

ACTIVATION, MOTIVATION AND SUPPORT OF LEARNING PHOTOGRAMMETRY AT THE BACHELOR'S LEVEL

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ABSTRACT:

Students at the Bachelor's level were activated with two new exercises. The first exercise was realized with the first-year students. For this exercise, a new database for supporting learning, teaching and research on photogrammetry, laser scanning and remote sensing was developed. The students were asked to weekly recapitulate lecture materials, search additional information from the Internet and add interesting Internet links to the database. The second exercise was applied with the second-year students. In this exercise, the student groups were activated by the means of the Problem Based Learning with the focus to develop a photogrammetric innovation to a private company or a public organization. However, the innovation was only prospected and not implemented. This exercise has obtained positive feedbacks from the students. The most important, the exercise seemed to increase intrinsic motivation of the students. During both exercises, students updated a blog in the e-learning environment "Optima", which has proven to be flexible practice for both the students and the staff.

1. INTRODUCTION

Motivation is one of the main driving forces in learning. Motivation can be divided into intrinsic and extrinsic motivation. When extrinsic motivation requires some reward, such as grade, money or awards, intrinsic motivation need only internal feeling of satisfaction (Walker et al., 2006). Both types of motivation can have several sub categories and additionally there is "amotivation", which refers to lack of motivation (Faye and Sharpe, 2008). In some cases, extrinsic motivation may lead students to perform minimum effort to achieve, for example, a grade. On the contrary, intrinsic motivation may lead to maximum effort and performance. Unfortunately, it is much easier to use tools to create extrinsic motivation than to wake student's intrinsic motivation. Surveying sciences includes great variation of focus areas and many students in the beginning of the Bachelor's level have not yet decided their major and minor subjects, which may cause lack of direction and intrinsic motivation.

Teaching requires constant refreshing and development. Besides lecturing, exercises, interactive e-learning (e.g. Höhle, 2004; Schrotter et al, 2007; König, 2009) and student derived learning, such as Problem Based Learning (PBL) (e.g. Gomes Pereira and Oliveira, 2004; Enemark, 2009) can be more activating and thus assisting students to find intrinsic motivation. In order to gain and maintain motivation and to transform motivation into successful learning process, students also need teaching, tools and practice on general skills, such as information acquiring, source information criticism, learning techniques, group work, presentation, communication, goal setting, collaboration, innovation know-how, business thinking, scientific writing and programming skills, just to name a few. Students who are intrinsically motivated and enchanted with general skills are well able to self-regulate their studies, which builds a strong base for lifelong learning. E.g. Dinevski and Dinevski (2004) discuss more about the role of universities on lifelong learning.

The aims of this paper are to highlight a new database that collects information on photogrammetry, laser scanning and remote sensing, and to describe also a new PBL-based exercise on photogrammetry. Both the new database and the PBL-based exercise are applied to support learning, to encourage students to be active and to increase motivation towards photogrammetric studies.

2. TEACHING OF PHOTOGRAMMETRY IN AALTO UNIVERSITY AT THE BACHELOR'S LEVEL

Aalto University is a new university in Finland. However, it was established by merging three previously existing universities: Helsinki University of Technology, Helsinki School of Economics and University of Art and Design Helsinki. Institute of Photogrammetry and Remote Sensing that was within Helsinki University of Technology continues its teaching and research in Aalto University School of Science and Technology as a part of Geomatics.

Institute of Photogrammetry and Remote Sensing uses currently a progressive learning model (Koistinen et al., 2008) meaning that at least one course in photogrammetry and remote sensing is available every year during the studies. At the first year, the course "Fundamentals of Photography, Photogrammetry and Remote Sensing" (4 credits, 1 credit = 1 ECTS credit) is given, which is obligatory for all students within the Department of Surveying. Therefore, this course has students from both B.Sc. degree programs available in the Department of Surveying: Geomatics and Real Estate Economics. The first exercise using the new database is integrated in this course.

At the second year, two courses are provided: "Fundamentals of Photogrammetry" and "Fundamentals of Remote Sensing". Both courses give 3 credits when completed. These courses are aimed mainly for students in Geomatics. An innovation-oriented exercise, which has been described more detailed later

in this paper, is realized in the course “Fundamentals of Photogrammetry”.

