International Journal of e-Collaboration
Volume 19 • Issue 1

An E-Collaboration Application for Final-Year Project Management

Razika Lounas, LIMOSE Laboratory, Faculty of Sciences, University of M'Hamed Bougara of Boumerdes, Algeria*
Ikram Hamzaoui, Faculty of Sciences, University of M'Hamed Bougara of Boumerdes, Algeria
Naima Bouguelmouna, Faculty of Sciences, University of M'Hamed Bougara of Boumerdes, Algeria
Hocine Mokrani, LIMOSE Laboratory, Faculty of Sciences, University of M'Hamed Bougara of Boumerdes, Algeria

ABSTRACT

The advent of digital technologies has contributed to collaboration in many areas of life, including academia. This paper examines student final year projects (FYPs) and proposes a collaborative system that provides tools in response to various needs such as communication, coordination, production, and resource sharing. The application is designed for multiple users: students, advisors, and administrative staff. It provides a personal workspace for each user. The novelty of the proposed system is that it covers all the collaborative aspects mentioned throughout the FYP process, including proposal processing, project assignment, project completion, and evaluation. The new system is based on the proposed layered collaborative architecture. The results indicate good scores in improving collaborative aspects, improved process efficiency, and that users are positively inclined to use the system as their FYP management system.

KEYWORDS

Collaboration Framework, Collaboration Tools, Communication, Coordination, Coproduction, Final Year Projects, Graduation, Resource Sharing

INTRODUCTION

Recent years have seen an increase in information and communication technology (ICT) for collaboration (Jones, M. (2012)). People are increasingly working together virtually in different domains. Among all these domains, pedagogy has been impacted by these tools, and this transformation is much more like a revolution that has redesigned the relationship between teachers and students and led to different and new ways of working (Hüttel, H., & Gnaur, D. (2019)). These modes require using particular collaboration tools and their inclusion in work platforms (Shamir-Inbal, T., & Blau, I. (2021)). They are designed to accommodate several curriculum-related activities students must

DOI: 10.4018/IJeC.315787 *Corresponding Author

complete, such as courtyards (Tarazi, J., & Akre, V. L. (2013, December)) or assessments (Efu, S. I. (2019)).

Final year projects (FYPs) represent the ultimate activity in the students' curriculum. They are designed to use, test, and enhance the knowledge students have gained over the years by confronting them with real-world projects (Beus-Dukic, L. (2011, August), Rozenes, S., & Kukliansky, I. (2013), Bringula, R. P., Balcoba, A. C., & Basa, R. S. (2016, May)). Preparing students for FYPYFP involves several tasks and actors, such as advisors and administrative staff. Projects are first reviewed and then assigned to students. A supervisor mentors a student for one semester to complete the project. At the end of the project, the student presents the study's results to a committee for evaluation. The orchestration of all the activities mentioned above and the involvement of the actors take advantage of collaborative tools. These tools address several aspects such as communication between students (Aiken, M., Wang, J., Gu, L., & Paolillo, J. (2011)) and their advisors, outlining projects, coordinating activities between advisors and administrative staff, sharing resources, or generating reports. Several studies have shown the use of online collaboration tools (Berthoud, L., & Gliddon, J. (2018), Chu, S. K. W., & Kennedy, D. M. (2011)) or social media in FYP.

In response to the rising requirement of integrating collaboration tools in working platforms (Prinz, W., Martínez-Carreras, M. A., & Pallot, M. (2012)), several researchers endeavored to provide systems for FYP that integrate tools for several collaboration functionalities. Some of the existing systems are intended for a specific step such as project assessment (Tiwari, G., Singh, R., Chandna, V. K., Shimi, S. L., & Jain, M. (2019)) or project allocation(Jailani, N. I. S. I., Ali, A. F. M., & Ngah, S. (2022, May, whereas others are deployed for several FYP steps (Leung, C. H., Lai, C. L., Yuan, T. K., Pang, W. M., Tang, J. K., Ho, W. S., & Wong, T. L. (2015), Bakar, M. A., Jailani, N., Shukur, Z., & Yatim, N. F. M. (2011)).

Despite the plethora of existing systems, this research topic is still exciting because several issues have been raised. First, the existing platforms do not cover the entire FYP process, including the preliminary discussions between students and advisors and the processing of project proposals. In addition, some aspects of collaboration are not captured in the steps covered, such as collaborative decisions or communication. Furthermore, the need for such tools and platforms has been accentuated with the Covid-19 pandemic. Indeed, several studies revealed the urge to use collaboration tools in academics during this period (Byrnes, K. G., Kiely, P. A., Dunne, C. P., McDermott, K. W., & Coffey, J. C. (2021), Craig, K., Humburg, M., Danish, J. A., Szostalo, M., Hmelo-Silver, C. E., & McCranie, A. (2020)). The research in this article is designed to explore the benefits of collaboration tools during the FYP process from different actors' points of view. The focus is given to every step of the FYP process. Questions are raised about:

- The principle means of collaboration among students and advisors;
- The difficulties experienced during the FYP process with regard to collaboration aspects;
- The benefits of using a collaboration platform.

This study aims to design and develop a solution that makes the following contributions:

- **Complete process:** The proposed framework covers the whole FYP management process by offering suitable tools for each step.
- **Collaboration suite:** The application provides coordination, communication, production, and sharing functionalities for students, professors, and administrative staff.
- **Complete virtualization:** The collaborative application for FYP is proposed for a case study of a Computer Science Department. The complete virtualization of the process makes the solution suitable for exceptional situations such as pandemic lockdowns.
- **Collaboration framework:** The proposed system is based on a layered architecture that follows the principle of distinguishing between aspects of the collaboration and the process.

The remainder of the paper is organized as follows: Section 2 presents related work on the use of collaborative tools and platforms for FYP; Section 3 is devoted to the methodology, including the presentation of the background and participants, the collection of data through the entire FYP process, and the description of the proposed system; Section 4 presents the application and discusses the results; Section 5 concludes this work and provides some future directions.

