and looking at the diagram in the picture below, it can be concluded that the goal of active communication among students within the Mattermost platform was achieved based on the number of users who posted on a given day in all teams on the system.

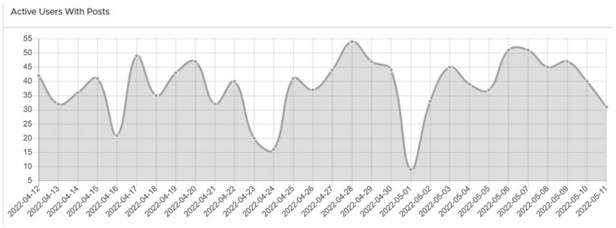

Fig. 4. Active Users With Posts

V. CONCLUSION

Students benefit greatly from project-based learning in computer science, but it requires careful planning. Many times, project ideas offered by students turn out to be successful. This is most likely due to the high amount of drive that students have in such situations. Surprisingly, these types of initiatives do not receive as positive feedback as projects set by faculty members. This phenomenon could be caused by several factors. The complicated arrangement of projects in computer science is one potential factor. Students who propose an idea are also in charge of determining project objectives. However, due to a lack of experience in creating such project goals, these targets are often unattainable. Even if the project's results in terms of grades are bad, the learning outcome is excellent in such instances.

The plan for the future development of this way of learning is to achieve cooperation with companies that are ready to engage students in the implementation of real projects in agreement with the faculty and thus provide students with an even more realistic picture of the business world. This way of project-based learning has great potential because, in addition to increasing the motivation of students, it will help them to get a job and contribute to the growth of the industry.

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