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Facilitating Student Achievement of Intended Learning Outcomes in Higher Education
Development and Evaluation of a Learning Analytics Dashboard

SEBASTIAN BUVARI
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SEBASTIAN BUVAHRI

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Supervisor: Olga Viberg
Examiner: Mario Romero Vega
School of Electrical Engineering and Computer Science

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Abstract

With the continued digitization of higher education, students’ ability to self-regulate their studies in online and blended learning settings has become critical for their academic success. Goal-setting strategies are an important aspect of self-regulated learning which universities aim to support through the implementation of the intended learning outcomes (ILOs) of courses and programs. These act as a promise for students of the knowledge and skills which they are expected to acquire. However, students often perceive an absence of clear connection between ILOs and course assignments that creates a disconnect between students’ course progression and their progression toward course ILOs. To assist students in this task, a student-facing learning analytics dashboard (LAD) allowing students to track and plan their learning progress toward the achievement of the selected course’s ILOs has been developed and evaluated in the context of STEM higher education. The LAD was developed using a participatory design approach combined with design science research methodology. Thirty-seven students contributed to the design of the dashboard through a F2F workshop and later a student feedback session in Spring 2023. The tool was evaluated through five semi-structured interviews informed by the Technology Acceptance Model. The results show students having a behavioral intention to use the dashboard in their everyday university studies. The thesis contributes with a LAD focused on student ILO achievement and task-interest.

Keywords

Learning Analytics, Learning Analytics Dashboard, Goal achievement, Higher education, Self-regulated Learning
Sammanfattning


Nyckelord

Learning Analytics, Learning Analytics Dashboard, Målprestation, Högre Utbildning, Självreglerad inlärning
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Stockholm, Sweden, December 2023
Sebastian Buvari
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Chapter 1
Introduction

1.1 Background

In recent years, there has been a drastic shift in the ways education is managed, distributing more resources to digital spaces than ever before [1]. Higher education institutions use digital technology such as learning management systems (LMSs, e.g., Canvas) for several different use cases, including the share of assignments, the formation of student groups, communication with students and grading student assignments. The digitization of education, facilitated by the Covid-19 pandemic has accelerated the use of online and blended learning and teaching practices [2], conducted through online synchronous and asynchronous meeting platforms increased the number of learning and teaching tasks conducted digitally, and increased the amount of study time students spend away from F2F campuses. Naturally, this has led to students having to take more responsibility for the achievement of their course- and program learning outcomes [3]. For student academic success in higher education (i.e., leading to improved learning outcomes), it has therefore become a necessity for students to have a higher level of self-regulation in their studies [3, 4].

Self-regulated learning (SRL) is the ability to plan, manage, and control one’s own learning process [5]. Individuals who have strong SRL skills are able to learn faster and perform better than those who lack SRL skills and knowledge, especially in such environments as online and blended learning settings, where there are lower levels of support and guidance on the part of the teacher and the educational institution [6]. SRL has also been shown to be especially important for academic achievement in STEM settings [7]. In
online contexts, SRL skills have shown to be an essential and predicting factor for students’ ability to successfully complete courses [8, 9]. It is, therefore, not surprising that extensive research has been made in the field of SRL, with the determination of developing and using digital tools aimed at assisting the development of SRL skills and knowledge among learners [10, 11].

However, current technologies aimed at assisting students in tracking and progression towards course intended learning outcomes (ILOs) have been hitherto limited [11]. ILOs refer to dispositions, skills and knowledge a student should achieve by the end of a course [12, 13]. Achievement of ILOs is an important factor in students’ learning progression; it has for example, been found to positively correlate with their academic outcome [14]. Further, to increase students’ academic performance and satisfaction, it is important to have well designed courses which adequately communicate course outline and learning expectations to students [15]. Constructing well defined and comprehensible ILOs is an instrumental part in the development of well designed courses [12]. With higher educational institutions moving to a more online setting, a new type of resource which may be used to empower students’ achievement of ILOs emerges.

The continued incorporation of digital technology into higher education, combined with the digitization of course materials has led to an increase in student generated log data being produced and trackable [16]. As increased volumes of student data have being produced, there is simultaneously a growing interest in using that data to support students and facilitate automated decision-making processes in education, and thus to further advance the quality of higher education, including students’ improved learning outcomes [17]. This has led to an increasing emergence of learning analytic (LA) tools [18].

