Exploring informal learning in higher education: A study in a technologically intense environment

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"Tell me, and I will forget, show me, and I may remember, involve me, and I will understand."
Confusius (450 B.C.)

***Abstract*—The study aims to investigate how students informally accomplish the acquisition of theoretical and practical knowledge in a technologically intense environment, and whether this accomplishment changes over a course. Furthermore, the study investigates the possible correlation to results.**

The study is based on a two-step survey conducted at the start and the end of a course in dynamic simulation. The sample consists of 40 students. The results are analyzed and presented based on two groups with different grade averages.

The results show the likeliness of using various informal learning actions based on the identified groups. The results furthermore show how this likeliness develops over the course. Of significance, the results indicate that students that use informal learning actions as a strategy for acquiring knowledge might achieve higher grades.

The results can be used to inform both students and teachers about the benefits of using informal learning actions in technology intense study environments. By highlighting such actions, students are made aware of additional opportunities to develop both their theoretical and practical knowledge of the topic at hand and not least improve their grades.

***Index Terms*— Informal learning, higher education, learning methods, learning culture, technology intense environment**

I. Introduction

IN line with scientific practice, teachers prepare learning activities to hopefully align with and achieve intended learning goals [1]. Such learning activities may consist of lectures, exercises, and seminars. Though such activities are beneficial and often necessary, much learning remains informal and is not connected to the planned learning activities. In technologically intense environments, informal learning has shown to play a role in bridging the gap between theoretical and practical knowledge [2]. Unfortunately, research on the topic is dispersed and not in line with its significance.

The study aims to investigate how students informally accomplish the acquisition of theoretical and practical knowledge in a technologically intense environment, and whether this accomplishment changes over time. Furthermore, the study investigates the possible correlation to results.

II. Theoretical frame of reference

A. Informal learning actions

Informal learning is often described as unconscious, invisible and lacking formalized learning outcomes [3]. In higher education it has been expressed as "a multi-dimensional construct consisting of behavioral, cognitive, and motivational components" [4]. This study focuses on the behavioral components of informal learning. The learning actions in Table 1 are derived from multiple sources [4-6] and the categorization inspired by Paraskevas et al [2].

TABLE I
Informal learning actions and their loci

Loci	Informal learning actions
Individual actions	Use google
	Test (trial and error)
	Use AI
	Use literature
Direct interactions	Ask peer to explain
	Ask peer to show
	Ask teacher to explain
	Ask teacher to show
Indirect interactions	Listen to peers passively
	Observe peers passively
	Listen to teacher passively
	Observe teacher passively

B. Learning outcomes

1) Theoretical and practical knowledge

Learning outcomes can be divided into theoretical and practical knowledge, both of equal importance [7]. While theoretical knowledge refers to "what", practical knowledge refers to "how". To master any knowledge, it is necessary to apply the "what" to understand the "how" [2]. This especially applies to technical education [8].

2) Progression levels

The Dreyfus skill model proposes that a student progresses through five distinct stages in their learning process, namely novice, advanced beginner, competence, proficiency and expertise. At the beginning, students rely heavily on rules and procedures to take in and manage a task, while developing into a more intuitive interpreter of a situation and needed subsequent action over time [9]. This study assumes that the Dreyfus skill model applies to progression of both theoretical and practical knowledge.

III. Methodology

A. Setting for the study

The setting for this study is a course named Applied systems modeling (based on dynamic simulation). The course is taken by students in social science with little experience from programming or other technical courses. It encompasses 15 credits and is taught half pace (50%) from September to December. The assessment is done through assignments, project work and an individual exam, all aiming to assess the understanding and ability to apply dynamic simulation in various situations. The course is based on experiential learning [10], including both theoretical and practical elements of learning. The first 3 weeks (8 occasions) are very structured and spent on learning the software and how to model various features. The initial training material is very instructive and starts from scratch. Each chapter consists of two training parts: one with very detailed instructions (possible for anyone to follow), and one with a similar task but without detailed instructions. Students may thus work on their own to a big extent. All remaining occasions have a more open structure and are more spent on assignments and project work.

B. Data collection and group identification

The study is based on two identical surveys conducted at the start and the end of the course. The questions are based on the theoretical frame of reference and include the students' perception of skill level in dynamic simulation (theoretically and practically) and their perceived likeliness of using informal learning actions for progressing their theoretical and practical knowledge in technical contexts. The survey forms (paper-based) were transferred to MS Excel and the data was slightly modified, for example the Dreyfus' skill levels were translated to numbers (1-5) and people that had written their full name in both rounds were identified and the rows marked as comparable.

Data analysis showed that 10 out of the 40 students chose to write their name in both rounds (voluntary due to student integrity and me being the only assessor of all examination modules in the course). The 10 known students turned out to achieve 8 VG and 2 G on the individual exam, thus obtaining an average of 80% VG in that group (hereafter called the strong group). The anonymous students achieved 13 VG, 15 G and 2 U, thus obtaining an average of 43% VG in that group (hereafter called the moderate group). The results are presented and analyzed based on these two groups.

IV. Results

The results show that students perceived an increase in their competence level both regarding theoretical and practical knowledge (apart from all but two students passing the individual exam). The increase between the rounds was almost the same for both groups and types of knowledge (approximately 1,6 points increase on a scale 1-5). What can be noted is a slightly higher confidence generally in theoretical knowledge, and an overall slightly higher confidence in the strong group compared to the moderate group.

