The Importance of Emphasizing Individual Learning in the "Collaborative Learning Era"

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ABSTRACT

In this paper we describe an instructional tactic of individually assigned homework that promotes and strengthens individual learning processes. We claim that current emphasis on the benefits of collaborative learning belittles the importance of individual learning processes and reduces the opportunities to require and assess individual learning within IS education. In our study, which used specially designed individual assignments, we succeeded in dramatically reducing the failure rate in two courses in two consecutive semesters. We present findings from additional research tools that support and explain the change we found in the failure rate when the tactic of the individually assigned homework was used. We conclude with some implications of the suggested tactic including dealing with academic dishonesty and lowering the dropout rate in IS education.

Keywords: Individual assignments, Individual homework, Individual learning, Effective learning

1. INTRODUCTION

Modern learning theories from any cognitive-constructivist paradigm assume that learning involves iterative processes of structuring, refining and restructuring of mental models. These processes are combined with other learning related processes like sense-making, debugging, evaluation, reflection and more. All these processes are necessary for meaningful learning whether employed in a context of collaborative or individual learning.

When one examines the current published research related to learning and particularly to computer-mediated learning, the proportion of research about collaborative learning is astonishing. Even though proponents of collaborative learning acknowledge the important role of individual learning (Dillenbourg, 2005; Stahl, Koschmann and Suthers, 2006), current research papers deal mainly with collaboration with very little mention of the individual facet. In addition, the research dealing with collaborative learning is shifting from looking at groups as a contextual variable to analyzing group dynamics and looking at learning as a group process. There is no doubt that collaborative learning has many advantages. There is also no doubt that group dynamics is an important facet of collaboration, but there is no need to belittle the crucial facet of individual learning.

As the focus of research influences practice and further research, we argue that more emphasis should be given to research regarding individual learning both as a prerequisite and as a complementary facet of collaborative learning. We argue further that as assessment tools shape and direct students' learning goals, it is necessary to incorporate more individual assessment tools in higher education in order to foster the necessity of individual learning skills and individual accountability. That is not to say that collaboration is to be abandoned; on the contrary, our argument has the goal of leveraging the benefits of collaborative learning processes. There is an underlying implicit assumption when dealing with collaborative learning processes that students are already used to learning as individuals. It is an implicit assumption that students have already practiced the relevant skills associated with learning, such as explaining to themselves, analyzing, synthesizing, combining and comparing to previous knowledge, making generalizations, reflecting and other relevant skills. It seems that compared with the efforts given to investigating how to support collaborative learning, individual learning is not supported enough. Even though collaborative learning can be seen as being the two facets of individual and group learning working together, this does not imply that the best way to promote collaborative learning is by exercising collaborative learning directly. We believe that there is much more need to foster and assess individual learning in order to obtain meaningful collaborative learning.

In this paper we describe an instructional tactic for promoting and strengthening individual learning processes. The instructional tactic suggested in this paper is based on a unique design for individually assigned homework. By individually assigned homework we mean homework that is required to be done individually (versus collaboratively).It is required to be done by the student him or herself, and

designed in such a way that each student uses different data than the other students for performing the task. The idea behind the design is to force students to try to employ individual learning processes. Intermediate and final values are different from one student to another and any comparison (or "borrowing") of values is fruitless for completing the homework assignments.

The assignments are not dynamically adapted to students' characteristics and knowledge. There is no skill profile or any use of student modeling capabilities as in intelligent tutoring systems. The individually assigned homework tactic that is described in this paper is much easier to implement than more intelligent adaptation techniques, and students' intermediate inputs can be checked easily.

The suggested tactic can also help in dealing with students' attitudes towards homework, in lowering student drop-out rates and in dealing with academic dishonesty among students.

2. LITERATURE REVIEW

The rationale for the design and implementation of the individually assigned homework can be discussed in several broad contexts such as assessment or teaching strategies. But in this literature review we focus on three contexts that relate more specifically to our study and most importantly relate to current trends. One is the relation between individual learning and collaborative learning, another is self-efficacy and learning, and the last one is homework and academic dishonesty. Our aim is to show how these three contexts provide the rationale for employing such a tool of individually assigned homework as suggested in this paper.