FYP TOOLS AND PLATFORMS

Communication is the foundation of collaboration (Buchem, I., Cochrane, T., Gordon, A., Keegan, H., & Camacho, M. (2012), Stevenson, D., & Starkweather, J. A. (2017). In Final Year Projects, this is mostly discussed in terms of an advisor-to-advisee relationship (Wrench, J. S., & Punyanunt, N. M. (2004)). Indeed, this relationship involves regular meetings that are important for setting goals and discussing ideas about the project (Ashraf, M. A., Shamail, S., & Rana, Z. A. (2012, August), de Kleijn, R. A. M. (2013)). In addition to face-to-face meetings, several tools are used to communicate, such as email, chat, web conferencing, or social software (Gaines, J., Akintewe, O., & Small, S (2019)). In addition, these tools are necessary for communication between all parties involved, including administrative staff, during different stages of projects, such as project allocation (Bakar, M. A., Jailani, N., Shukur, Z., & Yatim, N. F. M. (2011)).

Coordination is related to the orchestration of tasks among different authors and considering several steps in time (Raposo, A. B., Magalhães, L. P., Ricarte, I. L. M., & Fuks, H. (2001, September)). During the FYP process, students pass through several steps, including investigations, state-of-the-art methodology definition, experiments, result interpretations, and conclusions. These steps are discussed with advisors to set goals and plan tasks and deadlines. Online shared agendas are used to schedule tasks and plan meetings. These tools are important, especially when an advisor supervises several student groups and has to keep track of their progress. In addition to agendas, tools for task management such as Gantt charts are used to record tasks to be completed and keep track of project progress (Deepamala, N., & Shobha, G. (2018)).

Collaboration is also strongly related to the functionality of production (Leung, K., & Chu, S. K. W. (2009, December)). During their FYP, students must produce documents such as project reports, codes, and entries. The supervisor's role is to guide them to understand and work around difficult problems. The involvement of advisors requires tools that allow them to intervene directly in the students' work if necessary (Singh, V., & Mayer, P. (2014), Roschelle, J., & Teasley, S. D. (1995)). With these tools, it is possible to share objects and environments, enabling the collaborative construction of outcomes and knowledge. Sharing knowledge and resources is also a major concern in the FYP framework. Sharing tools and mechanisms such as online libraries, blogs, and podcasts are used to enhance the outcomes of student projects. These tools provide better learning environments and enhance students' abilities to work in teams and apply learned skills (Gardner, M., & Elliott, J. (2014)).

Several research works have highlighted the importance of integrating communication, coordination, production, and sharing tools into a platform to provide a collaborative work environment (Prinz, W., Martínez-Carreras, M. A., & Pallot, M. (2012), Abdullah, N., Salleh, S. N. M., Mahdin, H., Darman, R., Daniel, B. D., & Surin, E. S. M. (2018, February)). Romdhani, I., Tawse, M., & Habibullah, S. (2011) presented the student project performance management system. It is student-centered and federates the efforts of several stakeholders: students, supervisors, administrators, and reviewers. The system relies on the project and supervisor databases to specify each project and on the expertise profile of each supervisor to facilitate the supervisor assignment process: the supervisory system automatically suggests potential supervisors for a given project. The system provides a performance management subscription to define milestones, tasks, and deliverables and check project progress. Progress forms are produced and exported to the relevant actors. The system also provides communication tools, a record management system, evaluation forms, and academic

and professional workshops database. It also provides training for students to consolidate and acquire new skills if supervisors indicate the necessary skills.

In (Bakar, M. A., Jailani, N., Shukur, Z., & Yatim, N. F. M. (2011)), the authors proposeBakar et al. (2011) proposed a web-based supervision management system. The users of the system are students, supervisors, and the head of the department. The system is composed of three modules. The first module manages students'and supervisors'profiles and provides a function to assign supervisors to students. The second module manages time for meetings between students and supervisors. The third module is dedicated to monitoring the project's process in two aspects: system development and report writing. It uses a Gantt chart to monitor the evolution of the project in time and provides deadline reminders and notifications. The system also provides spaces for discussions and uploading documents and reports.

The system proposed by Leung, C. H., Lai, C. L., Yuan, T. K., Pang, W. M., Tang, J. K., Ho, W. S., & Wong, T. L. (2015)) is for three users (FYP program organizer, supervisors, and students) and is based on five modules. The first module is used to perform project selection and assignment procedures. The second module provides communication tools such as chat and conferencing among students and between students and supervisors. The system provides a resource-sharing module for a secure, centralized location to share files, code, and produce results. The project management module tracks student schedules and checks on project progress. A submission scoring module allows students to submit their reports for scoring. Clement, R., & Bounds, P. (2013 proposed a system that, in addition to communication, file sharing, and task management functions, provides tools to facilitate the connection between students and potential supervisors before the assignment process begins. This connection lets students learn about the supervisor's projects and helps administrative staff quickly generate a draft for project assignments. The system also provides tools for submitting evaluations.

The system proposed in (Awad, M. (2017)) provides tools to manage proposals by implementing a call for proposals module. Students can search for projects and sign up for topics that interest them. At the end of their projects, students upload their final reports, presentations, and other deliverables for evaluation. In addition, a coordinator can create a schedule by defining dates, times, locations, and examiners for exams. The system provides reporting functionality on student and grade statistics and an analytics data module to discover patterns that can be used to adjust and improve learning activities. The framework presented in (Naeem, U., Islam, S., & Siddiqui, A. (2019, April)) provides tools that support several activities such as supervisor selection, project assignment, and checking student progress through engagement checkpoints. The system also provides individual project sites for students. This functionality is used for several aspects: having a workspace, sharing documents, collaborating in real-time, submitting project documents, and managing the project. The site provides subscription tools to detail activities and their start and expected completion dates. In addition, it provides information on additional knowledge and skills that students need to acquire to achieve a successful outcome for their projects. An assessment module allows students to present posters and live presentations to be graded. In (Abdullah, N., Salleh, S. N. M., Mahdin, H., Darman, R., Daniel, B. D., & Surin, E. S. M. (2018, February)), the authors present a system consisting of two modules to manage the FYP. The first module is for enrollment. It allows assigning supervisors to students, recording supervisor approval, and providing student notifications. The second module is related to assessment and provides tools for the grading process as a co-decision between reviewers and supervisors.