“General Photogrammetry” (3 credits), “Digital Image Processing” (4 credits) and “General Remote Sensing” (3 credits) are aimed to be completed during the third year of studying. These courses are obligatory only for those students who select the major in Geodesy and Photogrammetry. When Bachelor’s thesis (10 credits) is completed as well, the total amount of studies in photogrammetry and remote sensing is 30 credits. Together with general studies, such as mathematics, physics, languages and computing sciences, students get an appropriate degree for the Bachelor of Science in Technology, which fulfil the requirements of the Bologna declaration.

As can be seen from the structure of our study program, each year the amount of students is decreasing because of their selections what to study. Typically, the amount of motivation of students varies considerably during the first two or three years of studying. In order to assist students to find their motivation and direction of studies, the first and second years of studying are highly important.

3. NEW DATABASE FOR SUPPORTING LEARNING

In 2009, we developed an open database, which is dedicated for collecting Internet links that could assist learning, teaching or research in the fields of photogrammetry, laser scanning and remote sensing. One reason to develop such focused database is that even if modern search engines find efficiently material from the Internet, they are not able to find, e.g., images and video clips if they do not originally have inclusive descriptions about the contents.

3.1 Structure and functions of the Foto.hut.fi database

The Foto.hut.fi database is accessible for any Internet users and is available in <http://foto.hut.fi/opetus/foto/index.php>. Figure 1 illustrates the current layout of the opening page of the database. Adding new information to the database requires registration, but searching links is open to everyone. When adding a new link, several information fields can be attached to them, such as name or header of the material, original author of the material, original source of the link, publishing date, research subject, category of the contents, material type, and keywords. In addition, it is possible to choose a course provided by the Institute of Photogrammetry and Remote Sensing that relates to the link.

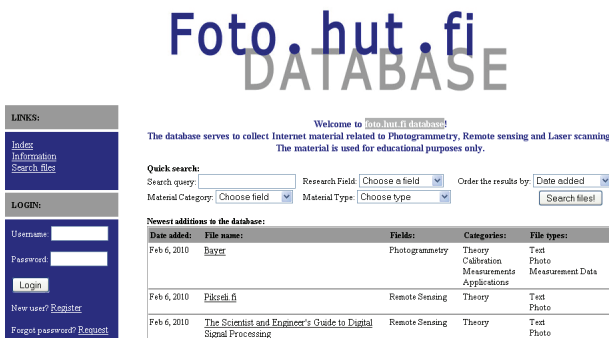


Figure 1. The main page of the “Foto.hut.fi” database.

The database was created using MySQL and the user interface programmed in HTML and PHP using CSS stylesheets. The database structure consists of nine related MySQL tables. The six main tables are: the link information (files), related Aalto University courses (courses), material category (category), material types (types), user reviews for the link relevance (reviews), and registered database users (users). As any link can be related to multiple material categories, material types or courses, three link tables (file_courses, file_categories and file_types) were created to normalize the many-to-many relations. The structure of the database is illustrated in Figure 2.

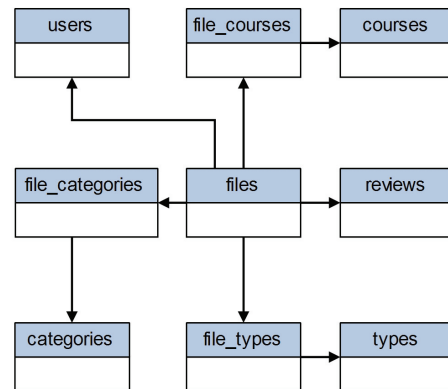


Figure 2. The structure of the Foto.hut.fi database.

Registered database users are divided into “users”, “moderators” and “owners”. All registered users can add new files to the database and edit the files they have added earlier. Moderators can edit all files but only owners can delete content from the database permanently or update a regular user into “moderator” or “owner” status. User login is managed with PHP sessions.

For moderators and owners, the database has dedicated “Admin” pages that allows management of registered users, material categories, material types and university courses. In addition to editing existing information, moderators and owners can add new material categories, material types, and university classes. This feature will enhance the use of the database in future, allowing more flexibility to database administration.

3.2 Exercise with the Foto.hut.fi database

The new database was integrated in an exercise within the course “Fundamentals of Photography, Photogrammetry and Remote Sensing”. The aim of the exercise was to encourage students to weekly recapitulate lecture notes and to get familiar with searching additional information from the Internet. As a side effect, the database was filled with links, which students can later utilize to support their learning.

