The Added Values of Investing Efforts in a Summative Information System Task

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Manuscript submitted December24, 2015; accepted: March 23, 2016.
doi: 10.17706/ijeeee.2016.6.2.71-83

Abstract: In this study we followed Information Systems students' performance in summative task in which they were required to demonstrate the knowledge gained during their studies and examined whether there is a connection between the extent of their investment in the task and the type of job they were assigned to after graduation. Data gathered on the extent of advanced technologies used by the students in their task, the time spent on the learning of the technologies used, the goals they were motivated by during the task and the job they found after graduation. Analysis of the data revealed 1) only a third of the students chose to invest time and efforts in learning new technologies 2) while all the students were motivated by performance goals, majority of high-achievers and few medium achievers were also motivated by mastery goals 3) students that invested more time and efforts in learning new technologies for their task found rewarding job while students who did not found less attractive jobs if any.

Key words: Summative task, self-regulated-learning, performance and mastery goals.

1. Introduction

According to Information Systems (IS) curriculum [1], most IS programs must include a summative project in their curriculum, in which the students design and implement a complete information system. The students find a potential customer, compose an initiation document in which they project feasibility is examined, compose a specification document in which the software specifications are provided, develop an information system that follows the design, and hand user and maintenance guide.

Students choose the technologies (i.e., programming environments) to be used for the implementation of their information system. While some students choose advanced technologies (i.e., beyond what has been learned during studies), others are satisfied with the basic technologies they are already familiar with. Evidently, projects in which advanced technologies are used require much more efforts to be invested than projects that are based on basic technologies.

While working on project that is implemented based on technologies that have already been learned, leave time for the students to invest efforts in other tasks during their studies, there are still quite a few reasons why they should invest efforts in learning new technologies for the development of their summative project. The main motivation would probably be to get employers' attention. As graduates, the students usually lack real-world experience, and the summative project is the only professional 'business card' they come with. Hence it is important that their project would be impressive in order to gain advantage over other candidates. Projects that are implemented by the use of new and advanced

technologies can make the right impression on the recruiters, and provide the graduates with a good starting point in their job seeking.

Another reason to invest efforts in learning and utilizing unfamiliar technologies in the summative project is that these technologies are address the project's requirements better than technologies that were learned during studies. Additional reasons may refer to the students' will to expand their professional knowledge and gain mastery over additional technologies, self-challenging with advanced tasks, development of self-learning skills and so forth.

The students that decide to take the opportunity and exploit the summative project to enhance their knowledge and skills, have to cope with many knowledge gaps. The academic courses they take during studies are usually focused on theoretical concepts, and use technologies mainly to illustrate and practice the theoretical materials. The students are usually introduced with elementary features of the technologies, and are not exposed to more advanced ones. For example, when studying to build HTML pages, they are introduced with basic HTML tags such as headers, and paragraphs in order to explain the structure of an HTML page. However, new advanced tags such as canvas and video will probably not be shown. When constructing the information system's web pages, the students will have to close the knowledge gaps and learn how to use these new elements, otherwise their project will be elementary and unimpressive.

Among the students that invest efforts in learning advanced technologies, there are several levels of efforts investments. While some choose a technology they have learned during studies and explore only **few** advanced features that had not been learned, others may prefer to gain mastery over **many** of such advanced features. There might be students who may choose to invest efforts in technologies completely new to them (e.g., new programming language, new environments) and gain mastery over its elementary and advanced features. Clearly, minor extension of technology that had been learned before is easier to accomplish than major one, and this in turn is easier to achieve than leaning new technology. The students make their own decisions as regard to the extent of efforts they are willing to invest.

Since the closure of knowledge gaps are the students' responsibility, they have to be able to learn by themselves, which means applying independent learning skills. Independent learners set goals for their learning, demonstrate curiosity and persistence, use critical thinking and able to reflect on their learning outcomes [2]. Using self-regulated learning theory terms, students are involved in a cyclic process in which they set learning goals, plan how to achieve them and evaluate their progress [3], [4].