Table 1 illustrates the positioning of the leading systems with respect to the stages of the FYP process. The FYP management process follows several stages (Yilmaz, M., Tasel, F. S., Gulec, U., & Sopaoglu, U. (2018)): proposal processing, project assignment, project completion, and project evaluation. In the proposal stage, project descriptions are discussed to standardize proposals against the students' curriculum, determine requirements, investigate complexity, and check alignment with the students' education and project originality. In the allocation stage, projects are assigned to students. This process is based on several allocation algorithms. Allocation algorithms are beyond

the scope of this paper. During project completion, students perform hands-on actions to achieve the defined goals, communicate with their advisors to provide feedback, discuss ways to achieve them, and produce the required project outcomes. The final step is related to the evaluation of the project. Students submit their reports and results for evaluation by committees that are usually appointed by the administrative staff. Table 1 also indicates that the proposed systems do not cover the entire FYP process. Moreover, most systems do not consider the step, including project validation and discussions between students and supervisors before the beginning of the allocation, although this step is critical for the student choice. Furthermore, in several covered steps, some collaboration functions are missing. For instance, in (Leung, C. H., Lai, C. L., Yuan, T. K., Pang, W. M., Tang, J. K., Ho, W. S., & Wong, T. L. (2015)), the steps related to assessment and the grading module do not take into account communication between grading members, and in (Awad, M. (2017)), the system does not provide tools for communication between students and advisors during projects processing neither coordination tools between administrative staff during projects processing or allocation. In this paper, we propose a solution that covers the whole process of FYP and includes collaboration tools suitable for each step.

METHODOLOGY

Context of the Study

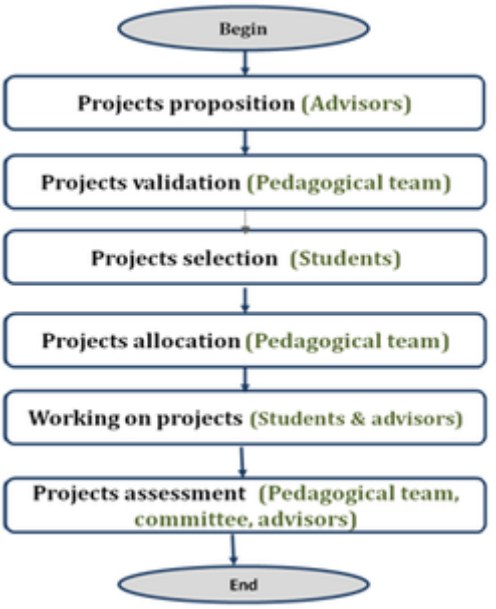
This article examines the case of FYP management in the Computer Science Department of the Algerian Boumerdes University. This project-based course is taught throughout the second semester of the senior year. Figure 1 illustrates the stages of the FYP process with the users involved.

The process begins at the end of the first semester. The department head initiates the processing of the project proposal and provides a timeline for each step. Supervisors (lecturers, professors, and associate professors) must propose projects by including the following information: project title, description, keywords, initial subscription, and tools. These projects are then reviewed by a pedagogical team composed of the department head, assistant head, and specialty heads and then published to students. Students are grouped into teams of two or three and select their favorite projects. An allocation process is then initiated to assign the projects to students. At the beginning of the second semester, students and advisors worked closely together to progress the project. The official course specifications state that a minimum of one and a half hours of weekly meetings is required. The rest of the work is done remotely using online tools.

Table 1. Covered steps in FYP systems

The system reference	Proposals Processing	Projects allocation	Projects realization	Projects assessment
Bakar, M. A., Jailani, N., Shukur, Z., & Yatim, N. F. M. (2011)	×	✓	✓	×
Leung, C. H., Lai, C. L., Yuan, T. K., Pang, W. M., Tang, J. K., Ho, W. S., & Wong, T. L. (2015)	×	✓	✓	✓
Clement, R., & Bounds, P. (2013)	✓	✓	×	✓
Naeem, U., Islam, S., & Siddiqui, A. (2019, April)	×	✓	✓	✓
Abdullah, N., Salleh, S. N. M., Mahdin, H., Darman, R., Daniel, B. D., & Surin, E. S. M. (2018, February)	×	✓	×	✓
Romdhani, I., Tawse, M., & Habibullah, S. (2011, January)	×	✓	✓	×
Awad, M. (2017)	✓	✓	×	✓

Figure 1. Steps of FYP process



Data Collection

This study enrolled participants with different profiles (final year students, professors, and administrative staff). The number of students is 42. All of them are between 21 and 25 years old. The number of professors (advisors) is 10. Five of them have more than 10 years' experience in conducting FYP, and five have between 5 and 10 years experience. The number of administrative staff is two respondents. Two members of a pedagogical team participated in this study.

The study used two questionnaires: one for students and one for advisors. The questionnaires were administered to students and faculty in Google forms. The student questionnaire was divided into three sections related to:

- Collaboration with advisors: include questions related to communication, coordination, resource sharing, and production activities between students and their advisors;
- Collaboration with teamates: include questions related to communication, coordination, resource sharing, and production activities;
- General collaboration: include aspects throughout the process.

The questionnaire intended for advisors contains items related to:

- Collaboration with their advisees: include questions related to communication, coordination, resources haring, and production activities;
- General collaboration aspects along the process.

The administrative staff and pedagogical team members are involved in the study, with live interviews conducted by the authors throughout the study.

Proposal Processing

During this stage, the pedagogical team reviews the proposed projects for verification. Members ensure that the projects are consistent with the proposed training, detailed project descriptions, methodologies, and tools. During this stage, the instructional team interacts with advisors to discuss issues such as: adding required details or bibliographic references for projects. The advisors improve their project descriptions based on this feedback. The verification step is manual and ends with an email to the departmental service to publish the list of projects. According to the team members interviewed, the main issues raised during this stage are the following:

- The progress of the verification stage depends on the advisors responding quickly to the required changes. The audit is not complete until all required improvements have been made. In some cases, another validation meeting is required.
- Enhancements are sent by email. This involves re-uploading the proposals a second time to finalize the verification step.

Students must form groups when the list of validated projects is published (by posting it manually via an official website or social network page). Each group can choose their preferred project topics. Each student group provides a list of its ten favorite projects. It is manually ranked to the departmental service. Before completing the top-ten list, students interact with advisors if they have questions about the proposed projects. These interactions are done face-to-face or through emails. This step is crucial for students to order their choices. Table 2 illustrates the data on issues raised by students.

Students agree at 95.2% on the importance of discussing proposed projects and 64.3% of them state that they changed their decision about their top-ten list after having discussions with professors about the proposed projects. The table illustrates that 61.9% of students declared that they had met some challenges during this step. The main challenges raised by students are related to discussing about proposals before the deadline of the top-ten list submission. Moreover, this challenge is accentuated when meetings with several professors are required. This happens when students feel interested in several proposed projects.