LA is the collecting, reporting, measuring and analyzing of data in order to optimize and improve education for students [19]. LA provides detailed information about student learning processes which have previously been unobtainable through traditional educational assessment such as tests given to examine student knowledge [17]. Implementing LA tools into higher education thus becomes increasingly important [18].

One category of such analytic tools is learning analytic dashboards (LADs), which aim to provide overviews of learners’ progression within
courses [18]. These tools can support both teachers in the provision of their in-time support to students, and also students, in the visualization of their learning progress. Student-facing LADs are aimed at supporting students in their development of knowledge and skills, such as SRL skills through innovative designs which are able to visualize student data in a meaningful manner [20]. However, LADs which aim to support SRL skills tend to largely focus on the monitoring and reflection aspects of SRL but only few have focused on the provision of support for improving students’ goal setting strategies, motivation and goal achievement strategies and skills [20], all of which are critical for student academic success. To fill this gap, the present thesis presents a learning analytics dashboard (LAD) that attempts to breach the gap by visualizing student progression in a selected course towards their achievement of course ILOs.

1.2 Problem

Self-regulated learners are said to be able to plan, set goals, organize, self-monitor, and self-evaluate their learning process [11]. The SRL skills are further proven to facilitate higher academic achievement [13, 21]. However, higher education institutions are still lacking in the support they provide for students to develop these skills in an online educational context [22, 23]. In the Swedish setting of higher education, every course available to students has a set of clearly defined ILOs, presented in the course syllables. ILOs are the goals that are used to set expectations for students in what skills and knowledge they will gain throughout completing a course. But there is currently no digital support mechanism in place to show students their progression toward these learning outcomes, nor does there tend to be any explicit information on how teaching and learning activities, including course assignments and tests, throughout a course connect to the course’s learning outcomes. So how does one breach this gap? The growing field of LA has led to the development of LADs which aim to support student SRL skills’ development through visualization of student data, based on the the analysis of student (digital) data. However, there is still a need for LADs which support student critical goal setting skills, and their achievement of ILOs. Consequently, to address this gap, the present study aims to answer the following research questions.

RQ 1: How can students be supported in their achievement of intended learning outcomes with learning analytics in STEM higher education?
RQ 2: What is the student’s behavioral intention to use the designed learning analytics dashboard in their studies?

1.3 Purpose and Goals

The purpose of this thesis is to explore the opportunities in which LA can support students’ goal setting, goal achievement, and achievement of course ILOs. There is a need in the field of LAD research for more LADs that support student goal setting and task motivation[20]. The thesis aims to contribute to the LA research area by developing a student-centered learning analytics dashboard (LAD), which visualizes student progression towards ILOs, ultimately leading to student academic success. The goal of this study is to test novel data-driven methods of assisting students in achieving their course goals. Further, we aim at: 1) raising stakeholders’ awareness to the current underutilization of ILOs and 2) exploring a possibility on how these can be used to give students a further and more defined understanding of their learning progression in the setting of higher education.

1.4 Structure of the thesis

In Chapter 2, the concepts used in this thesis are explained and the results of previous related works in the field are presented. Chapter 3 introduces the methods used for data collection, solution development and data analysis. Chapter 4 presents the results of the design and evaluation phases, including the final version of the LAD as well as the results from students’ interviews exploring student intentions to use the tool in the future. Chapter 5 discusses the thesis’ findings in the context of earlier related research. It is also in this final chapter where the study’s limitations, future research directions and a conclusion are presented.
Chapter 2

Theory and Related Work

2.1 Intended learning outcomes in higher education

Intended learning outcomes (ILOs) sometimes used interchangeably with the term ‘course goals’, is an aspect of each course which sets a precedence to the expectations of what a course aims to teach. The Swedish Council for Higher Education [24] and Swedish Regulation for higher education [25] dictate that all courses of higher education specify their ILOs in the course syllabus alongside the educational cycle and a number of credits. However, there are no strict requirements on the part of higher educational institutions about how ILOs are to be achieved in educational practice.

ILOs between courses can vary considerably, both in number of ILOs and in the level of detail in which they are presented [26, 27]. An ILO is intended to define the expected knowledge in what a student should have learnt upon course completion [28]. The purpose of writing ILOs includes increasing transparency between educator and students but also acts as a foundation for how the course’s learning activities are built [28]. This includes being the foundation for assignments, teaching and learning activities (TLA) as well as what content and materials are chosen for students to partake in. Through this lens, ILOs are not only intended to help students gain a better understanding of the course and its working, but also for teachers to structure a course which meets student expectations set by the ILOs [28].