The students were informed to select weekly couple of keywords from the lecture notes. Using these keywords, they searched Internet links that provided some additional information or illustration about the subject in focus. These Internet addresses were added to the database with a description and keywords. As a result, over 400 links were added in the database by the students within couple of months. It appeared that the selected keywords were often chosen to gain additional information on a new term or a difficult subject, or as a result of personal interest in a certain topic. In addition, the reliability of

the Internet links was considered as an important adding criterion.

During the whole period, the students updated blogs, which were stored in an e-learning environment “Optima” (Discendum Oy) provided by the Aalto University. In these blogs, the students justified their reasons for adding the chosen links to the database. Moreover, the blogs were utilized to receive exercise feedback from the students. By reading the blogs, the instructors of the exercise were also able to monitor the students’ progress with the exercise. The usage of the e-environment possessed the benefit of flexibility. In other words, the students could perform the weekly tasks outside of the campus, if necessary.

The total amount of time students needed to complete the database exercise varied from a few to over 10 hours. As expected, motivated students spent considerably more time exploring the discovered Internet sites compared to others. Some students highlighted that it was sometimes time-consuming to find a good and reliable Internet link that had not already been added to the database. However, the workload of the exercise was considered reasonable.

The feedback about the database exercise divided strongly among the students. The values in Table 1 are estimated from the free-text feedback, thus to be taken only as suggestive information. However, the effect of intrinsic motivation seems to be significant to the results. Some students believed that the exercise would benefit them in their future studies, while others considered the exercise fully unnecessary. Generally, the divination seems to relate with the students’ B.Sc. degree program. In this case, it is expected that occurred amotivation towards this exercise and course is caused by strong focus and motivation towards other subjects.

Table 1. The effect of intrinsic motivation to the opinions about the database exercise.

| | Positive | Negative | Neutral | Total |
|--------------------|----------|----------|---------|-------|
| Motivated | 14 | 4 | 4 | 22 |
| Amotivated | 2 | 18 | 5 | 25 |
| Motivation unknown | 7 | 4 | 7 | 18 |
| Total | 23 | 26 | 16 | |

A general opinion in the feedback was that the exercise did not help directly with passing the exam of the course this time. However, especially the students not having the opportunity to attend course lectures felt that the exercise encouraged them to follow the course content regularly.

The future potential of the database divided opinions among the students as well. Some students questioned the usefulness of the database, because they felt that the corresponding links could be directly discovered in Google with less effort. On the other hand, many students believed that continuous maintenance would help to improve the usefulness of the database.

4. INNOVATION-ORIENTED EXERCISE

The innovation-oriented exercise in photogrammetry has been realized in the course “Fundamentals of Photogrammetry”. In the students’ second year of studies, the ideas and knowledge of the field are still relatively small. The main objective of the

innovation-oriented exercise in photogrammetry is to motivate students towards photogrammetric applications.

In the innovation-oriented exercise, the students develop innovative photogrammetric concepts for existing companies. During this exercise, the students get in touch with a private company or a public organization, which seem to motivate more on finishing the exercise with good results. In addition, they are able to discover how photogrammetry is utilized in practical working environments. By having a closer contact to the authentic working environment, the exercise feels also more meaningful for the students. They are part of a real activity and the results of their innovative output can actually be utilized in the companies.

In addition to the improvement of the motivation, other benefits have been obtained during the exercise as well. By implementing the PBL, the students learn important skills, such as working in groups, searching for information, analyzing it, scientific writing, presenting, and communicating with companies, just to name a few.

4.1 Realization of the exercise

The students work in groups and create novel ideas and innovations for the companies or organizations in the field of photogrammetry. Each group selects one hosting company, which has agreed to be available for the exercise. No financial investments were required from the companies. Students visit the company a couple of times in order to explore the products, applications, services, and other functionalities of the company. During the visits, they also have a great opportunity to discuss about the needs, bottlenecks and other areas, which could be good starting points for the innovation.

The exercise takes place during the whole period of seven weeks. Overall, the students are relatively free to choose the topic of the innovation. However, the topic has to be related to photogrammetry. Naturally, the opinions of the company are recommended to be taken into account as well. The implementation is not part of the exercise. Therefore, the idea for the innovation can also be something futuristic, which is not yet feasible at that time.