The research aims were to explore the perceptions of Management Information Systems (MIS) students of the summative project and its goals, and how these perceptions affect their decisions and actions regarding the efforts they invest on the summative project. The research questions deriving from the above aims are:

1) What was the extent to which students used advanced technologies in their summative projects with relation to their academic achievements?
2) What were the students' perceptions regarding the summative projects and their goals with relation to their academic achievements?
3) What were the roles graduates were assigned to after graduation and whether there is a connection between these roles and the investment in the summative task?

The rest of this paper is organized as follows. We first provide a brief description on the context of the study, then a theoretical background is presented followed by the research method. Next we present the results and discussion and finally concluding remarks are presented.

2. The Context of the Study

During the last year of studies, MIS students are required to build a complete information system with all

the accompanying documentation. They do it as part of their academic duties, during an annual mandatory course. The students are given the standards expected regarding the level and scope of their summative project. The students are divided into pairs, and each pair is a separate team. The MIS department appoints an advisor to each team, chosen randomly among the faculty staff. At the beginning, the students have to find a customer with a 'problem' that requires an information system as a solution. Than the advisor have to approve the suggested project as such that meets the minimum requirements in terms of size and complexity, and then the actual work begins. The students define and develop a whole information system following a life-cycle of a software system in the real-world. The project includes three main phases: initiation, specifications &design and implementation.

At the initiation phase each team defines the system' goals, the problems to be solved in the current situation, and the system's users. They have to prove that that information system they suggest is feasible, from technological, organizational and financial perspectives. To prove feasibility they should collect information from the system's customer regarding the technologies used and the ability of the Information System department to deploy the suggested system, the potential users' attitude towards the suggested system, and the costs and benefits of using it. They analyze the data collected, and summarize them in an initiation document with recommendations regarding the continuance of the project.

The specification &design phase requires the students to carry out a comprehensive analysis of the proposed system, including specifications of the system's requirements and use cases(i.e., users' scenarios), design of the data model and computerized processes, definition of the software components involved and their interfaces, and more aspects such as information security and system tests. All these specifications and designs are integrated in a design document that is used as the basis for the next phase.

The implementation phase includes programming and integrating of code components following the design document, and documenting the developed system via user guide and maintenance document. The teams are free to choose any technology environment (e.g., programming languages, database management system, network protocols, operating systems, user interface libraries, etc.) that enable them to address the system's specifications and design. In the field of software development there are plenty of environments used in the industry. During studies the students are usually exposed to very few such environments and these are used mainly to demonstrate the theoretical concepts of the field. The students can rely on environments they have learned as part of their academic studies, or they can extend their knowledge beyond that by expanding current knowledge via exploration and use of advanced libraries and component. They can also choose completely new environments that were not learned during their studies and use them to develop their information system.

After the teams finish the implementation of the system, they prepare user and maintenance guides. The user's guide includes explanations about the system functionality with accompanied screenshots, a list of frequently asked questions and information about the support provided by the team. The maintenance guide includes a technical description of the developed system, a list of software components and their descriptions, a list of tools and environments (including specific versions and configurations)that were in use, and a list of software tests and their results.

After the teams deliver the system and the supplement documents, they prepare a poster that summarizes the project goals and the system's features. The posters are printed and presented at a project conference conducted at the end of the last year of studies. At the conference the students present the developed system in front of an audience consisting of project advisors, faculty members, students, alumni and potential employers.

During the academic year, the teams provide monthly report to their advisor, with specific details on the time the spent, the activities they were involved with, and outcomes. The supervisor duty is to monitor the

project progress, provide feedbacks and evaluate the outcomes of every phase. Each artifact is evaluated based on predefined criteria such as correctness, accuracy and completeness.

The use of advanced technologies is not a part of the criteria list; hence students may choose basic technologies for the development of their system and get a good grade. Therefore, students who decide to invest a lot of effort in the project are derived by different motivation. They have to learn by themselves advanced technologies they are not familiar with from their studies, and they take full responsibility to close the knowledge gaps and use these technologies to implement their project. They have to set learning goals and timetable, look for learning materials, invest the time needed to acquire the knowledge and practice it. They should monitor their progress continuously and adjust their learning accordingly.