Earlier research has explored the value of ILOs, and how they contribute to students’ learning [29]. Simon and Taylor in their study [29], in which
three courses with detailed learning outcomes were studied, explored whether course-level learning goals improve student experience with the course. The study gathered 553 student responses pertaining to their experience with the courses ILOs, 471 of the responses had a positive response towards the ILOs. When exploring the perceived value of learning outcomes, the findings showed that the dominant value as perceived by students is that the ILOs aided in student recognition of “Know what I need to know”. The study showcases how the students perceived ILOs to work as a guiding tool in the courses, giving them focus, helping them stay on track and summarize. The results also showed that the ILOs helped students narrow down the most important aspects of the courses, allowing them to focus their efforts. This supports the studies hypothesis that students generally do not possess the ability to determine assignments relative importance and course organization, but are able to build an understanding through the aid of ILOs. The study also indicated that detailed ILOs assisted teachers with communication both with students and other faculty members by providing a method to clearly outline what the course covers. The paper summarizes that students find ILOs to be a valuable tool of communication, providing clarity for students and instructors while aiding students in their ability to organize, prioritize and understand the purpose of course material [29]. The same set of skills can be found in an important indicator for student academic achievement and self-regulated learning [5].

### 2.2 Self-regulated Learning

Self-regulated learning (SRL) is an umbrella term used for describing a holistic approach towards cognitive, metacognitive, behavioral and motivational aspects of learning. In more concrete terms, it refers to a learner’s ability to plan, manage, execute and self-reflect on their studies [5]. The most well-known SRL model has been offered by Zimmerman, who explained the SRL process as the cyclic model representing the relationship between three phases of SRL, forethought, performance and self-reflection [5]. In the forethought phase, learners make plans and set goals. In the performance phase, students carry out the assignments, working with their plans to achieve their goals set in the forethought phase. Furthermore, the performance phase includes learners monitoring their progress and employing self-control strategies to move progress forward. In the self-reflection phase learners focus on understanding what key attributes led to the successes and
failures they encountered during their task. The phase envelopes students building an understanding of how this knowledge can be used to impact the success of their future assignments [5]. The more adapted and trained a learner is in performing these three phases, the better they will perform in their achievement of new skills [30].

The continued research growth of the SRL field is in itself a testament to the field’s importance, but there is still a need for implementations in the academic world which convey, assist and educate SRL skills to students [8]. The need for students to adopt SRL skills has been shown to be especially important in STEM education where students who are competent or reflective-oriented self-regulated learners outperform minimally self-regulated learners in both learning gains and task performance [7]. With the emergence of courses moving online, the heightened need for autonomy has also contributed to the need for resources which support students’ SRL skills [9]. The demand for such resources has led to the development of tools which aim to support and contribute to students in using and acquiring SRL skills [31]. The results of a study by Kizilec et al. demonstrate the importance of SRL skills for student academic achievement [6]. The study covered a sample of 4831 students’ SRL skills. Goal setting and strategic planning were highlighted as critical factors for academic achievement, both which are considered part of the forethought phase in Zimmerman’s three phase model [5]. Further importance of SRL skills was indicated in a 2023 study by Xu and colleagues [32] who conducted a literature study covering 163 papers on SRL and academic achievement. Out of the 163 papers examined, 73 were intervention studies and 90 were attributed to correlation studies. The study found that 63% of the intervention studies demonstrated that a SRL intervention resulted in a positive effect on learners academic performance. Out of the 90 correlation papers, 40% demonstrated a positive correlation between student SRL skills and academic achievement, 21% showed no correlation and 35% showed a mixed correlation. The study concludes that SRL is an effective tool in increasing learners’ academic performance and highlights the importance of goal setting strategies and the need for further research on specifically the preparatory (forethought) phase of SRL.