On the other hand, advisors agree at 100% about the importance of this step and 60% of them pointed out that they receive several groups of students asking, in some cases, the same questions about the proposals. Another issue is when students want to update the list (possibly before the deadline). According to the administrative staff, this update involves filing and providing another manual version.

Projects Allocation

After receiving all the top ten lists, the pedagogical team executes the allocation process. Allocation is based on student preferences. Conflicts in choices between groups are resolved by referring to a printed list of students' academic rankings calculated for the previous year. Each group is assigned a project proposal to work on at the beginning of the second semester. The administrative staff validates

Table 2. Proposal processing issues

Questions and issues	Rates
Importance of discussions about proposed projects	95.2%
Challenges and difficulties during this step	61.9%
Change decision about top-ten list after discussions with professors about the proposals	64.3%
Join professors and discuss proposals before deadlines	39.4%
Challenges in joining and discussing with several professors	39.4%

this assignment. The main problem with this step is that it is done manually and takes a long time. The allocation result is published by manual posting on the official website or social media page.

Projects Realization

During the project's realization, students must meet with supervisors to establish a working plan, steps, tasks, the required output of each step, and the deadlines. This intense exchange raises several issues from both students' and advisors' points of view as depicted in Table3.

Table 3 illustrates the rates of students and advisors that raised issues related to several aspects of collaboration:

- Students and advisors communicate via face-to-face meetings, messaging, or conferencing tools. The use of various communication platforms leads to situations of scattered information. Indeed, crucial information, data, and files are shared during communication, and using several tools makes it difficult to search for the right information if required.
- Advisors share resources and files with students. If an advisor shares the same resource with several students, he has to send it to several addresses, and the student has to manage resources in his email box. Some advisors share resources through online drives. This solution becomes tedious with the increase of advisees.
- Students produce reports and codes that have to be corrected and checked by advisors. The students' reports pass through several versions. These versions are sent by email to the advisor. The email storage of both sides becomes rapidly overloaded, making managing different versions difficult.
- Advisors supervise several FYPs in a semester. They use personal tools (manual or online lists and tracking files) to track all students' progress. Using various applications and platforms for each aspect of collaboration during project realization leads to slowness or repetition as the user must open several windows to manage these aspects and post some information or data on several platforms.

Table 3. Projet realization issues

Questions and issues	Rates
Students' point of view	
Challenges in communication with the advisors	51.2%
Challenges in communication with teammates	12.2%
Challenges in coordination with advisors	56.1%
Challenges in coordination with teammates	31.7%
Issues related to means of resource sharing	47.1%
Issues related to means of version tracking	44.1%
Issues with data and information search	50%
Advisors' point of view	
Challenges in communication with advisees	30%
Challenges in coordination with advisees	60%
Challenges in keeping track of different groups' progress	80%
Challenges in keeping track of different versions of students reports	60%
Issues with data and information search through advisees' resources	50%
Issues related to resource sharing with advisees	40%

Projects Assessment

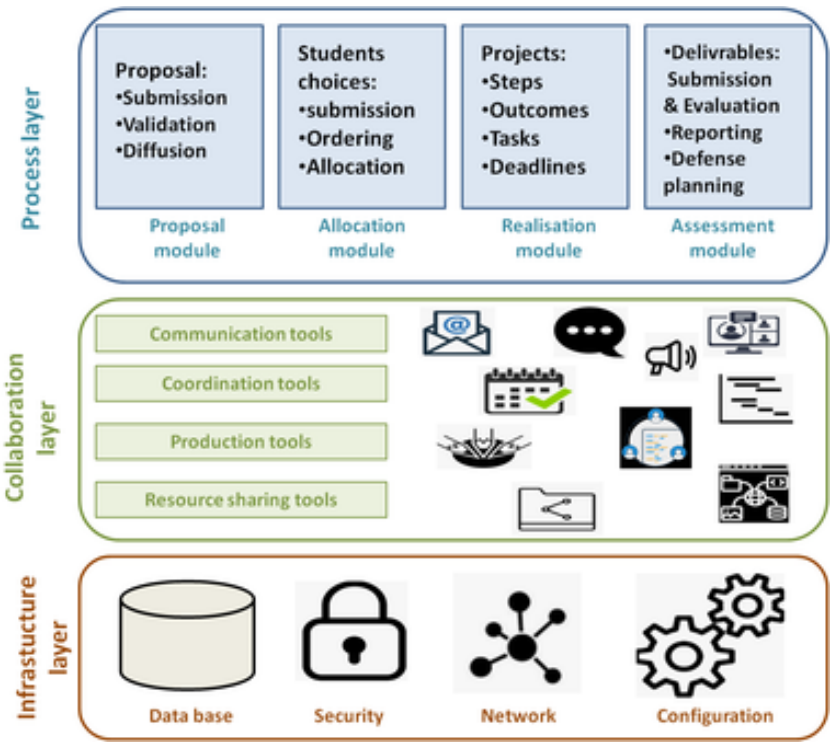
By the end of the second semester, FYP defenses are planned and prepared. The department chair provides a schedule and materials for these events. The pedagogical team assigns committee members to each project. Advisors and students are informed of the composition of each project defense, its date, time, and location (published on the official medium). Students are required to provide their physical manuscripts to committee members. These reports are provided to the department. The members of the defense committee (lecturers, assistant professors, and professors) must review and evaluate the reports. The evaluation is given after the defense of the project by filling out evaluation forms. At the end of the defense sessions, administrative reports are produced for the statistics. These tasks are done manually and by traditional office applications.

System Overview

In response to the issues raised at each stage of the process, a collaborative solution is proposed in this section to provide a comprehensive working environment that covers all stages of the process and provides tools for each issue raised. The proposed system is structured into three layers as depicted in Figure 2. The layered collaborative architecture separates basic requirements, collaboration requirements, and process requirements. This separation of concerns is the foundation of collaboration architectures. The three layers of the system are:

1- **Infrastructure layer:** This layer provides the execution platform for the system. It includes the database, networking resources, securing functionalities for user data and identities, and configuration functions. The system configuration allows defining the global calendar of the process: dates and deadlines for each step. The configuration also includes the definition of the

Figure 2. Overview of the FYP system



different roles: students, advisors, pedagogical team members, or department head (from one year to another, the team members can change, and also the department head). Configuration is to perform at the start of the second semester.