3. Theoretical Background

In this section we bring a brief literature survey regarding self-regulated learning and related works.

3.1. Self-regulated Learning

Self-regulated learning (SRL) refers to the process in which students organize their thinking, behaviors, and emotions in order to successfully cope with their learning experiences [4]-[6]. SRL is especially important when referring to learning experiences of independent learners. SRL can help students improve their learning and develop their learning skills [7]. It also can help students monitor their learning performance [8], and evaluate their academic progress [9].

Models of SRL are composed from three main cyclic phases: Forethought and planning, performance monitoring, and reflections on performance [3], [4]. Within the forethought and planning phase, students examine and analyze the learning task and set goals toward its completion. To cope with knowledge gaps by self-learning the goal students set to themselves is to close these knowledge gaps. However they may not know the best ways to fulfil their goals. In these cases they can consult with experts such as lecturers or classmates. In the performance monitoring phase, students employ strategies to close the knowledge gaps and monitor the effectiveness of the used strategies for accomplishing the tasks they set to themselves. To avoid fixation by using strategies that do not facilitate the process of closing the knowledge gap, external monitoring and specific feedback from experts can help students consider the use of new strategies. In the third phase, students reflect on their performance and evaluate their achievements both practically and effectively with respect to the strategies they decided to use. These reflections influence students' future planning and goals, and initiating a new cycle to begin. Since after the execution of the above three phases, one never return to the exact starting point, hence we may say that the above SRL model is spiral rather than cyclic.

In the first phase of the cyclic model of SRL the students has to set learning goals and achieve them by monitoring their learning process. In our case, an external goal is set for the students, to plan and develop a summative project. However, although the general goal is external, and stems from the need to provide a working system, some of the students set to themselves internal goal which is to develop a project using innovative environments which requires completion of knowledge. The completion of knowledge is project oriented. That is, the students learn the necessary information they need to successfully accomplish their project. During the learning of theses environments the students can reveal additional options that might improve their developed system further. Hence the learning process is dynamic and last as long as the students believe there is more in the technology to discover.

Zimmerman [5] found that in SRL, motivation can have a pivotal impact on students' academic outcomes and that without motivation SRL is much more difficult to achieve. In the context of this study in which students are engaged in the project, the ones who decide to use new technologies and as a result have to invest efforts in gaining mastery of these technologies are motivation-driven [10].

To be able to overcome knowledge gaps in general, and in the area of information technologies in particular, the students have to develop independent learner skills [2]. Independent learner has to be curios, self-motivated, critical thinker, self-examiner and persistent. As to curiosity, independent learner has to be proactive and seeks for ways to widen his knowledge by himself. As to self-motivation, independent learner is motivated by setting goals to achieve and is driven mainly by his own personal achievements. As to critical thinking, to function effectively as an independent learner, one has to be able to filter important information from a given one and to be able to assimilate new knowledge with existing one and not just memorize new facts. As to self-examination, independent learner has to possess monitoring skills that enable him to navigate his learning process and to be aware to his strengths and weaknesses. As to persistence, Independent learner strives to understand new knowledge on his own before asking for help.

3.2. Related Works

Integrating a summative project in the IS curriculum stems from the Experienced-based learning approach [11]. Mills & Treagust [12] reported on modifications made in the Engineering disciplines curriculum to address calls from industry on what they need from engineering graduates. Following these calls, many universities integrated into the curriculum project-based components in which students have the opportunity to cope by themselves with complex tasks resembling real world situations. McDermott & Machotka [13] presented the final year project as a capstone course and described its merits. Among these merits are shaping practical skills on top of theoretical knowledge gain in early study years.

Despite the existence of an extensive literature on project-based learning [14]-[16], we found no studies that explored in depth the relationship between the investment in the project and the quality of jobs and roles students joined after graduation. Our research is pioneering in that it examines the extent of the students' investment in the project and their expectations of it (mastery and performance goals). The study also offers insights into project-based courses to make them more effective in preparing students to vocational career in the IS field.

4. The Study

In this section information regarding the following is presented: the research population and the environment in which the research took place, data collection and analysis tools.