2.3 Goal setting and Academic Achievement

To gain an understanding of how to maximize course goal achievement, it is relevant to first look at how goal achievement is obtained. Having goal
intentions refers to a person having the intention of performing the actions which will eventually lead to their goal attainment. Goal intentions have long been considered to be both the best predictor and tool for goal attainment [33]. However, the actual efficacy of goal intentions have been shown to be low to moderate instead of high as previously expected [34]. Furthermore, only 53% of those with goal and goal intentions seem to achieve their goal, meaning for 47% of the people there is an intention-behavior gap [34]. In other words, while goal intentions are important, there is room, a need, for something to address the intention-behavior gap. Gollwitzer and Sheeran [35] conducted a meta-analysis of 94 independent studies on the subject of goal attainment through implementation intentions to reach goal attainment. In their work, they have identified four common problems which can lead to failed goal achievement and which should be solved when attempting to close the intention-behavior gap. These four are: failing to get started, getting derailed, not calling a halt and overextending oneself. Implementation intentions, which are presented as the paper’s solution to deal with the 4 presented problems, are defined as if-then plans which are meant to allow the user to act on good opportunities by recognizing such opportunities and have planned actions for how to to capitalize on these opportunities. The planned actions are to be built upon cognitive and behavioral responses which are connected with an increased chance of goal attainment. The main differing factor between classical goal intentions and implementation intentions is that implementation intentions include scenario context, for example, “I want to make pancakes in the morning” is a goal intention which when structured as a implementation intention becomes, “if I wake up at 7am, then I have time to make pancakes in the morning”. Waking up at 7am now provides a recognizable opportunity to act towards one’s goal by providing when, what, how, in contrast to goal intentions which simply focus on what. The study concludes that implementation intentions were able to close the intention-behavior gap and substantially increase goal achievement [35].

Unsurprisingly goal-setting has also been shown to be an effective tool and predictor for students’ academic achievement [36]. Students consistently end with the grade which they believe they can and aim to achieve, making self-efficacy an important factor for achieving more complex goals [36]. Goal-intervention programs have been shown to significantly increase academic performance of students in higher education [37], which displays the importance of assisting students in their goal-setting skills. The first step of effective performance goals is to provide students with monitorable progress
towards their goals for them to receive feedback on their progression [36]. This allows students the ability to shift their strategies and work effort in an opportunity to better align their progression with their academic goals. The second step is to build goal commitment through importance and attractiveness of the goal while also making the goal achievable [36]. Students given the opportunity and tools to set their own learning sub-goals for courses have been shown to have an increased academic performance and have an increased ability to regulate their own learning [38]. With the importance of effective goal setting strategies established, it is relevant to examine recent work done to support students’ in SRL skills, one such tool which has gained research popularity is learning analytic dashboards.

### 2.4 Learning Analytic Dashboards

With the importance of SRL skills for students established, researchers have started to explore how the affordances of new technologies can be used to support student’s SRL skills [11]. A popular choice to explore has been the implementation of analytic technologies which have more generally been used to provide data-driven insights that improve decision making and innovation in different fields [18]. For the field of education, analytic technologies are aimed to increase student course completion by increasing visibility for the need of teacher intervention or improving student learning experience and learning ability [18]. A prominent analytic tool which has emerged in this field of research is the learning analytics dashboard (LAD) which aims to provide users with an overview of their progression within a course [11, 18, 39]. A definitive definition for LADs has yet to be decided but generally it is agreed that a LAD is a tool that provides an overview of information and presents such information in a manner which allows a user to make meaningful and improved decisions [39]. In this work, we focus on student-facing LADs as compared to the dashboard aiming to assist teachers. For student-facing LADs generally, there has been an interest in developing descriptive or predictive LADs [18]. While all LADs, even predictive LADs, have an element of descriptiveness to them, what this means in practice essentially depends on what the designed LAD is attempting to achieve [39]. In [40], a descriptive LAD was designed to allow students the ability to visually compare their performance in a course to the general performance of their classmates in an attempt to enhance students’ ability to understand their progression. This was shown to increase students’ engagement with course material [40]. A predictive LAD is introduced and evaluated in [41] where the presented LAD would use a Bayesian model to
compare students’ grade trajectory and predict students’ final grades. This resulted in an increased motivational level for students who were already highly motivated while having a detrimental effect for students who entered the associated course with low motivation [41]. According to [10], who have examined 29 different LADs, a common weakness in the design of LADs was that there was a lack of user-centered design which needed to be used in conjunction with theory to develop effective LADs [10], i.e., those that lead to improvements in student academic success and skill development. The results of another literature study [20], in which 28 LADs were examined, demonstrated a general lack of LADs which focus on the forethought or planning phase of SRL and suggested that more LADs should be constructed which aim to support students goal setting and interests in course tasks [20]. This thesis targets this gap, and introduces a LAD which aims to provide students with relevant insights in their learning progression towards course goals. Further, it aims at displaying the interdependency of course goals and course learning activities. The designed LAD has been evaluated (throughout the different stages of the design process) with students using the technology acceptance model (TAM)[42, 43].