2- **Collaboration layer**: The study of the process and the raised issues has demonstrated the importance of collaboration tools to manage final year projects; hence, the proposed system contains a layer that provides a pleiad of tools for every aspect of collaboration. This layer includes communication, coordination, production, and resource-sharing tools. Every module of the process uses these tools. Details about some tools will be presented in the following section.

3- **Process layer:** The FYP process layer is divided into four main modules: a proposal management module, an allocation module, a project delivery module, and an evaluation module. The proposal management module allows advisors to publish their projects. Before these projects are published for students, they are first validated by members of the pedagogical team. This module provides tools to view, discuss, and validate proposals. It also allows the modification of proposals by advisors if necessary. Once validated, students view the proposals and discuss the projects with advisors before filling out their top ten list forms. The assignment module provides forms for filling out student preferences. The system implements a feature to assign projects to students based on their choices and with reference to their academic records from the past year. Students are allowed to update their choices by a defined deadline. The completion module allows advisors and students to manage the development and progress of the project. Tools for defining milestones, timelines, and outcomes are provided. This module also allows advisors to share different resources (documents, images, videos) and define access permissions to these resources. Students can produce documents on the platform. These documents can be viewed and modified by students and advisors. They can save different versions of the documents produced. This module allows advisors to manage the progress of several projects during the semester. The evaluation module allows students to upload their final reports or other documents. Students can view their deliverables. This module allows administrators to subscribe to defense sessions and committees. Committee members can view student evaluation reports and complete evaluation forms and defense reports.

PRESENTATION OF THE APPLICATION AND RESULTS

The proposed system was implemented as an online platform providing personal workspaces, collaboration tools, and FYP process functionality. The application is developed using PHP as the backend framework and MySQL as the database system. For the front-end development, HTML and CSS 3 were used. The GUI components are provided in a way that makes it easy to navigate between the different modules of the system and the most used features and data. Functions for all process steps and user categories are implemented. Each user has a profile with the corresponding tools and functions. Before the start of the second semester, the application administrator (department head or deputy) creates user accounts so that supervisors can submit their project proposals on the system and the pedagogical team can check them.

At the reception of all the proposals, the pedagogical team members access the platform to study the proposals. They interact online with the advisors with regard to proposals if necessary and with each other (via instant messaging) to provide a decision for every project. In the case of necessary improvement, advisors update their proposals. After the validation, the list of projects is published on the platform for students. It is added by the administrator in a common shared resources space. The student users are then registered to access proposals and discuss them with advisors. Figure 3 represents a communication interface related to a proposal by a professor. The window provides, on the left side, an abstract of the project, its title, keywords, and used tools. The right side of the window provides a discussion space related to the project description.

Figure 3. Interface for student-advisor discussion about a proposal

Figure 4 illustrates the overall satisfaction of the users (students and advisors) about the discussion of the proposals in both the old and new system. The user evaluation of the functionntionality is based on a 5-point scale such that: (1) Strong dissatisfaction; (2) Dissatisfaction; (3) Neither satisfaction, nor dissatisfaction; (4) Satisfaction; (5) Strong satisfaction.

Students provide the list of their top ten projects on the platform. This list is used by the pedagogical team to perform the allocation. The process of allocation is automated by the application. When the projects start, the application provides different functions to support students, advisors, and administrative staff. These functions are related to communication tools (chat, emails), file sharing, planning, writing, and task management.

The figure (Figure 5) illustrates an interface to track student's progress with regard to different tasks in the project. Each task is given by its state (complete, pending, or late), its beginning date and deadline, and the percentage of the progress. The percentage progress of each task helps to calculate the percentage progress of the whole project. This tool is very useful for advisors who evaluated the functionality with the score of 5 (50%) and 4 (50%). The tool is also useful for the Department head.

Figure 4. Proposal discussion scoring

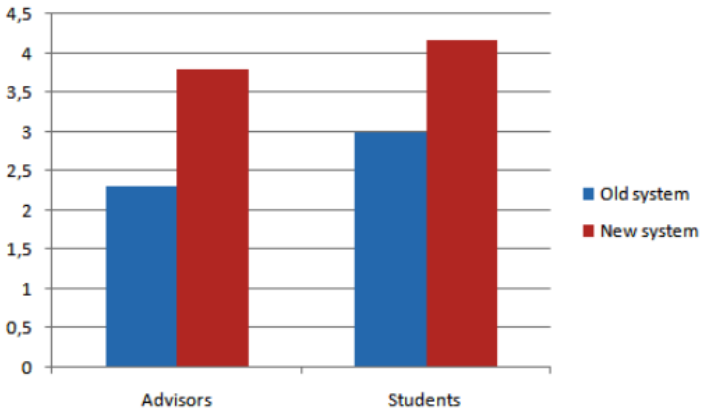
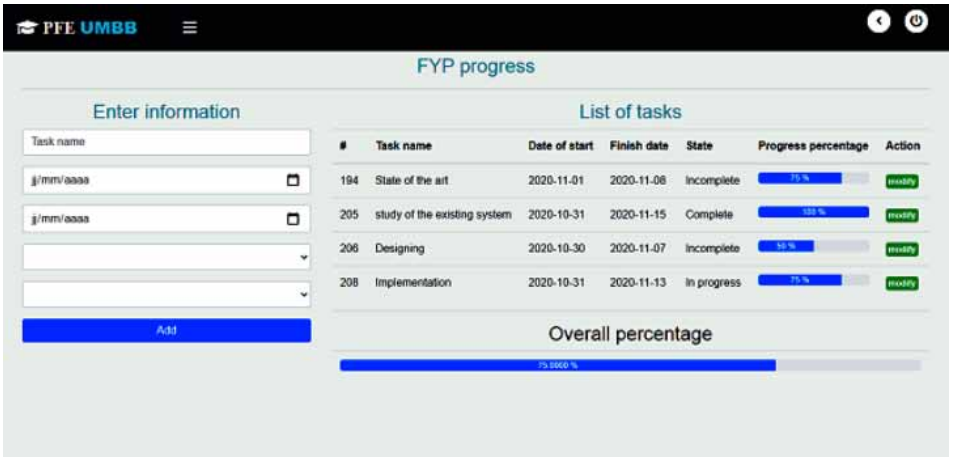