4.1. Environment and Population

The study subjects were Management Information Systems (MIS) students who in their last year of studies of the years 2013 and 2014 from a regional academic college. In these study years about 70 students graduated and 64 students out of them consented to participate in the study and fill the research questionnaire. About third of them were female students and all of the participants represent all talent levels. Majority of the students were of 24-32 years of age.

4.2. Data Collection and Analysis Tools

The research involved four phases. At first we read and analyzed the maintenance document handed by the teams and the monthly reports submitted to the advisors. The maintenance documents provide information concerning the tools and technologies used by the students to implement the information system. The monthly reports provide information regarding the time spent by the students, and enable to measure the efforts invested in learning new technologies. Based on these sources we classified each project according to the extent to which students challenged themselves to expand existing knowledge and learn new and unfamiliar environments to implement their projects.

Next, the study participants were asked to fill a questionnaire including open questions referring to their

perceptions regarding the project, their decisions and the underlying motivations regarding the technologies they chose to implement their information system, and the efforts they invested in learning new technologies.

The first question was targeted to grasp the students' perceptions towards the summative project course and its goals, and the significance they attribute to its outcomes. The second question was targeted to understand the motivations behind the selection of technologies made by each team. The third question was targeted to evaluate the level of effort invested in the project in general and in learning new technologies in particular.

The study participants' responses were analyzed using content analysis [17] and analytic induction [18] to identify emerging categories.

Then, we chose five teams and conducted in-depth interviews with them. The purpose of these interviews was to gain a better understanding of their decisions regarding the technologies they selected for the development of their systems and for the establishing of the category set we reached at the previous phase. These teams provided us with additional insights on their motivations. We chose for these interviews students of different achieving levels: high, average and low achievers.

Content analysis [17] of the gathered data revealed a connection between the students' academic achievements and the extent of use of advanced and unfamiliar (to them) technologies. We classified the projects according to four effort-levels: 1) the students used only technologies learned during studies to develop their information system; 2) the students used mainly technologies learned during studies with minor extensions; 3) the students used technologies learned during studies with major extensions; 4) the students used technologies that were not learned during studies. Clearly, the efforts required were proportionally to the extent of the knowledge gap they had to close. Namely, level 1 requires minimal efforts and level 4 requires maximal efforts.

At the last phase, we followed the study participant six months after the graduate and ask them about their jobs in general and the roles they perform in particular. We classified the responses into four categories: 1) software developer / system analyst 2) QA / IT / support 3) Unprofessional job 4) Unemployed. This classification was set according to the level of professionalism and prestige attributed to these roles in the IS filed. In order to work as a software developer or as a system analyst, one has to demonstrate high abilities of problem solving and programming, and self-learning abilities. As to second category, the latter abilities are also required but not stressed.

5. Results and Discussion

In this section we present and discuss the students' perceptions as regards to the benefits they can gain from the summative project and how these perceptions affected the selection of the technology. We than discuss the underlying motivations provided by the students as regards to the technology they used for the implementation phase.

5.1. Technologies and Students' Achievements

Analysis of the projects' maintenance document as regards to the use of technologies revealed four categories: 1) using only technologies that had been learned; 2) using massively technologies that had been learned beforehand with minor extension; 3) using technologies that had been learned beforehand with major extension, and 4) using new technologies not learned before (Fig. 1).

From Fig. 1 we can learn that more than two-thirds of the students (69%) implemented their projects using technologies they had been learned earlier during academic studies with no (50%) or with a minor extension (19%).

We also classified the students according to their academic achievements (based on the average BA's

average grade on a scale of 56-100) in the following categories: low achievers (58-71), average achievers (72-85) and high achievers (86-100). Fig. 2 presents the distribution of students according to their achieving level. As shown, thirteen (20%) of the study participants were classified as low achievers, Forty (63%) of the study participants were classified as medium achievers and Eleven (17%) of the study participants were classified as high achievers.