2.5 The Technology Acceptance Model

The technology acceptance model (TAM) is a predictive framework developed and used to assess whether or not new technology will be accepted by the target audience and within that audience promote new behavior. The model was first coined by Fred Davis in 1986 and has since then been integrated into the research field of technology management and information systems where it has had significant impact [44]. TAM is rooted in psychology with the core aspects of the framework being to evaluate a user’s perceived usefulness and perceived ease-of-use. Perceived usefulness refers to the users belief that using the new tool will improve their performance or simplify their execution of tasks. A tool which is perceived as useful is more likely to be accepted by the user and have a behavioral impact. Perceived ease-of-use refers to a user’s prediction of how easy they expect a tool will be to master and utilize, with users being more likely to adopt tools which they predict to be easy to use [42, 43]. Both the aspect of perceived usefulness and perceived ease of use contribute to the third component of the TAM framework which is the attitude towards using the technology. However, early in the evaluation of the TAM framework, attitude by itself was deemed a less important contributor to user adoption of technology than the other two core components of the model [45].
Later, Davis extended the TAM framework with the addition of behavioral intention which would be a component directly influenced by both perceived usefulness and attitude towards using the technology and indirectly influenced by perceived ease of use (See Figure 2.1). Behavioral intention is measured as the strength behind a user’s intention to use the introduced technology and is seen to have direct influence over a user adopting the technology into their work [46]. The visualized layout of the TAM framework can be viewed in Figure 2.1

![TAM Framework Diagram](image-url)

Figure 2.1: Example of the TAM presented in [42].

Since TAMs debut in 1986, it has made a prominent impact in the field of user acceptance of technology, especially in the field of ICT and has consistently been shown to be a good predictor of user behavioral intention [47]. The TAM has also been used extensively to evaluate a variety of education focused technology, and such technology’s integration into the academic world [48, 49, 50]. Moreover, recent literature reviews have put forward TAM as the most extensively used model for behavior prediction and user acceptance for technologies such as web-based learning platforms and e-learning tools used to support teaching and learning in higher education [51]. TAM has also been used to evaluate technology adoption likelihood in STEM education [52]. Through its popularity and previously supported research the TAM model has been chosen to be the basis for evaluating the behavioral intention of users (students in the context of the present study) and their likelihood to adopt the technology developed in this thesis.
2.6 Case-study setting

The work performed in this thesis has been conducted in the setting of the DD2321 Information Visualization course provided at KTH. The course is mapped to approximately 160 hours of work for students. The work consists of attending lectures, presenting work, reading course material, programming, working in groups, developing projects, critiquing, discussing and writing their own learning journals. The course uses Canvas as the learning management system for all course learning activities. The course has approximately 50 students registering every year and has 16 scheduled two-hour F2F meetings where 8 are dedicated lectures. Throughout the course, students are to write learning journals which focus on self-reflection for individual ILOs the students have set for themselves. The students submit a total of three journal entries which are each worth 10% of the final grade, these are to be submitted after each project delivery a group makes. In their journal entries, the students reflect on and evaluate the work they have completed in the course, what they have learnt and what plans they have for the next stage of their work. Students are also expected to reflect on actions and plans which did not advance their projects and how the newly gained knowledge will affect their work going forward. Students are given feedback on each journal submission, this feedback is given shortly after submission and focuses on students’ individual ILOs and reflections.
Chapter 3

Method

When developing a technological tool it is important to select an appropriate design approach to ensure user needs are identified and answered. Research in the field suggests using a participatory design approach (PDA) when developing an to meet such student needs [53, 54, 55]. This study combines the use of a PDA with the framework of a design science research methodology. Both the PDA and the design science methodological approach are presented below.

3.1 Ethics

From an ethical viewpoint this thesis’ aim is to improve the quality of students’ interaction with higher education in the hope of furthering student ability to achieve course goals, thus increasing the quality of education through the power of technology. All user participation has been voluntarily with participants being able to opt-out at any point for any reason.