Figure 5. Interface for tracking project progress

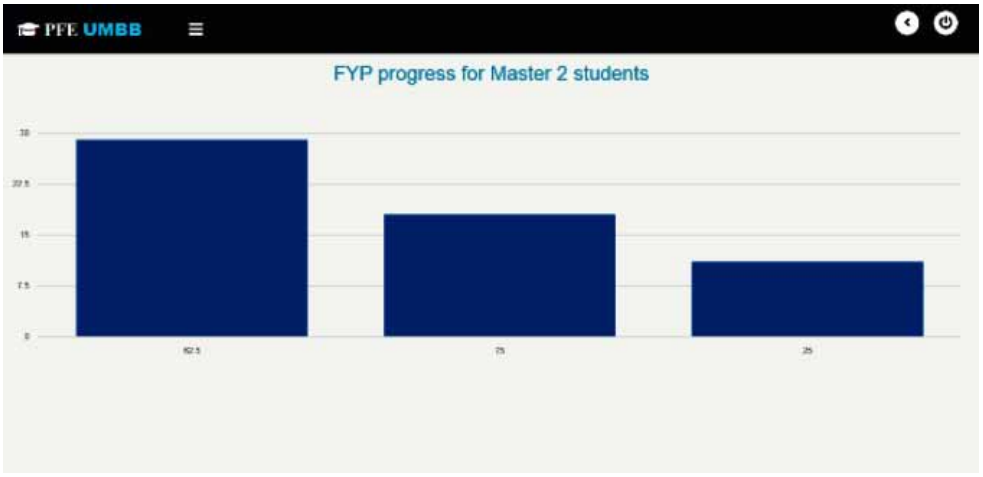


At the approach of the end of the second semester, advisors are required to provide a report about the progress of their students. These reports are a file to be completed with information such as tasks completed, the percentage of tasks, and an estimated deadline.

The department head studies the submitted reports to get an insight into the projects' progress and plans the defense session accordingly. Instead of the manual process, the application provides visual tools for this concern. Figure 6 represents statistics on the progress of Master 2 students in the Department (the number of student groups that reach a given percentage). The department head publishes on the platform the agenda related to project defense, and the pedagogical team provides the information about defenses (committee, date, and place). Students submit project reports for assessment on the platform. Defense committee members are then informed about the submissions and access the reports for evaluation.

The evaluation of the system was performed in the Computer Science Department. The evaluation members included student delegates, advisors, and administrative staff. The presented system has obtained a satisfying official rate. The system was evaluated about the following criteria: virtualization

Figure 6. An example of a reporting function



of the process steps, the ease of use, and response to collaboration requirements. Table 4 details the developed tools at each step of the FYP process. The development of these tools leads to the virtualization of the process. The advisors showed 90% attention to use. The rate of intention to use is 92.8% for students.

Figure 7 depicts the department's online tools before and after the deployment of the proposed system. Figure 6 also illustrates the usage rate of the online tools for each process step. The percentage of each step is calculated as follows: first, a detailed task list for each step is provided. Second, a score of the virtualization of each task is provided for the two cases: before the system development and after the installation of the proposed system. Finally, an average is calculated for each step in both cases. Figure 6 also shows that the production stage has the lowest percentage. This is since the current application does not consider the production of some results such as codes and does not provide advanced editing functions. The high degree of virtualization of the steps related to the processing, awarding, and evaluation of proposals has reduced the processing time related to each step. This additional time was estimated to be 4 weeks and is invested in the completion phase to allow for better student performance and knowledge acquisition.

Figure 8 illustrates the improvement made by the application with respect to the aspects of online collaboration. The four aspects are presented in two cases: before the development of the system and aspects using the developed system. In the first case, the tools considered are the online tools used as official means in each procedure by the department (official social networks, professional emails,

Table 4. Recapitulation of proposed tools

Process Step	Tools proposed by the application
Proposal processing	Online schedule on a common sharing space, projects submission forms, Online discussion space about proposals, Voting option for validation, Project top ten list forms.
allocation	Online top ten list form, Automatic allocation, Publication of the result of the allocation on the system
Project realization	For each project: a workspace containing: Shared resources function, Shared calendars, Redaction space, Progress bar tools & task states, Emails, discussions.
Defense preparation	Announcement space, statistics reporting functions, report submission, evaluation forms.

Figure 7. Online deployment scores for FYP steps

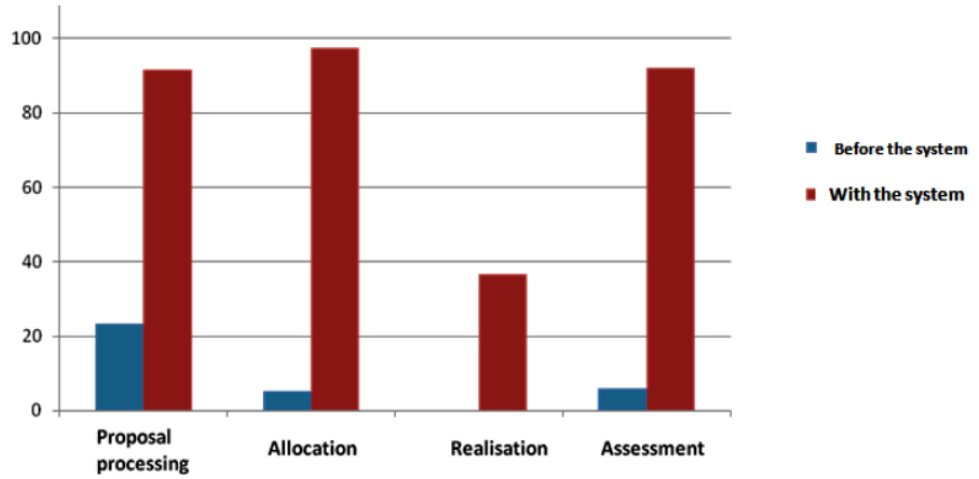
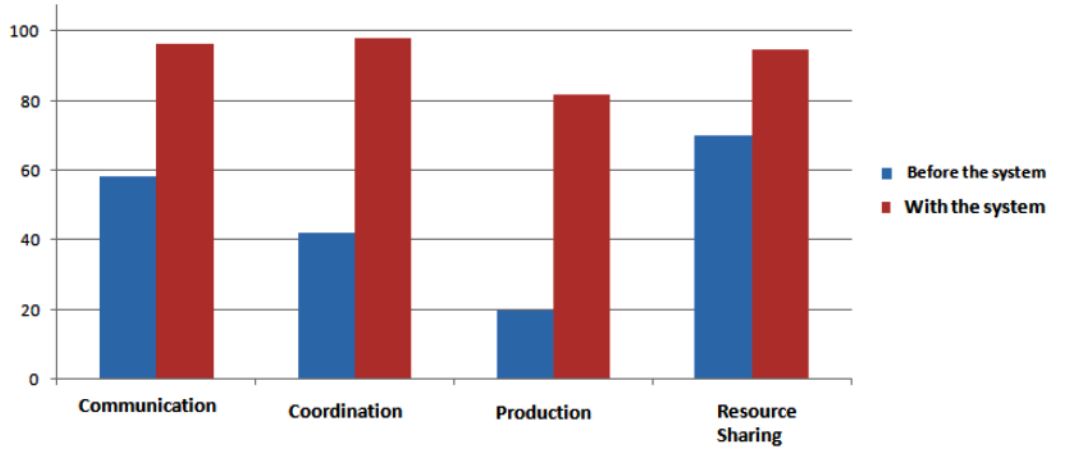