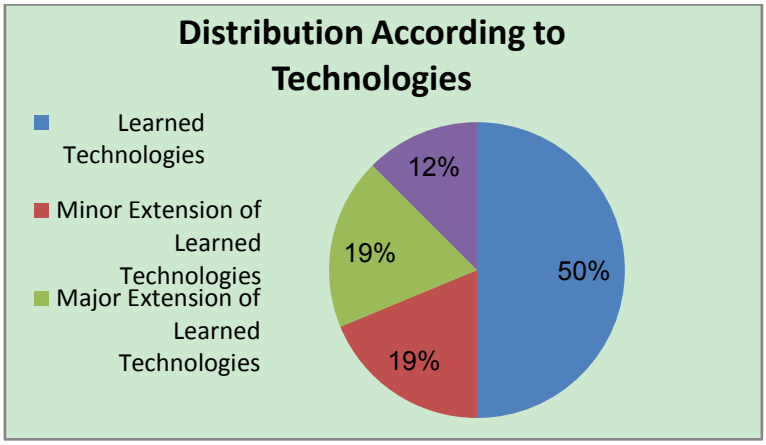

Fig. 1. Projects' distribution according to the use of technologies.

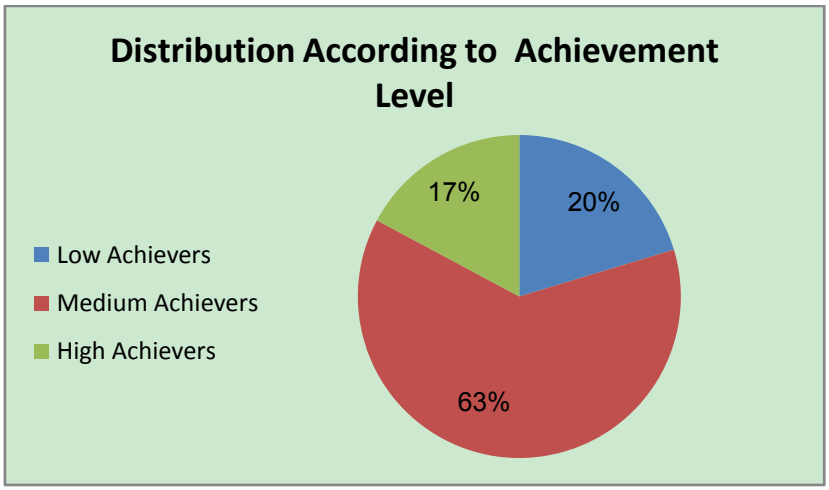

Fig. 2. Students' distribution according to achievement level.

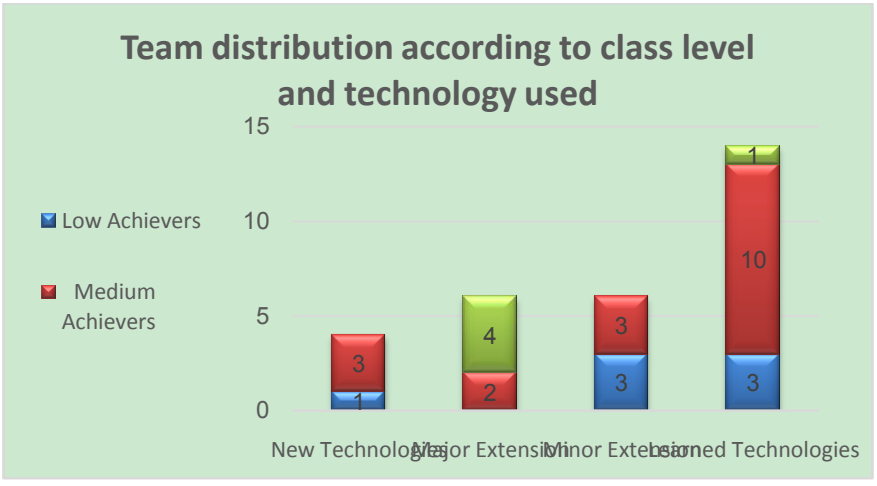

Fig. 3. Projects' distribution according to the use of technologies.