3.2 Delimitations

This studies user input is majorly collected from students participating in the Information Visualization course DH2321 at KTH and as such is limited in its reflection on the entirety of students participating in higher education around the world. While the field of LADs is rich in previous works and design propositions, it is still a newer technology and research pertaining directly to student-facing LADs is limited which presents both a drawback and opportunity.
3.3 Participatory Design

A participatory design approach (PDA) has been recommended in several works pertaining to the development of LADs and student-facing learning dashboards [53, 54, 55]. In essence, the PDA aims to build a tool tailored to the needs of its users directly, and build corresponding solutions with the help of user input [54, 56]. An example of an extreme contrast to PDA would be to apply zero interaction with users, instead attempting to guess or approximate user needs and ways to address those needs through isolated theory. The major drawback of a PDA approach is that it is time costly, as it relies on the designer to gather data from users in order to identify their needs [56]. The upside, however, is that PDA allows for the development of a solution to target and address user needs directly while also including user preference in the design process, which makes the solution more accurate to user needs [54, 55]. Another aspect to keep in mind when working with a PDA is described in [56], and that is that even if a developer is a fair representative of the user group, there will still be differences in thoughts and perceptions between the designer and end user. The wider this perception gap is, the more data needs to be collected through the PDA [56]. This essentially means that a PDA approach will always require the presence of some users who are not the developer/designer of the project, in contrast to a strict theory based approach which can be completed in a more isolated environment. In this project, PDA was applied through gathering information on what students wanted and needed out of a ILO focused LAD to be useful to them. The information gathering was done through a F2F workshop and student group feedback session which is further described in the following section.

3.4 Data Science Research methodology

The design science research (DSR) methodology, adapted in the present thesis work, is a methodology used for feedback oriented development, which cyclically aims to create and develop a design or product [57]. The main concept of the DSR methodology is to minimize guesswork by making new knowledge a key contributor in the design process and base theory construction on this newly collected knowledge [57]. In combination with a participatory design approach, the new knowledge gathered becomes valuable feedback data directly from the target audience. The DSR methodology divides a design process into five main consecutive phases in the order of awareness of problem,
suggestion, development, evaluation and conclusion. While the phases are consecutive, a cycle can end before reaching the conclusion stage, for example, awareness of a new problem could be gained during the evaluation phase, which might lead to the choice of starting a new cycle [57]. For this project, two five-phase cycles were completed. The first cycle which employs PDA acts as a foundation for understanding the needs to be met for a successful student-centered LAD implementation. The second DSR cycle focuses on using the knowledge contribution provided by the first cycle to create a new tentative design which will then be developed and evaluated, providing the result for this project, which will be discussed further in the final section of the thesis. The two DSR cycles can be seen in Figure 3.1.

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</table>

Figure 3.1: The combined DSR cycle structure used in this project.
3.5 Phases of a DSR cycle

3.5.1 Awareness of the problem

This phase starts when a new research problem is identified, this tends to spark from new developments within research fields but may also start through something as simple as a conversation with another party. The main goal in completing this phase is to build a proposal in which a potential solution to the problem is stated.

3.5.2 Suggestion

The main goal of the second phase is to produce a tentative design as compliment to the proposal discussed in the first phase. The suggestion phase is a creative phase where the researcher aims to combine existing or new elements to construct a tentative design which adds new functionality to a field.

3.5.3 Development

The development phase is where the tentative design is further developed and an artifact such as a prototype is created. The way in which the implementation is made does not need to be beyond state-of-the-art, it is the design itself which holds the novelty.

3.5.4 Evaluation

The evaluation phase is where an analysis of the prototype is conducted, information that contradicts the initial hypothesis is recorded and as contrast to a positivist research method, the most important aspect of this phase is not to prove or disprove the initial hypothesis but to feed the gathered result back into the DSR model, usually pertaining back to the suggestion phase, for another cycle of development. This is the result of the DSR model’s cyclic nature and the encouragement for design improvements based on continuous feedback.

3.5.5 Conclusion

The conclusion phase can be both the end of a research cycle or be the final part of a research effort. This phase when used as a final part of research effort is reached when the artifact has reached a stage of development which
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is satisfactory in a “good enough” sense. It is at this part a research effort’s knowledge contribution is thoroughly discussed and motivated. Depending on the research field and implemented artifact, the depth and complexity of the knowledge contribution may vary but a strong case for its significance needs to be made regardless.