Each week, the students are expected to use four hours in average for the exercise. A relatively detailed timetable is recommended to be followed during the period in order to divide the workload equally for the whole time (Table 2). Each of the group of students has a personal tutor from the teaching staff of the Institute of Photogrammetry and Remote Sensing.

The innovation-oriented exercise in photogrammetry has so far been implemented two times, in 2009 and 2010. The topics of the exercise have been widely spread across the entire fields of photogrammetry and laser scanning.

As the examples of innovation topics, the students have concentrated on the stereographic visualization of laser scanning point clouds, integration of data from multiple sources, new and innovative applications for laser scanning data, new ideas for the realization of the aerial photography signalization, possible ways for the change detection of dams, and visualization of photogrammetric products in mobile phones. The subjects always deal with the field of interest of the hosting company.

The resulting reports have been surprisingly extensive, innovative and of high quality. Taking into account the low experience and knowledge towards photogrammetry, the outcome has been excellent. This denotes that the students have truly taken effort for the development of new ideas and searching for information previously unknown to them.

Table 2. Timetable of the innovation-oriented exercise.

| | |
|--------|--|
| Week 1 | <ul style="list-style-type: none"> - Starting event for the whole course <ul style="list-style-type: none"> o Creation of groups o Company selection for each group - Contact to the company during the next days - 1-2 group meetings |
| Week 2 | <ul style="list-style-type: none"> - Collect data of the company, it's activities, applications, clients, products from the web - Preliminary conversation within the group about the innovation possibilities |
| Week 3 | <ul style="list-style-type: none"> - Visit the company - 1 group meeting - Selection of the area(s), where you start generating the innovation <ul style="list-style-type: none"> o preliminary conversation about the topic - 1 group meeting <ul style="list-style-type: none"> o Focus on the area of innovation and work on it |
| Week 4 | <ul style="list-style-type: none"> - Visit in the company again during this or next week <ul style="list-style-type: none"> o Find out more about the selected innovation area - 1 group meeting <ul style="list-style-type: none"> o Work on innovation |
| Week 5 | <ul style="list-style-type: none"> - 1 group meeting <ul style="list-style-type: none"> o Work on innovation - 1 group meeting <ul style="list-style-type: none"> o Work on innovation o Prepare a report - Return the report |
| Week 6 | <ul style="list-style-type: none"> - Closing event for the exercise <ul style="list-style-type: none"> o Each group presents their innovation and act as an opponent for the work of another group in a seminar - Present the innovation to the company as well |
| Week 7 | |

4.2 Implementation of PBL

In the innovation-oriented exercise, Problem Based Learning method (PBL) is applied. Typically, the PBL method includes seven steps (Wood, 2003). However, for this exercise the amount of steps has been reduced to five. The following instructions were given to the students to be followed.

In every meeting, a chair and a secretary is selected among the students of the group. The chair takes care of the timetable and the working order. The secretary, respectively, writes notes from the meeting. Every student should act as a chair and a secretary at least once during the exercise. The meetings should include the five steps as presented below.

Step 1. "Defining the problem". The purpose is to define the subject and give an overall description for the selected innovative issue.

Step 2. "Brainstorm". In the brainstorm phase, there should be no critic toward any thoughts by the group members. Instead, all the ideas related to the subject are brought together. In practice, for example, the following procedure can be utilized: Everyone has some time to write his/her thoughts related to the subject to his/her own paper. Finally, all the ideas are brought together. The aim of the procedure is proactive, i.e. to put emphasis on interaction between the fresh ideas rather than previous knowledge.

Step 3. "Analysis of the problem and defining the learning objectives". The thoughts which were brought together will be divided into "facts" and "opinions". Based on these, it can be defined which areas need more studying before starting to create solutions for the problem. The common learning objectives will be documented.

Step 4. "Self-study". In contrast to the traditional group working method, the self-study part should not be divided into sub tasks between the group members. Instead, everyone search information according to the common learning objectives, which were defined in the previous step. The aim is that in the next meeting every member of the group is an expert of the same subject. An extra value becomes from the fact, that every student approaches the learning objectives naturally from a slightly different viewpoint.

Step 5. "Collecting and evaluation of findings from the self-study phase" (in the next meeting). All the new information gathered by the group members will be combined into one entity. The group will evaluate the success in reaching the learning objectives. At this point, the group should have enough knowledge to develop new solutions to the defined problems.