We assumed there is a connection between the level of academic achievements and the decision to invest more efforts in the summative project. Since the decision on which technologies to use is a team decision, we first examined the team set in terms of academic achievement level. We found that 22 out of 32 (69%) teams constituted from students belonging to the same class level. It is in line with [19] who confirmed that students prefer to study with colleagues who share similar academic goals and achievements with them. The remaining couples (31%) were mixed couples (each belongs to different achievement level), but after examining the data we noticed that the gap between their average scores was relatively minor (between 1 to 4 points) and they belong to successive achievement levels. Fig. 3 presents the project distribution according to the extent to which new technologies were used, taking into account the level of achievement of students.

The most interesting finding observed in Fig. 3 is that high-achievers did not use new technologies to develop their summative project. There were 4 teams who invested the maximal efforts in learning completely new technologies; all of them were medium and low achievers. As shown, most high-achievers used technology that they were already familiar with its basics, and made extended use of its advanced features, features that they had to learn by themselves. As expected, most of the low achievers made use of basic technology or a minor extension of it. Surprisingly tough, one team who was classified as low-achievers invested many efforts in new technology. As for the medium achievers, most of them made use of basic technologies, few used basic technologies with minor or major extensions, and surprisingly, three teams selected new technologies to the development of their project.

In the research we may find that self-efficacy and the use of self-regulation strategies have reflexive positive influence on one another. As self-efficacy beliefs gets higher, the higher is the use of self-regulation strategies [20] and vice versa. Moreover, use of self-regulation strategies might cause an increase in academic achievements [21]. Pajares & Graham [22] found that students that with high levels of positive self-efficacy tend to accomplish academic tasks more successfully and cope better with difficult tasks. They also found that such students are more motivated to use various strategies to solve problems than students with low self-efficacy.

We also collected the average time spent on learning technologies based on the teams' monthly reports, and the results are presented in Fig. 4:

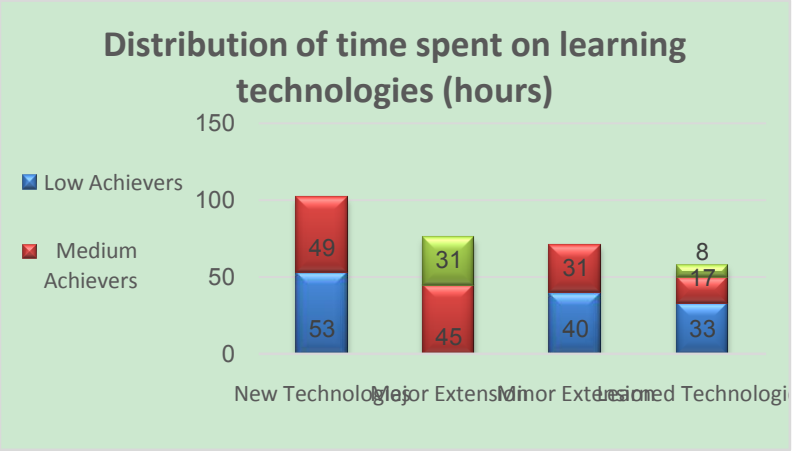

Fig. 4. Time spent according to the use of technologies and the level of new technologies used.

As shown in Fig. 4 low and medium achievers had to spend a lot of time in learning new technologies, and as the level of extension to basic technologies is reduced, the amount of time dedicated for learning is reduced accordingly. Even when low achievers used learned technology, they had to spend relatively long

time to rehearse and gain mastery, while medium and high achievers spent much less time. In contrast, high achievers had to spend much less time in order to gain mastery over advanced features of learned technology, and that probably stems from higher learning abilities.

In what follows we further analyze the students' responses to the questionnaire provided in the second phase of our research.

5.2. Students' Perceptions of the Summative Project

The students' responses to the question why invest efforts in the summative project were analyzed and revealed the students' goals. These goals were classified into two main categories: mastery and performance goals [23]. Under the performance category we included responses referring to their aspirations to cope with the complexity of the summative task, get a fine score and gain practical experience. Under the mastery category we included responses referring to aspirations to extend their professional knowledge and gain mastery over new technologies, become experts in the IS field, and be well prepared to vocational career. After completion of the analysis we ended up with 102 responses in the performance category and 55 responses in the mastery category. We further analyzed the responses in each category according to the students' level of achievement to examine a possible connection between the students' goals and their achievements. The results of the above categorization are presented in Fig. 5.