2.1 Individual and Collaborative Learning

Research on learning in the last decades emphasizes the important role that collaborative learning plays in the learning process. Collaboration is expected to promote activities like elaboration, justification and argumentation that trigger learning mechanisms. Despite the expectations, there is no guarantee that these activities will occur without additional educational design constraints (Dillenbourg, 1999). Information Technology graduates are expected to work in teams and collaboration skills are necessary; but how do their capabilities for individual work come in? Is it necessary for making the collaboration effective? Research on online collaborative learning shows that for successful collaborative learning to occur, students have to exhibit a high degree of motivation and involvement as well as both interdependence and autonomy (Hansford and Wylie, 2002). In spite of the many benefits of the collaborative learning students still may have some problems using the method and display some degree of unwillingness to participate in group learning (Barker, Garvin-Doxas, and Jackson, 2002; Waite et al., 2004). Morrison (2004) outlines another pitfall of collaborative learning and specifically collaborative programming: the free riders. Free riders are students who enjoy the benefits of collaborative work, but don't contribute to the common goal. Joyce (1999) even defines the free-rider problem as the biggest problem in collaborative learning.

We believe that any successful collaboration starts with individual capabilities and individual responsibility and motivation. In this paper we stress the need for instructional design for enhancing these individual capabilities, which later become a cornerstone in any collaboration activity. Some researchers dealing with instructional design for collaborative learning also emphasize the individual facet (Puntambekar, 1999). Hoadley and Enyedy (1999) use the metaphor of monologue and dialogue to describe the social activities in which learning is grounded and suggest the need for learning environments that help students' transition from dialogue to monologue and back again. Pair programming, for example, when employed as an instructional methodology emphasizes the different roles and responsibilities of each participant. This collaborative environment is effective only if each student carries his/her own task and does not "rely" on the other. This demonstrates the importance of personal assignments and accountability even in a collaborative framework. Within collaborative learning research there are also studies where the conflicts between individual solutions are used to trigger effective collaborative learning (Constantino-Gonzalez, Suthers, and Escamilla, 2003; Or-Bach and Van Joolingen, 2004).

We claim that there is not enough focus in the current learning research on ways to make students employ spiral learning processes by themselves: i.e. analyze, solve, debug, reflect, and repeat the process as long as necessary. These individual capabilities (or learning habits) play a crucial role in any future collaborative learning or collaborative work environments that the students will encounter.

2.2 Self-efficacy and Learning

During the past two decades, self-efficacy has emerged as a highly effective predictor of students' motivation and learning. Self-efficacy is a person's perception or judgment of their own knowledge, capabilities, and capacity to perform a task at a specified level of performance (Bandura, 1993; Seifert, 2004). Self-efficacy measures focus on performance capabilities rather than on personal qualities, such as one's physical or psychological characteristics. Respondents judge their capabilities to fulfill given task demands, such as solving fraction problems in arithmetic, not who they are personally or how they feel about themselves in general. Self-efficacy beliefs are not a single disposition but rather are multidimensional in form and differ on the basis of the domain of functioning (Zimmermann, 2000). Self-efficacy is essential for learning, since self-efficacy and motivation will influence efforts and vigor more than actual ability (Cavaco, Chettiar, and Bates, 2003; Zusho, Pintrich, and Coppola, 2003). Students' judgment of their own self-efficacy in a discipline has been found to predict their performance in these disciplines (Glynn, Aultman, and Owens, 2005). Positive self-efficacy for a task will lead to higher goals, more commitment, more effort and persistence. In addition, there is evidence that students with positive self-efficacy beliefs are more likely to continue with even more difficult tasks (Linnenbrink and Pintrich, 2002). Students with negative self-efficacy and beliefs tend to give up when a task becomes difficult, or just avoid the task (Zimmermann, 2000). Research has verified that self-efficacy is related positively to most of the factors that contribute positively to learning outcome: persistence, cognitive engagement, use of self-regulatory strategies and

actual achievement (Bandura, 1997; Pintrich and Schunk, 2002). Students should neither overestimate nor underestimate their capabilities; they should rather have fairly accurate, but optimistic beliefs about their efficacy to accomplish a task (Linnenbrink and Pintrich, 2002).

When it comes to pedagogical implications, self-efficacy is best facilitated by providing students with an opportunity to succeed. When students work with challenging tasks within their range of competence, preferably towards short term goals, they strengthen their positive self-efficacy beliefs and at the same time develop new capabilities and skills (Glynn, Aultman, and Owens, 2005). Instructors who give feedback should attempt to foster positive but accurate self-efficacy beliefs. This is the challenge for the design of homework, a design that relates to content, submission procedures and assessment scheme. This challenge becomes more significant with current trends, as will be described in the following section.