4.3 Communication and reporting

During the exercise, the students report the progress of the work after each meeting by writing a blog. These blogs are stored in the e-learning environment "Optima", where the tutors can read blogs and, thus, monitor the progress. Additionally, optional weekly gatherings for the group members have been arranged in order to have a close contact with the tutor. Many student groups utilize this option, since it is an easy way to find time and a place to meet within the group. Moreover, the weekly meeting is an effective way to receive help from the tutors.

At the end of the exercise, the student groups prepare a report of the innovation. The report includes the explanation of the new ideas and a plan for the possible implementation. The results of the work are presented in a final seminar. In addition, each group is asked to be opponents for another group. The results are reported to the companies as well.

4.4 Results from the feedback in 2009 and 2010

The innovation-oriented exercise has been executed two times so far, in 2009 and 2010. Altogether, there have been 20-30 students attending the course each year. An extensive feedback has been collected to gather students' opinions about the exercise. The questionnaire contained several questions related to organization of the exercise, experiences workload, co-operation with the hosting company, group working, and the increase of the motivation during the exercise (Table 3).

Table 3. Statistics for the different groups of questions.

| | 2009 | | 2010 | |
|---------------|------|------|------|------|
| | n | mean | n | mean |
| Organization | 219 | 3.8 | 252 | 3.7 |
| Workload | 63 | 3.4 | 69 | 3.2 |
| Companies | 63 | 3.3 | 68 | 3.0 |
| Group working | 110 | 3.7 | 115 | 3.7 |
| Motivation | 242 | 3.3 | 276 | 3.5 |

In the questionnaire, the students answered the multiple choice questions with scale 1-5 (1 = strongly disagree, 2 = disagree, 3 = don't know, 4 = agree, 5 = strongly agree). The higher the mean value is, the better the various aspects of the exercise were considered by the students in average. Symbol n describes the number of answers to the specific category of the questions.

Overall, the results are very positive. All the mean values, both in 2009 and 2010, are equal or above 3. The organization of the exercise and the functionality of the group working among the students, in particular, were estimated to be very successful.

The workload of the exercise divided students' opinions. Some of them considered it to be in balance with the study credits, others felt that the amount of work was slightly overwhelming. The nature of the exercise is towards creativity since no clear instructions are given, which may have caused stress among some of the students. However, most of the students found it easy to find time for the exercise. In addition, the learning was perceived to be efficient compared to the received study credits.

The companies have been advised for the exercise. Most of the students visited the hosting company or organization two times during the exercise and the reception was experienced welcoming. However, the communication between the students and the companies contact persons could have been even more active. In many cases, only the minimum contact opportunities were utilized.

The improvement of the motivation during the exercise was determined by several questions. Most of the students felt that the hosting company increased the amount of motivation. Similarly, the larger project work was considered as an effective learning method. The usefulness of the exercise was important for many of the students, as well as the interesting and up-to-date topic for the innovation. Majority of the students felt that the motivation towards photogrammetry increased.

The students considered development of the innovation highly interesting. In addition to the students own information retrieval, the lectures in the course gave many ideas for the innovation topic. Some of the groups would have been eager to continue the further development if the time and resources would have allowed such a work. These groups felt that the companies could actually benefit from the new ideas.

The cooperation between the students and the companies is complementary. On the other hand, the students develop new ideas for the companies, but on the other hand, the students get familiar with existing practices in the photogrammetric field. Moreover, the students get to know their possible employers and the companies meet their future employees. For example, some students got summer or part time jobs from the company hosting the exercise. The companies have experienced the exercise as a refreshing activity and that it is worth of keeping it in the course program.

5. DISCUSSION

Because of the database exercise, the Foto.hut.fi database has now several hundred Internet links available to any user. The experiences with the exercise revealed how essential intrinsic motivation is when extrinsic motivation, such as obligatory exercise, is utilized. It was quite obvious that this exercise could not increase intrinsic motivation among the amotivated

students. In opposite, these students felt that the exercise forced them to do extra work and therefore disliked it. On the other hand, the exercise succeeded to activate students with any amount of motivation. As an alternative for applied obligatory exercise, students could be given extra credit for filling the database with new links. In that case, amotivated students might be more willing to complete the exercise and some of them could even become inspired by the subject as well.