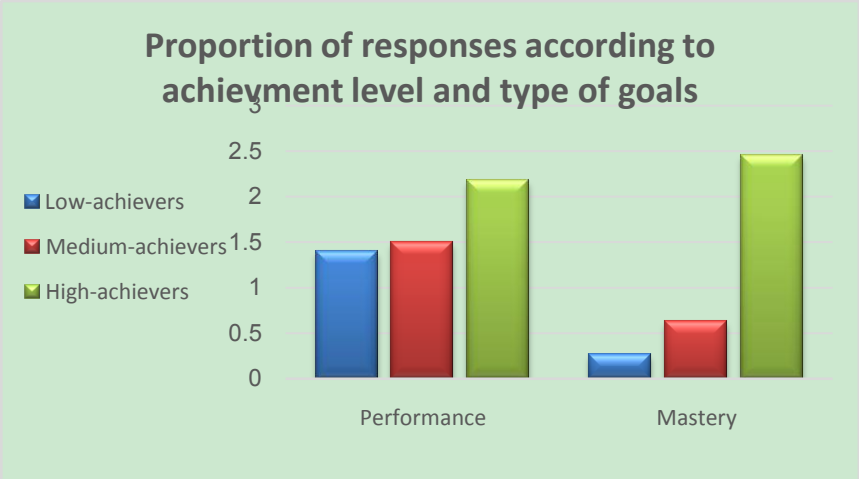

Fig. 5. Proportion of responses.

In Fig. 5 each column represents the ratio between the number of responses belonging to a certain category and the number of students of the relevant class. For example, the number of responses provided by the high achievers as regards to the performance category was 24 and there were 11 high achievers, hence the column height is 2.18.

As can be seen from Fig. 5, all the students are motivated by performance goals, however, mainly high achievers are motivated by mastery goals as well. Students that are mainly motivated by performance goals are usually interested in getting the job done. They tend to avoid obstacles and usually choose the easy way to get to accomplish the task successfully. High achievers however, are also motivated by mastery goals. They want to improve their professional abilities and develop new skills, even though these goals are not directly derived from the given task. They utilize the summative task as a leverage to extend their professional knowledge and gain mastery over new tools and technologies. They evaluate their success by examining their abilities to use this acquired knowledge properly [24]-[26].

As can be seen from Fig. 5, in both categories the percentage of high achievers is the highest, and according to SRL [5], [6] terms we may say that high achievers tend to set themselves ambitious goals

regarding academic tasks they are engaged with.

5.3. Distribution of Roles after Graduation

Six months after the study participants had graduated they were asked to report on their current job and provide details about the role they perform. Out of the 64 students 59 provided responses. Out of the five students that did not respond there were three low-achievers and two medium-achievers. The student's responses were classified according to the classification presented at the end of section 4.2, and the results are shown in in Fig. 6.