3.6 DSR Cycle 1

3.6.1 C1 Awareness of the problem and Suggestion

The awareness of the problem is in this study the lack of visible connection between course goal achievement and assigned course tasks, an understanding derived from several discussions with teachers and course responsibles at KTH as well as first hand experience as a student. The first proposal, implementing a learning analytic dashboard to aid in solving this problem was given by this project’s supervisor Olga. To better grasp the field of LADs and their ability to assist students in their learning endeavors, the concept was further explored as presented in the related works section of this study. To develop a first iteration of a tentative design, the suggestion phase included a participatory design approach as suggested for development of student facing LADs by previous research [53, 54, 55]. For the suggestion phase, this was done by hosting a F2F student centered workshop. Thirty-seven students partaking in the targeted course - Information Visualization DH2321 attended the workshop which started with introducing them to the problem and proposal discovered in the first phase. The students were then asked to form smaller groups, where they worked together to brainstorm ideas on the different types of functionality that would exist within the dashboard. The students submitted their suggestions through the tool Menti. In the final part of the workshop, students worked in full group to further develop their submitted suggestions, providing useful insight into the ways they imagined the tool could function and how the interface could be designed. Key concepts which were important to students was that the tool connecting assignments and course goals had to be fast to use, simple in nature, feature clear visualizations and not require complex inputs through for example notes. Concrete ideas for the dashboard were also suggested by students, such as using a barchart for tracking learning goal progression and suggesting that uncompleted assignments could be tracked using a to-do list-esq solution. More abstract ideas were also discussed, such as implementing a tool which suggests different course paths depending on individual grade and learning outcome goals. After composing the results
of the F2F workshop, a tentative design was developed. In the third phase, development, the tentative design was made into an artifact, a prototype built using the tool Figma, the prototype can be seen in Figure 3.2 (Edited with enlarged text for the purpose of readability.)

![Welcome Henry!](image)

**Figure 3.2:** The developed Figma prototype.

### 3.6.2 C1 Development

The dashboard prototype incorporates several aspects which were discussed during the F2F workshop. The focal point of the dashboard design is implementing the barchart associated with learning goal achievement and connecting it to an extended version of the to-do list-esq assignment list explored during the F2F workshop. The assignment list includes assignment name, percentages of course goal achievements and estimated completion time. The idea is that once a task has been completed, the student can log its completion into the tool, which then provides the student with direct feedback to their course goal progression. This essentially provides a SRL loop, where students are able to be motivated by understanding the goal of an assignment, being able to connect those goals to their own, motivating them to complete an assignment and then being able to reflect on their overall progression of what they have learnt during the course. The artifact also includes the
idea for a grade progression chart, which would give students an idea of which grade they currently have, what grade they are approaching, and an approximate visualized distance between each available grade. It is intended to help students both have an easily accessible and direct read of their grade progression. While it also somewhat fulfills the abstract idea of the course paths discussed during the workshop, by providing students with the ability to evaluate which assignments result in both the most grade progression and progression towards self-designated prioritized course goals, it is not a main intent of the design itself.

3.6.3 C1 Evaluation

To evaluate that the designed prototype was aligned with student needs for course goal achievement, a feedback group session was organized where 3 students from the Information Visualization course participated. During this feedback session students were given the opportunity to give their thoughts and opinions on the Figma prototype, including giving their views on what features that could be added to improve the quality of the prototype. The purpose of the session was not to act as an extensive examination towards student behavioral intent of the proposed tool, an evaluation of that nature is saved for the second DSR cycle. Instead, the purpose of the session was to examine if the current concept of the dashboard was progressing in an aligned manner with student interests. The following feedback and suggestions were gathered during the session.

Desired changes and suggested improvements

- Indicator showing 0% or 50% in the graph (To make it more clear that % is being used and to clarify progression).
- Better display on which LO is selected in the graph and textbox.
- Deadline dates added onto assignments.
- Would prefer to have the implementation in canvas as opposed to standalone.
- Remove learning outcomes from the assignment list to avoid clutter of text.
- If the list of uncompleted tasks becomes too long, perhaps add some sort of dropdown for related tasks.
General feedback of the design

- The tool was intuitive enough that the students were able to understand the workflow of the tool without explanation.

- The students liked the idea of having an overview where course information was gathered in one space. They explained that as it is now, every teacher organizes their canvas differently, which leads to confusion and wasted time spent on opening and monitoring several tabs just to keep track of their progress and figuring out what they need to do and have completed.