2.3 Homework and Academic Dishonesty

There is a general agreement that homework plays an important role in students' learning. We argue that without examining and re-examining the potential benefits of homework assignments and whether they are achieved, we miss the opportunity to support students' learning. This issue becomes significantly important due to several trends in higher education. Some of the trends relate to the characteristics of incoming students, and others to economic constraints that affect the teaching load and the availability of teaching assistance. In many countries there has been a trend in the recent decade towards widening opportunities for obtaining higher education. The result is that the student population gets more heterogeneous with regard to prior knowledge, learning habits, and cognitive and meta-cognitive skills that affect learning. The variety makes it necessary for the teachers to have tools for formative assessment and also makes it necessary for the students to exercise self-assessment. In a paper titled "Homework? What Homework?" (Young, 2002) the author summarizes findings from the National Survey of Student Engagement of that year and suggests some explanations. "Students are studying about one-third as much as faculty say they ought to, to do well," said the director of the survey. The most striking statistic: Nineteen percent of full-time freshmen say they spend only 1 to 5 hours per week preparing for classes. Many education experts say that is well below the minimum needed to succeed. Seniors who answered the same survey reported studying even less than freshmen, with 20 percent studying 1 to 5 hours per week. Many professors say their students are doing less homework these days, though there are always a few model students. The problem may start in high school, where students are apparently spending far less time on homework than those who graduated a decade ago, and also have problems managing their time and getting the most out of their studying (Young, 2002).

As many students come to higher education to make good grades rather than explore new topics, academic dishonesty becomes prevalent. Academic dishonesty may be defined as students' attempt to present others' academic work as their own (Jensen et al., 2002). Academic dishonesty among high school and college students is highly common—so common, in fact, that some observers describe it as an ''epidemic'' (Haines et al., 1986). Academic dishonesty is not a new problem, but it seems to get worse (Ercegovac and Richardson, 2004). Already in 1979, a Carnegie Council Report warned of ''ethical deterioration'' in academic life, and the U.S. Department of Education issued a report describing cheating among college students as a ''chronic problem'' (Maramark and Maline, 1993). The IEEE Transactions on Education devoted a special issue in May 2008 to the problem of plagiarism. The special issue included ten papers focusing on the topic of plagiarism. The motivation behind the special issue was to uncover the root causes of plagiarism and suggest new ways of counteracting these causes.

When students submit homework assignments done by others they miss the chance to learn, and the teacher misses the chance to get a realistic mapping regarding students' understanding. As stated by Gibbs and Simpson (2004), plagiarism on assignments presents a serious problem for the integrity of the educational process. Various tools were developed for detecting plagiarism (Jones, 2008) and especially for detecting plagiarism in programming courses (Zhang, Zhuang, and Yuan, 2007; Gitchell and Tran, 1999; Joy and Luck, 1999). Bowyer and Hall (2001) in their paper about reducing effects of plagiarism in programming classes describe the effectiveness of such a system – MOSS (Measure Of Software Similarity). They further stress that detection of program plagiarism is made relatively simple using MOSS but the real challenge for the faculty member is to design procedures that reduce the perceived pressure on students to cheat and make the learning process more effective. Our approach is along similar lines; we are not interested in punishing students and even though we try to raise ethical issues, still our main goal is to maintain an effective educational process. The approach we suggest in this paper is not an approach for detecting plagiarism after the fact, but an approach for designing assignments that make plagiarism more difficult and thus support students' learning. Study results of Broeckelman-Post (2008) showed that students' engagement in academic dishonesty is most influenced by whether they believe their peers are engaging in academic dishonesty. This is a good reason to invest in the design of assignments that explicitly require individual work and make plagiarism more difficult.

3. INDIVIDUALLY ASSIGNED HOMEWORK AND THE RESPECTIVE COURSES

The research described in this paper was conducted within two courses: (1) Computer Organization and Programming; and (2) Systems Architecture. This section provides a brief description of these two courses, an example of an individual assignment and a further explanation of the instructional tactic of individually assigned homework. Another example, along with a description of the initial use of the individually assigned homework in the Computer Organization and Programming course, can be found in a previous paper (Yadin and Or-Bach, 2008).

3.1 The Computer Organization and Programming Course

The Computer Organization and Programming (COAP) course is a mandatory, introductory course which is intended to provide basic understanding of computer system operations, data representation, system architecture and Assembly language. The participating students are in their second year. The course is aimed at software developers and its main objective is to enhance the students' understanding of hardware functions and operations. The Assembly language is used to enable students to demonstrate their understanding of the various hardware components. This course is a pre-requisite for the Systems Architecture course.