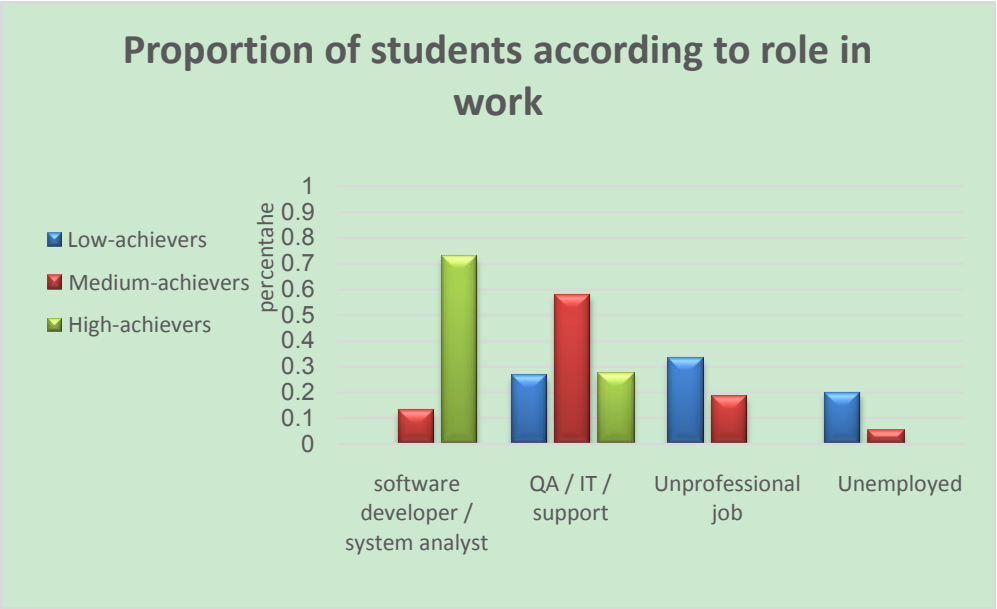

Fig. 6. Proportion of students to roles.

From Fig. 6 we can learn that most high-achievers (8, 72%) were recruited to work places in which they were assigned to software development and system analyst roles while only small percentage (5, 13%) of the medium-achievers and none of the low achievers joined similar jobs. Delving into the data revealed that among the high achievers in this category, all of them developed their summative task using major extension of learned technologies. As to the medium achievers in this category, all of them used new technologies to implement their summative task.

As to the second category in Fig. 6, three (27%) high achievers, 22 (58%) medium achievers and four low (26%) achievers were recruited to work places in which they were assigned to QA/IT/support. Most of these students had developed their summative task using either new technologies or major/minor extension of learned technologies.

As to the third category, in which there are only medium (7 students) and low achievers (5 students), were recruited to unprofessional jobs. The rest of the student (also belonging to medium and low achievers) were unemployed. All of these students (category three and four) had choose to develop their summative task using merely learned technologies.

Form the above results it can be seen that investing efforts in the summative task was worthwhile. The medium and low achievers who decided to invest many efforts and advance their professional knowledge and skills via the summative task, succeeded to get professional jobs compared with their mates from the same categories who did not.

6. Implications to Instruction

According to the job distribution of the research participants presented above and the extent to which they were willing to invest in the summative task, one can learn that only one third took the challenge and invested efforts in developing their task using new or major extension of learned technologies and about the importance of the summative task as a leverage to get a professional job in the IS industry. Successful accomplishment of the summative task requires the student to demonstrate self-learning capabilities [2] that are essential among other skills for vocational career in the IS domain [27].

In order to increase the number of students that are willing to invest the required efforts to develop the above skills, we suggest that during the students' engagement in the various phases of the summative task their advisors will encourage them to incorporate advanced technologies in their developed systems. The evaluation process should include proportional scoring according to the extent to which the technologies selected are advanced.

It can be seen (Fig. 2) that only few low-achievers selected major extension of learned technologies or new ones for their task. This is probably because they want to avoid self-learning, which is difficult for them. To support these students, we recommend on providing them with a scaffolding support, during the task, in which their advisors will take an active role in the learning progress. They should provide the students with modular learning program in which the students are given small tasks and provide them with feedback on their progress [28]. Gradually the control on the learning process will be shifted to the students' responsibility, so that eventually they will be able to monitor their learning process independently and become successful self-regulated learners [3], [4].

7. Concluding Remarks

The summative task provides an opportunity to extend the students' professional knowledge and improve their skills. However, it necessitates the investment of self-learning efforts which comes at the expense of other duties. The results obtained in this research can point on a positive connection between the efforts invested by students in their summative task and the quality of the job they find after graduation. It can be seen that high-achievers tend to invest efforts in their summative task, low and medium achievers tend to avoid these efforts. As a result, low and average achievers are less prepared to professional career which comes to fruition in the type of jobs they find.

During the engagement in the summative task the students apply SRL [5], [6] in various levels according to their learning capabilities. The students set to themselves learning goals, they look for strategies to achieve them, and handle difficulties they tackle with during learning.

This research is ongoing and we continue to collect data about the above issues in order to establish the results by statistical analysis. We suggest that further research with a large number of participants should be conducted in additional engineering fields in order to establish the results revealed in this study.

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