Figure 8. Collaboration aspects improvement



online directories). The improvement study considers the four FYP steps. For example, communication is necessary throughout the process. Therefore, to improve, the ability to ensure communication between all users involved is considered in both directions. For example, prior to the development of the system, communication tools from students to administrative staff and from administrative staff to students did not have the same facilities and were considered as information dissemination. On the other hand, in the second case, with the new system, communication is easy between all users. The scores of the other aspects are provided, for each of them, by citing all the activities that require it. For example, the production function is mostly required by the implementation phase; however, other activities require collaborative production, such as the production of an evaluation form by all members of the defense committee or the production of a final verification report for all projects at the end of the proposal processing stage. A score is assigned to each task based on the tools used to accomplish it, and then an average is calculated for the entire aspect.

CONCLUSION

This paper introduced a collaborative FYP application. The presented system can significantly reduce the users' workload and introduce flexibility during the whole FYP management process. The modules provided address communication, sharing, coordination, and production needs. The modules related to the different user profiles, project proposals, validation, allocation, execution, and defense preparation have been successfully developed. The application is implemented considering a computer science department; however, it generalizes well since state-of-the-art has shown common steps for several disciplines. In the future, we will subscribe to enhancements to the system's functionality, such as online editing and versioning. We also subscribe to student communities based on similarities in the project areas.

ACKNOWLEDGMENT

This research was supported by the Algerian General Directorate for Scientific Research and Technological Development (DGRSDT).

REFERENCES

Abdullah, N., Salleh, S. N. M., Mahdin, H., Darman, R., Daniel, B. D., & Surin, E. S. M. (2018, February). Mitigating Manual Final Year Project (FYP) Management to Be Centralized Electronically. In *International Conference on Soft Computing and Data Mining* (pp. 105-114). Springer. doi:10.1007/978-3-319-72550-5_11

Aiken, M., Wang, J., Gu, L., & Paolillo, J. (2011). An exploratory study of how technology supports communication in multilingual groups. *International Journal of e-Collaboration*, *7*(1), 17–29. doi:10.4018/jec.2011010102

Awad, M. (2017). GPMS: An educational supportive graduation project management system. *Computer Applications in Engineering Education*, *25*(6), 881–894. doi:10.1002/cae.21841

Bakar, M. A., Jailani, N., Shukur, Z., & Yatim, N. F. M. (2011). Final year supervision management system as a tool for monitoring Computer Science projects. *Procedia: Social and Behavioral Sciences*, *18*, 273–281. doi:10.1016/j.sbspro.2011.05.039

Beus-Dukic, L. (2011, August). Final year project: A test case for requirements engineering skills. In *2011 6th International Workshop on Requirements Engineering Education and Training* (pp. 5-8). IEEE. doi:10.1109/REET.2011.6046272

Bringula, R. P., Balcoba, A. C., & Basa, R. S. (2016, May). Employable Skills of Information Technology Graduates in the Philippines: Do Industry Practitioners and Educators have the Same View? In *Proceedings of the 21st Western Canadian Conference on Computing Education* (pp. 1-6). doi:10.1145/2910925.2910928

Buchem, I., Cochrane, T., Gordon, A., Keegan, H., & Camacho, M. (2012). M-Learning 2.0: The potential and challenges of collaborative mobile learning in participatory curriculum development. In *Proceedings of the IADIS Mobile Learning Conference* (pp. 243-252). Academic Press.

Byrnes, K. G., Kiely, P. A., Dunne, C. P., McDermott, K. W., & Coffey, J. C. (2021). Communication, collaboration and contagion:"Virtualisation" of anatomy during COVID-19. *Clinical Anatomy*, *34*(1), 82–89. doi:10.1002/ca.23649 PMID:32648289

Chu, S. K. W., & Kennedy, D. M. (2011). Using online collaborative tools for groups to co-construct knowledge. *Online Information Review*, *35*(4), 581–597. Advance online publication. doi:10.1108/14684521111161945

Clement, R., & Bounds, P. (2013). Making connections between final year students and potential project supervisors. *Proceedings of the HEA STEM annual learning and teaching conference 2013: Where practice and pedagogy meet*.

Craig, K., Humburg, M., Danish, J. A., Szostalo, M., Hmelo-Silver, C. E., & McCranie, A. (2020). *Increasing students' social engagement during COVID-19 with Net. Create: collaborative social network analysis to map historical pandemics during a pandemic*. Information and Learning Sciences. doi:10.1108/ILS-04-2020-0105

De Kleijn, R. A. M. (2013). *Master's Thesis Supervision: Feedback, interpersonal relationships, and adaptivity*. Utrecht University.

Deepamala, N., & Shobha, G. (2018). Effective approach in making Capstone project a holistic learning experience to students of undergraduate computer science engineering program. *JOTSE: Journal of Technology and Science Education*, *8*(4), 420–438. doi:10.3926/jotse.427

Gaines, J., Akintewe, O., & Small, S. (2019). Engineering Design Instruction Using Slack for Project Support and Team-work. In *2019 ASEE Annual Conference & Exposition* (pp. 16-19). Academic Press.

Gardner, M., & Elliott, J. (2014). The Immersive Education Laboratory: understanding affordances, structuring experiences, and creating constructivist, collaborative processes, in mixed-reality smart environments. *EAI Endorsed Transactions on Future Intelligent Educational Environments, 14*(1).