3.2 The Systems Architecture Course

The Systems Architecture (SA) course is an elective second year course mainly for students who are looking to improve their knowledge regarding the technology used in the various information systems solutions. This course is intended to enhance students' knowledge regarding basic hardware functionality, and new technological developments and possible impacts they may have on organizational information systems solutions.

In both courses a student's final grade is calculated based on a final exam (70%), a mid-term exam (20%) and several (at least 6) homework assignments (10%).

We had these courses running for several years with on-going evaluation and respective modifications. The students considered these courses to be difficult ones and the failure rate was disturbing. The courses were accompanied by an action research study that brought up some changes in the courses over the years, such as the inclusion of mid-term exams, additional in-class lab exercises and revised assignments, both manual and computerized. Despite the improvement attempts there was a constant increase in the failure rate percentage, consistent with the decrease in enrollment. During the academic year 2007-2008 we introduced into these courses the idea of individual assignments. We tried to foster individual learning by designing assignments that make students invest more time in the task before comparing with other students as they are used to doing.

All the assignments in the above described courses were of the "individualized" type. Each submitted assignment was graded and in addition, since feedback is essential for the students' improvement, detailed informative feedback was provided. The feedback included extra explanations (when needed), and links to the learning materials and to additional exercises. Our electronic submission system was used to publish the assignments and set the last date for submission, to collect the students' work and to present to each student the relevant feedback for each submitted assignment.

3.3 An Example of an Individual Assignment

The following is an example of an individual assignment given in the COAP course. The purpose of the assignment is to assess understanding of the [Segment:Offset] concept and the hardware stack mechanism.

a. Absolute Addressing

1. On top of the assignment write your 9 digit student ID number ($N_1N_2N_3N_4N_5N_6N_7N_8N_9$)
2. Starting from the left-hand side, divide the ID number into groups of 3 digits each (N1N2N3 N4N5N6 N7N8N9)
3. Calculate the Binary equivalence of the number in each of the groups.
4. Assume that the rightmost group is the Segment address and each of the other groups represents different offsets.
5. Calculate the absolute addresses referred to by these offsets. (N7N8N9:N1N2N3 N7N8N9:N4N5N6)