A. Informal learning aiming at theoretical knowledge

The results show that students are likely to use a variety of informal learning actions in their quest to acquire theoretical knowledge. Most informal learning actions have also increased slightly over the course. However, *Use google* has decreased by over 1 point from round 1 to round 2, indicating that this learning action has been somewhat disappointing for students' learning.

More interesting is to investigate the results per group. Strong students seem more likely to use informal learning actions than the moderate group. The biggest exception is *Use AI* where the moderate group rank 0,7 points higher. This might indicate that strong students prefer other learning actions for their learning or have recognized the limitations with *Use AI*. Strong students furthermore seem to have increased their likeliness of using informal learning actions more compared to the moderate group. This applies especially to indirect interactions like *Listen to peer passively*, *Listen to teacher passively* and *Observe teacher passively*. As stated before, informal learning is often unconscious, and students are often unaware of how they learn. The increase in indirect interactions for the strong group could indicate that these students have become more aware of the range of possibilities there are to learn and therefore rank such previously unnoted learning actions higher at the end of the course. Regardless, likeliness (and increase of likeliness) of using informal learning actions seems to have a correlation with results.

B. Informal learning aiming at practical knowledge

The results show larger differences for acquisition of practical knowledge compared to acquisition of theoretical knowledge between various learning actions. Specifically, *Test* and direct interactions like *Ask peer to explain*, *Ask peer to show*, *Ask teacher to explain* and *Ask teacher to show* are likely to be used in a practical context.

When comparing the groups, the results reveal interesting similarities and differences for acquiring practical knowledge. *Use google* and *Test* are very likely to be used by both groups, though *Use google* decreases in probability over the course while *Test* increases. Regarding *Use AI*, the results show similarities to the theoretical context above, that is, *Use AI* is much less likely to be used by the strong group than the moderate one. This might again indicate that the strong group prefer other learning actions or that they see more the limitations and risks of *Use AI* than the moderate group.

For all remaining informal learning actions (i.e. direct and indirect interactions), the strong group shows a distinct higher initial ranking in round 1 compared to the moderate group, except for *Observe teacher passively* where the moderate group shows a slightly larger likeliness of usage. In round 2, the strong group continues to show a distinctly higher ranking for the indirect interactions, while there are changes in the direct interactions. For example, the moderate group is at the end of the course more likely to use *Ask peer to explain* and *Ask peer to show* than the strong group. In contrast, the strong group is more likely to *Ask teacher to explain* or *Ask teacher to show*. One explanation could be that the strong group has surpassed their peers in knowledge level during the course and therefore prefers to

involve the teacher instead of peers. But though the strong group is likely to involve the teacher, their likeliness for *Ask teacher to show* and *Ask peer to show* has interestingly decreased (though from high levels). This might be explained as when students have understood the importance of doing things themselves (*Test*) instead of only observing, they prefer *Ask teacher to explain* and do/solve the practical issues themselves instead of someone showing them. In addition, the likeliness for *Observe teacher passively* has increased distinctly for the strong group, which could also correlate with a preference for doing themselves (*Test*) for practical knowledge acquisition.

V. Discussion

A. Informal learning and its development in the course

There might be several reasons for the increase of likeliness in using specific informal learning actions. One reason could be natural development, where students noticed on their own what worked and what did not. Based on these reflections, the students might use beneficial learning actions to a greater extent. Another reason could be the teacher's attempt to support a learning culture in the classroom by promoting and informing about informal learning. At the beginning of the course, the teacher presented a short description of the two knowledge types, explaining that this course is a two-step learning process where the students first needed to understand the concept theoretically (the "what") to then be able to do it practically (the "how"). Thus, not knowing how (i.e. practically) must not mean that they didn't know anything at all. They might already be half-way, knowing what. After the presentation the students were asked to fill in the survey and reflect upon their current view and usage of the presented informal learning actions.

During the following three weeks when the basics of dynamic simulation were taught, the teacher repeatedly informed the class about the two levels of knowledge as well as the benefits of using the informal learning actions from the survey. Not least, the teacher tried to counteract the Swedish "Jantelag" who tells you to stay in your seat and don't try to impress. In addition, eavesdropping (listening to peers passively) was said to be more than welcome in this technologically intense environment, as were spying (observing other students' screens). In brief, the teacher aimed to support a learning culture in the classroom where students felt safe both to ask and show.

B. Informal learning and its correlation to results

The results showed a positive trend of increasing likeliness of using most of the informal learning actions, along with a perceived change in knowledge level both theoretically and practically. This is satisfactory, but the major takeaway from this study is the correlation between the strong group and their superior usage and development of informal learning actions. This indicates that students that use informal learning actions as a strategy for acquiring knowledge, both theoretically and practically, might achieve higher grades.

VI. Conclusions

A. Implications

The results can be used to inform both students and teachers about the benefits of using informal learning actions in technology intense study environments. By highlighting such actions, students are made aware of additional opportunities to develop both their theoretical and practical knowledge of the topic at hand and not least improve their grades.

B. Limitations and future research

A totally non-anonymous survey would have allowed a distinct split in groups based on exam grades. Though I assured the students that the surveys would not be investigated or analyzed until after the course was finished, I chose to let name be optional in the survey to avoid any uncomfortable situation for the students. Though the exam is assessed anonymously in Inspera, the assignments and project work in groups are not, and I am the assessing teacher of all modules. However, a completely non-anonymous survey would probably have changed the results in a more distinct direction but would require consideration of student integrity. Future studies could also be done with and without the intervention of trying to establish a learning culture to explore the effect of such an invention in more detail.

Acknowledgment

Thanks to my students in cohort 2023 for participating in the study and bringing so much energy to the computer lab.

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