Some students suggested that the database exercise would benefit them more if the exercise would help them to identify the most crucial contents of the course. This could be accomplished with a small questionnaire for lecture subjects, for instance.

In some cases, students remarked that it was difficult to find reliable sources with proper and extensive information, which were not already added in the database. This could indicate that there is relatively small number of excellent Internet sites related to photogrammetry or that these sites are not easily accessible. On the other hand, students' motivation may affect to that how extensive Internet searches they are willing to make. Overall, the exercise has potential to improve students' skills in information searching and source information criticism.

Many of the course attendees believed that the database possesses the potential to be a useful tool in the future. To achieve this, however, the database would require regular updating and maintenance. This calls for descriptive and extensive keywords, as well as regular check-ups in order to erase unsatisfactory sources and broken links. Additionally, user reviews on the existing links would help other users to distinguish helpful and reliable sources.

Because the database exercise was applied at the first time, it will need continuous improvement in the future. The database is growing and, therefore, it will be more difficult to find more relevant links. Thus, the exercise cannot be organized in the current form too many times. It is very likely that in the future the exercise will include possibility to use the database as a source of information as well as to use it as an open access site to store new links.

The innovation-oriented exercise has turn out to be an excellent tool for teaching and practicing general skills as well as the substance of the subject. With the use of PBL method, new ways of group working, communication and acting in various situations has been introduced. The exercise has encouraged the students to take independent responsibility of the task. All of these abilities are extremely important in the real working environments.

The involvement of the private companies and public organizations has brought additional business perspective to the exercise. The situation, where the results of the work are truly useful and can benefit the company, is naturally a supportive source of motivation. Therefore, the companies have had a very essential role in the exercise. According to the feedback from the students, the motivation towards photogrammetry typically increased during the exercise.

The hosting company and the inspiring novel ideas have a significant effect on the pleasant working experiences and the motivation of the students. In addition, the functionality of the group working has an important role in the success of the

exercise. The feedback from the students shows, that the group working has received high grades in both of the years.

The implementation of the innovation-oriented exercise will most probably be continued in the next year, too. There has been conversation among the staff concerning the placement of the exercise in the curriculum. At the moment, the exercise is at the Bachelor's level, whereas there would also be some benefit in executing it at the Masters level. Afterwards, the students possess more knowledge meaning that the innovation ideas could be processed further on and even continue with the implementation. However, with lower level students the ideas are fresh without generalized and standard point of view towards the theory and applications. Additionally, it is important to offer such experiences for young students. After this exercise, they may feel it easier to focus on to the forthcoming studies with better motivation. In the future, the innovation-oriented exercise could continue through several courses. In that case, the students could actually implement their innovations as well. A longer co-operation between students and private companies or public organizations during the studentship would most probably create additional employment opportunities.

6. CONCLUSIONS

A new database for supporting learning, teaching and research on photogrammetry, laser scanning and remote sensing was developed. The database is open access. At the first time, the use of the database was integrated in an exercise in order to activate the first-year students at that Bachelor's level to weekly recapitulate lecture material, search additional information from the Internet and add interesting Internet links to the database. As a result, the exercise succeeded with these objectives.

The additional interest was towards the effect of the exercise on the motivation of the students. Typically, the exercise appeared to be interesting for those students who already had intrinsic motivation towards the subject. However, the unmotivated students felt that the exercise did not provide much additional value to the course but only increased the workload.

In the future, it is expected that the Foto.hut.fi database will grow and become a useful tool to support learning photogrammetry, laser scanning and remote sensing. The global significance of the database depends on how other universities internationally adopt the database for their use. However, at the Aalto University, the use of the database is already locally utilized.

An innovation-oriented exercise was realized with the second-year students for the second time. This exercise was completed using PBL method in groups assisted by tutor from the university staff. The exercise was completed having keen co-operation with real companies. The exercise has proven to be versatile providing excellent opportunity to teach and learn general skills as well as the substance. Most importantly, the exercise seemed to increase students' intrinsic motivation, which is highly important for forthcoming studies. The exercise received, typically, positive feedback from the students.

In both exercises, students were asked to update regularly a blog about the progress within the e-learning environment "Optima". This practice has appeared to be flexible and useful for both students and staff. In particular, this assisted the staff

with monitoring how students were progressing, and therefore, the staff could interact efficiently with students if they had any difficulties.

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