b. Stack Addressing and Content

1. Write once again your student ID number
2. Starting from the left-hand side divide the ID number into groups of 2 digits each ($0N_1$ N_2N_3 N_4N_5 N_6N_7 N_8N_9)
3. Calculate the Binary equivalence of the number in each of the groups.
4. Assume that the rightmost group (N8N9) represents the Stack Segment starting address and the Stack Offset.
5. Each of the other groups represents values to be entered into the Stack.
6. Write down the absolute addresses and the Stack content after executing the following assembler instructions:

```
PUSH    0N1
PUSH    N2N3
PUSH    N4N5
PUSH    N6N7
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This type of assignment requires the students to carefully analyze the algorithm principles and then to mentally execute it. The mental execution helps students understand the abstract algorithm and provides the student as well as the teacher with evidence regarding this understanding. The use of individual input data for executing the algorithm ensures that each student follows all the steps of the algorithm. This type of assignment makes it impossible to "import" the full or partial solution from a colleague or compare results before employing self-monitoring/debugging procedures. Any help provided by a fellow student or a teaching assistant has to concentrate on the solving process without mentioning exact outcomes. This is again a measure to make students practice by themselves the cognitive processes required for meaningful learning.

The individual assignments provide a good mechanism for assessing the students' knowledge by closely analyzing their intermediate answers. For this specific assignment, evaluating students' understanding at an early stage of the course was very important since the hardware stack in the x86 architecture works in a peculiar way (as the top of stack pointer decreases the stack actually grows). Based on feedback accumulated in previous years, the stack proved to be a difficult point for students to grasp. While working on the assignment, the students had to demonstrate their understanding by applying the stack principles to their individual data. The assignment relates to both the stack content as well as addressing behavior including dealing with end cases such as stack overflow/underflow. In the event of an erroneous reply, the student got back his/her assignment including feedback that directly related to the

specific error. Sometimes an explanation was added, including the directing of the student to the relevant section in the learning materials.

The "individualization" method just described might also have an affective effect, making students more attached and motivated to solve their own tasks. In this case students might relate better to any feedback given to them because they feel that the feedback is personal – relevant to their "own" problem and produced especially for them. Since the students think about their assignment by themselves, the feedback they receive makes sense to them.

4. THE STUDY – TOOLS AND RESULTS

4.1 Introduction

In order to investigate the effect of the individually assigned homework we used several research tools. The main tool was the comparison of students' failure percentage during the years that these courses were taught. We also administered a post-course survey to the students who used the individually assigned homework in order to better understand the results we got from the failure percentage data. Two other research tools were also used to explain and cross validate the results of the failure percentage comparison. These tools were comparison of students' access to the Learning Management System during the study year and the year before, and informal interviews with some students.

The individual assignments were introduced for the first time in the academic year 2007-2008. In the Computer Organization and Programming (COAP) course during the academic year 2007-2008 there were 18 students (39% female and 61% male) and in 2008-2009 there were 27 students (22% female and 78% male).

In the Systems Architecture course during the academic year 2007-2008, there were 14 students (57% female and 43% male) and in 2008-2009 there were also 14 students (29% female and 71% male).

4.2 Failure Percentage

Completing the course successfully requires passing the exam and then the final score is calculated by the specific scheme for the final score of that course. As was mentioned in the courses' description, in both courses a student's final grade was calculated based on a final exam (70%), a mid-term exam (20%) and several (at least 6) homework assignments (10%).

The following figures describe the failure percentage of both courses during the years that these courses were administered. The years in the graphs are an abbreviation of the academic year, where for example 2009 means the academic year 2008-2009. Figure 1 describes the failure rates for the COAP course, while figure 2 describes the failure rates for the SA course. In both figures the number of students who took the course during this year appears in parentheses under the year.