Hüttel, H., & Gnaur, D. (2019). A Web-Based Platform for Competence Development in PBL Supervision. *International Journal of e-Collaboration*, *15*(3), 20–33. doi:10.4018/IJeC.2019070102

Jailani, N. I. S. I., Ali, A. F. M., & Ngah, S. (2022, May). Final Year Project Allocation System Techniques: A Systematic Literature Review. In *2022 IEEE 12th Symposium on Computer Applications & Industrial Electronics (ISCAIE)* (pp. 99-104). IEEE.

Jones, M. (2012). The Evolution of Digital Technologies–from Collaboration to eCollaboration–and the Tools which assist eCollaboration. *Issues in Informing Science and Information Technology*, *9*, 209–219. doi:10.28945/1617

Leung, C. H., Lai, C. L., Yuan, T. K., Pang, W. M., Tang, J. K., Ho, W. S., & Wong, T. L. (2015). The development of a final year project management system for Information Technology programmes. In *Technology in Education. Transforming Educational Practices with Technology* (pp. 86–97). Springer. doi:10.1007/978-3-662-46158-7_9

Leung, K., & Chu, S. K. W. (2009, December). Using wikis for collaborative learning: A case study of an undergraduate students' group project in Hong Kong. In *The International Conference on Knowledge Management* (pp. 1-14). https://web.edu.hku.hk/f/acadstaff/447/2009_wiki_learning.pdf

Naeem, U., Islam, S., & Siddiqui, A. (2019, April). An Effective Framework for Enhancing Student Engagement and Performance in Final Year Projects. In *2019 IEEE Global Engineering Education Conference (EDUCON)* (pp. 401-410). IEEE. doi:10.1109/EDUCON.2019.8725253

Prinz, W., Martínez-Carreras, M. A., & Pallot, M. (2012). From collaborative tools to collaborative working environments. In Advancing Collaborative Knowledge Environments: New Trends in E-Collaboration (pp. 1-10). IGI Global. doi:10.4018/978-1-61350-459-8.ch001

Raposo, A. B., Magalhães, L. P., Ricarte, I. L. M., & Fuks, H. (2001, September). Coordination of collaborative activities: A framework for the definition of tasks interdependencies. In *Proceedings Seventh International Workshop on Groupware. CRIWG 2001* (pp. 170-179). IEEE. doi:10.1109/CRIWG.2001.951845

Romdhani, I., Tawse, M., & Habibullah, S. (2011, January). Student project performance management system for effective final year and dissertation projects supervision. *London International Conference on Education.*

Roschelle, J., & Teasley, S. D. (1995). The construction of shared knowledge in collaborative problem solving. In *Computer supported collaborative learning* (pp. 69–97). Springer. doi:10.1007/978-3-642-85098-1_5

Rozenes, S., & Kukliansky, I. (2013). An Embedded Approach for Project Management Learning Process. *International Journal of Information Technology Project Management*, *4*(3), 38–49. doi:10.4018/jitpm.2013070103

Sadik, A. (2017). Students' acceptance of file sharing systems as a tool for sharing course materials: The case of Google Drive. *Education and Information Technologies*, *22*(5), 2455–2470. doi:10.1007/s10639-016-9556-z

Shamir-Inbal, T., & Blau, I. (2021). Characteristics of pedagogical change in integrating digital collaborative learning and their sustainability in a school culture: e-CSAMR framework. *Journal of Computer Assisted Learning*, *37*(3), 825–838. Advance online publication. doi:10.1111/jcal.12526

Singh, V., & Mayer, P. (2014). Scientific writing: Strategies and tools for students and advisors. *Biochemistry and Molecular Biology Education*, *42*(5), 405–413. doi:10.1002/bmb.20815 PMID:25052425

Stevenson, D., & Starkweather, J. A. (2017). IT project success: The evaluation of 142 success factors by it pm professionals. *International Journal of Information Technology Project Management*, *8*(3), 1–21. doi:10.4018/IJITPM.2017070101

Tarazi, J., & Akre, V. L. (2013, December). Enabling e-Collaboration and e-Pedagogy at an Academic Institution in the UAE. In *2013 International Conference on Current Trends in Information Technology (CTIT)* (pp. 118-124). IEEE. doi:10.1109/CTIT.2013.6749489

Tiwari, G., Singh, R., Chandna, V. K., Shimi, S. L., & Jain, M. (2019). Outcome-Based Assessment of Engineering Undergraduate Final Year Projects for Tire-2 Institutes. In *Third International Congress on Information and Communication Technology* (pp. 211-221). Springer. doi:10.1007/978-981-13-1165-9_19

Wrench, J. S., & Punyanunt, N. M. (2004). Advisee-advisor communication: An exploratory study examining interpersonal communication variables in the graduate advisee-advisor relationship. *Communication Quarterly*, *52*(3), 224–236. doi:10.1080/01463370409370194

Yilmaz, M., Tasel, F. S., Gulec, U., & Sopaoglu, U. (2018). Towards a process management life-cycle model for graduation projects in computer engineering. *Plos One, 13*(11), e0208012.

Razika Lounas is a lecturer at the Computer Science Department and a researcher at LIMOSE Laboratory at the University of Boumerdes. She received her PhD from Boumerdes University, Algeria and Limoges University, France in 2018. Before that, she received her Magister Diploma form the Boumerdes University and her Diploma of Computer Engineering at the Tizi Ouzou University, Algeria. Her main research interests are dynamic software updating, formal methods and Internet of things. She has a ten years of experience in teaching the design and development of collaborative applications for MCS students at Boumerdes University. She supervised more than ten final year projects about collaborative applications from both academia and industry.

Ikram Hamzaoui is a software engineer. She reeived her MCS degree from Boumerdes University in 2020. Her principal interests are Software design, software development, distributed applications, collaborative applications.

Naima Bouguelmouna is a software engineer. She received her MCS degree from Boumerdes University in 2020. Her main interests are software design, software development, distributed applications, collaborative applications.

Hocine Mokrani is an associate professor at the department of computer science of the Boumerdes university (Algeria) and a researcher at the LIMOSE laboratory (Laboratory of Computer Science, Modeling and Optimization of Systems). He received his Ph.D. degree from Telecom Paris School (France) in 2014. His main research interests are System on Chip specification, Internet of Things, and the use of formal methods to prove the correctness of these systems. He has eight years experience in teaching the design and development of software systems, formal methods, and computer architectures for MCS students at Boumerdes University (Algeria).