Both figures show a clear change of trend since the new tactic of individual assignments was introduced in 2007-2008. The academic year 2007-2008 was the first year ever that no one failed the Systems Architecture course, as can be seen in figure 2. This was repeated in 2008-2009 as well. During the 2005-2006 academic year, the SA course was not offered, so in the graph we used the average of 2004-2005 and 2006-2007. In the Computer Organization and Programming course the decrease in failure percentage is also dramatic, as can be seen in figure 1: In 2006-2007 (before the introduction of the new method) it was 14.3%; later in 2007-2008 it dropped to 5.6%; and in 2008-2009 it dropped to 3.7%.The numbers of students indicated in the two graphs show the decrease in the number of students during these years. This decrease could have provided another explanation for the reduction in the failure rate. But a more careful examination shows that in the COAP course in 2004-2005 there were 23 students and the failure rate was 8.7%, while in 2008-2009 there were 27 students with a failure rate of 3.7%. Similarly, in 2005-2006 there were 16

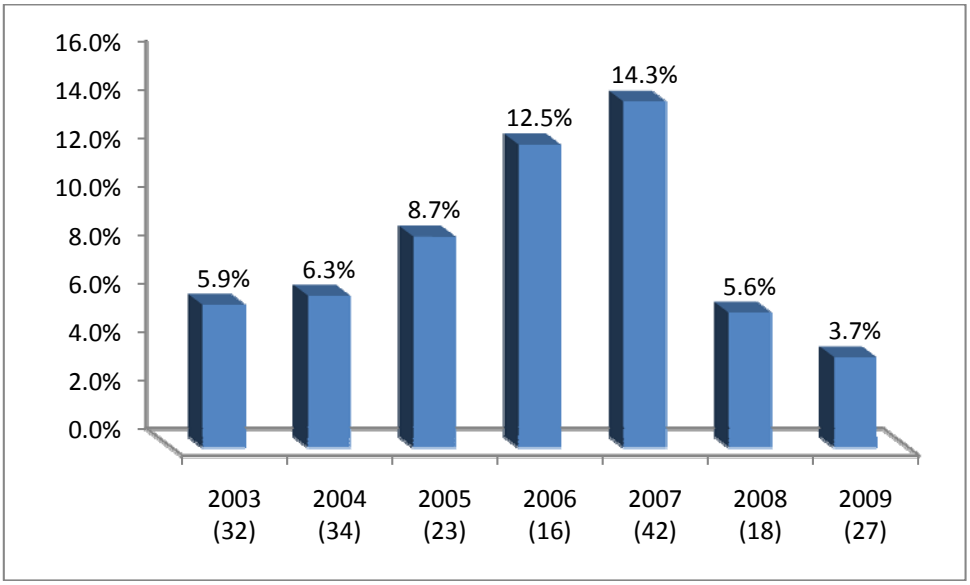

Figure 1: Failure rate in the COAP course.

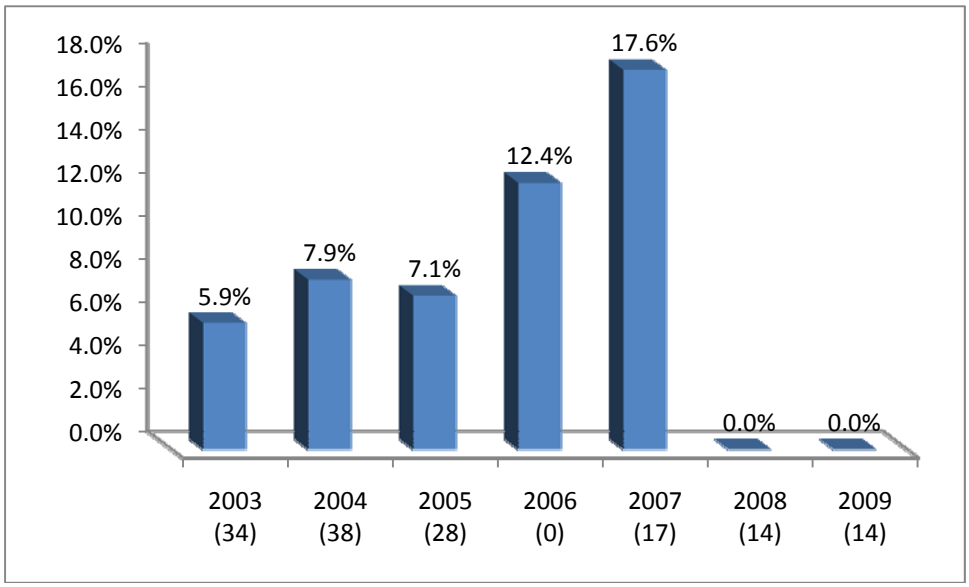

Figure 2: Failure rate in the SA course.

students with a failure rate of 12.5%, while in 2007-2008 there were 18 students with a failure rate of 5.6%. So the new method of the individually assigned homework seems a more plausible explanation for the decrease in failure rate.

4.3 The Survey

A survey was designed in order to examine the students' attitudes towards the individual assignments. The survey was administered in a subsequent semester in order to get from the students a retrospective view after they had finished the course and taken the final test. A translation of the survey from Hebrew appears in appendix 1.

The survey had 17 Likert type items. The items related to facts ("… I devoted more time…"), opinions ("Helping a fellow student in the individual assignments method is more challenging than helping with other learning methods"), feelings ("Due to the use of individual assignments I felt more prepared for the final exam"), beliefs ("I believe…increase motivation…"), preferences ("I prefer individual assignments instead of the kind of assignments used in other courses") and wishes ("I'd like to have individual assignments in all courses"). The scale was 1-5, where 1 was "totally disagree" and 5 was "completely agree".

Students were also asked to summarize in free text their opinion about the individual assignments and to add any comments or suggestions they had regarding the individual assignment method.

Fourteen students filled in this survey. These were the students who studied both courses during the academic year 2008-2009, so their input represents their attitude based on two courses in two semesters where the individual assignment method was employed.

4.4 Survey Analysis

We calculated the average score for each of the survey items. If we exclude item 11, which does not relate directly to the employment of the individual assignments, we see that students are in favor of this method. The average of the averages (excluding item 11) is 3.71. The highest average was for item 4: "With the individual assignments I felt the instructor comments addressed my own work". The average score for this item was 4.79 with standard deviation of 0.58. This is a very interesting finding as it means that students expect and appreciate the attention to their individual work. In the free text this was also clearly expressed by one of the students: "Getting feedback adapted to me led me to invest more in the course because I felt I was treated individually by the teacher". This specific student gave the maximum score (5) to many items (10 out of 17), but he or she chose the above sentence to capture his or her attitude regarding the use of individual assignments. Another item with an average greater than 4 was item 1: "I think that the individual assignments improved my learning skills". The average score for this item was 4.14 with standard deviation of 1.03. This can be considered a significant achievement for the individual assignments method which might have a transferable effect. Two other items had an average score very close to 4: 3.93. Those are items 3 and 10 which are statements of general opinion regarding the benefits of individual assignments. Item 3 is a statement regarding doing homework individually versus within a team (whether of the suggested tactic or not), and item 10 also relates to the relative benefits for learning – individual assignments versus other types of assignments. Again the high average shows that students are aware of the advantages of the individual assignments to their learning. Items 6 and 7 can be considered as dealing with self efficacy. Item 6 is "The individual assignments increased my confidence in mastering the learning materials" and item 7 is "Due to the use of individual assignments I felt more prepared for the final exam". The average for both items was 3.79, which is not high, but still on the positive side.

4.5 Additional Findings

The additional findings relate to the analysis of students' access to the Learning Management System (LMS) during the course and to informal interviews that were conducted

with some of the students.

It turned out that there was an increased use of our LMS in these two courses during the semesters when the individual assignments method was introduced. We checked the number of times students accessed the LMS, whether for revisiting learning materials, checking for news, presenting questions to the instructor, answering other students' questions in the forum, or other learning related activities.

The average number of times a student entered the LMS for the Systems Architecture course during the first semester of this study was 72 (or on average 5.5 times per week), while for the previous year (before the individual assignments method was introduced) the respective number is 22. This high increase of 224% might be an indication of increased motivation and increased active engagement in learning during the semester. In the COAP course the average number of times a student entered the LMS also increased, but not as dramatically as in the SA course. The average number of times a student entered the LMS for the COAP course during the first semester of this study was 53, while for the previous year the respective number was 39. Again, even an increase of 35% might be an indication of increased active engagement in learning during the semester.

Informal interviews with several students were conducted during the academic year 2007-2008, when the new method was initially introduced. The interviews that we conducted with students revealed additional encouraging findings: (1) Students expressed higher motivation, independence, and confidence in their ability to cope with new and difficult topics related to the course; (2) Students became more involved in self-assessment before submitting their work; (3) Students got to appreciate the value of the feedback they got from the instructor; (4) Most students reported an increase in the level of understanding and the level of perceived clarity due to the individualized assignments.

In addition to the above findings, the instructor (the first author) noticed that there was a higher degree of student participation and involvement in class (compared to previous years), as well as an increase in students' willingness to assist fellow students, both in person and by using the course web forum.

5. CONCLUSIONS AND DISCUSSION

The findings presented in the previous section seem promising. The dramatic change in failure rate presented in figure 1 and figure 2 provides a clear indication of a change. Even though the number of students is small, still the trend was exhibited in both courses where the individual assignments method was employed and during the years that it was employed. We did not see this trend in other courses, so the change cannot be attributed to the student population of these years. The other research tools that we employed provide data that support and explain the hypothesis regarding the benefits of the individually assigned homework.

The reason for developing and employing the individual assignments method was that for a long time we had had the impression that many students do not invest the time and effort required in thoroughly thinking about the courses' assignments, about possible ways to solve them, and about how to evaluate the solution they submit. Instead they tend to share partial solutions and add some "patches". Only very few students really follow the whole process. As a result of this evolving learning culture students do not exercise good learning habits, do not feel responsible for their submitted work and cannot benefit from the instructor feedback as it is not addressed to their own line of thought. Gibbs and Simpson (2004) in their paper "Does your assessment support your students' learning?" stress several points that are relevant to our study. They claim that students are unlikely to engage seriously with such demanding practice unless it is assessed or at least required by the assessment regulations. The individually assigned homework explicitly portrays the regulation regarding requirement of individual work.

Gibbs and Simpson (2004) also claim that much assessment simply fails to engage students with appropriate types of learning, and that research on the impact of the use of "classroom assessment" in college in the USA again and again stresses the impact not on the learning of specific content but on the development in students of "meta-cognition" and the ability to gain control over their own learning. Our aim was exactly this: not just to have students master the topics, but to have them exercise learning activities by themselves. With this aim it makes sense to employ the individual assignments as formative assessments during the semester.

From our survey analysis we can conclude that our students appreciated the contribution of our method to their learning. The average score for the item "I think that the individual assignments improved my learning skills" was 4.14 (in a scale of 5). Gibbs and Simpson's basic assumption is that there is more leverage to improve teaching through changing aspects of assessment than there is in changing anything else (Gibbs and Simpson, 2004). Along the same lines, Nicol and MacFarlane-Dick (2006) argue that in higher education formative assessment and feedback should be used to empower students as self-regulated learners. The construct of self regulation refers to the degree to which students can regulate aspects of their thinking, motivation and behavior during learning. They propose seven principles of good feedback practice which include encouraging positive motivational beliefs and self-esteem. In the analysis of our survey we saw how important the individual feedback was considered to be by students. As previously mentioned, one of the students wrote in the free text section of the survey "Getting feedback adapted to me led me to invest more in the course because I felt I was treated individually by the teacher". The highest average of the survey items was for item 4: "With the individual assignments I felt the instructor comments addressed my own work". The average score for this item was 4.79 (in a scale of 5) with standard deviation of 0.58.

The increased access of students to the Learning Management System that we observed is also an indication of additional learning efforts on the one hand, and an explanation for the reduction in failure rates on the other.

As we mentioned in the introduction, we think that nowadays with the efforts made to investigate how to support collaborative learning, individual learning is not supported enough. There is an underlying implicit

assumption when dealing with collaborative learning processes that students have already practiced the relevant skills associated with learning, such as explaining to themselves, analyzing, synthesizing, combining and comparing to previous knowledge, making generalizations, reflecting, and other relevant skills. From our findings and our experience it seems that this assumption is not valid for a great number of students. In recent years most western democracies have experienced a shift from elite to mass higher education. This fact, along with other trends in youngsters' characteristics and education, makes the above assumption problematic. Our findings show that there is a need to support individual learning and individual accountability even in order to achieve effective collaborative learning. Papers that deal with successful collaborative learning (e.g. LeJeune, 2003) foster the need for individual and group accountability and responsibility. We claim that it is true, but not sufficient in order to exercise the facet of individual accountability and responsibility. It is difficult and sometimes impossible to assess individual input as opposed to assessing the collaboration process or the collaboration product. We agree that with the changing conceptions of learning, emphasizing the social and constructivist nature of learning, there is also a need to develop social-constructivist assessments that foster collaboration and give students the responsibility to assess their own collaborative process. The fact is that although the idea of assessment for learning is now widely accepted, little attention has been given to the alignment of learning, assessment, and collaboration (Chan and van Aalst, 2004).

Survey results and the interviews showed that students got to appreciate more the role of homework in their learning. We showed that the suggested tactic helps in dealing with students' attitudes towards homework, and we believe that in turn it might lower student drop-out rates, which are a big problem especially in computing related topics (McGettrick et al., 2005). The suggested tactic helps in dealing with students' academic dishonesty as related to homework submission. The requirement for more individual learning activities might reduce students' need to get involved in further academic dishonesty that in turn undermines the trust and confidence that managers place in new employees (Hogan and Jaska, 2000). As we mentioned in the theoretical background, our approach is not an approach for detecting plagiarism after the fact; it is an approach for designing assignments that make plagiarism more difficult and thus support students' learning.

Future plans involve expanding the use of this tactic. Respective individual assignments are currently designed for two additional courses. We plan to investigate the effects of employing this tactic in these courses; and intend to start investigating the interplay between individual and collaborative learning.

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APPENDIX 1 – THE SURVEY

Dear students,

We are conducting a study on the contribution of individual assignments to learning and understanding, and we will appreciate your participation.

Please read carefully and for each item please check the answer that seems the most appropriate for you:

5 = totally agree, 4 = partially agree, 3 = uncertain, 2 = partially disagree, 1 = totally disagree

		5	4	3	2	1
1	I think that the individual assignments improved my learning skills					
2	Due to the individual assignments I devoted more time to doing homework (compared to other courses)					
3	I think it is better to do the homework individually (not as part of a team)					
4	With the individual assignments I felt the instructor comments address my own work					
5	I think that with individual assignments the instructor comments are more significant to my learning (as compared to other types of assignments)					
6	The individual assignments increased my confidence in mastering the learning materials					
7	Due to the use of individual assignments I felt more prepared for the final exam					
8	I'd like to have individual assignments in all courses					
9	With the individual assignments I feel that the grade reflects my personal knowledge					
10	I think that the individual assignments method contributes to learning more than other learning methods					
11	Usually, in courses without individual assignments, I look at other students' solutions before answering					
12	Helping a fellow student in the personal and individual assignments method is more challenging than helping with other learning methods					
13	The individual assignments improved my understanding beyond the class materials					
14	The individual assignments method increases the motivation to learn					
15	I think students' solutions to individual assignments better represent the students' knowledge than other methods					
16	I prefer individual assignments on other types of assignment (as used in other courses)					
17	Due to the individual assignments I took more seriously my homework even in other courses					

We thank you for your cooperation!

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