- Estimated time was a valued feature, which they would use to better/more accurately plan their studies by better understanding how much time the educator expected them to work on the task.

- The students felt that a visual progression towards learning outcomes would help motivate them in completing their tasks, and assist in keeping them motivated through tasks they considered less interesting.

- They perceived that the tool would help them keep better track of the intended learning outcomes and their importance to each task, which they felt would also give them a better understanding of the task itself.

- The students had a positive association with ticking off tasks, stating “it feels good clicking a completed task” which they appreciated over the need to make the several notes they tend to write to keep track of their course progress.

- The grade bar was seen as valuable as it assisted them in understanding which tasks were valued higher by the teacher for grading and assisted them in keeping track of their course progress.

- The visualizations were seen as good and clear, no additional visualizations, for example a visualization of time spent was desired when asked.

3.6.4 C1 Conclusion

The student’s had a positive response to the prototype and gave feedback in the form of both suggestions for improvement as well as emphasis on how they would use the tool to enhance their studies. The gathered feedback strongly
indicated that the tool design was aligned with the student needs discussed in
the F2F workshop. The suggested improvements given by students layed the
groundwork for further development of the tool which was explored before
development of the artifact in the following DSR cycle.

3.7 DSR Cycle 2

3.7.1 C2 Awareness of the problem and Suggestion

The student feedback gathered from the first cycle’s evaluation phase works
as a foundation for the problem awareness phase of this cycle. As such, initial
suggestions for how to improve the design were suggestions which directly
addressed the gathered student feedback. To improve the clarity of progression
in the course goal graph, the suggestion is made to add a complete y-axis label
accompanied by indicators for 10% intervals, this is to allow for a more clear
and exact reading of the graph. To increase clarity between the LO progression
chart and LO textbox, the selection feature concept for the progression chart
was scrapped completely and replaced with a more classic x-axis which allows
for a more intuitive and recognizable display of LOs. The ability to switch
text box tabs as a follow up suggestion was made to be selectable in the text
box itself, to further increase clarity on selected tab a color will be chosen
to display the currently selected tab instead of using a simple shade out.
The associated LO text was removed from the assignment list to discard the
cluttering students experienced. This left space next to each assignment which
was instead used to implement the smaller and more compact information of
deadline dates associated with each assignment. To address the issue of the
uncompleted task list becoming too long and making scrolling difficult, the not
too intuitive design suggestion was made to increase the display range of the
assignment lists and make the uncompleted and completed assignment lists
stack dynamically on top of each other. This change reduces the amount of
scrolling necessary to traverse the lists and allows for a better overview of the
assignments.

3.7.2 C2 Development

The implementation was decided to be coded in JavaScript on the basis that it is
a well known and frequently used programming language for web applications.
This would add the additional strength of the application being browser based,
which if the project was later decided to be launched more wide spread, would
allow users to easily access the project without the need of downloading it onto their devices. The implementation was written using React.js, on the basis that it is a framework which is a widely known, well documented, component-based approach which combined with its declarative nature allows for quick and real-time rendering of an application and state changes [58]. This makes React a good candidate for the development of dashboards, and specifically for this LAD implementation which is intended to have several components linked to each other with the need to be quickly and smoothly updated in order to not negatively impact the user experience. Another benefit of using react is that it allows for the use of the next technology to be introduced, Material UI (MUI).

MUI is a react component library [59] which provides styled customizable components and icons that can be integrated into a react application. For this project, this means that instead of using standard HTML tags for constructing for example a button, a more polished version with the same or advanced functionality is able to be integrated through the use of MUI. This allowed for more focus to be directed towards the overall composition, functionality and visibility of the implementation by providing a better base than what is offered by standard HTML and React documentation. Cascading style sheets (CSS) were used for the stylizing of certain components, fonts and general aesthetics. The graphs were developed using Nivo [60], which is a chart library written on top of D3.js, a prominent and widely used JavaScript library for data visualization, and React.js. The output of this development phase is the LAD now named Ilopo, the Intended learning outcome progression organizer.

3.7.3 C2 Evaluation

The evaluation for Ilopo was done through think-aloud interviews in 1-on-1 sessions with five students, who have been participating in the targeted course. Each interview lasted for 30 minutes. The interviews started with students consenting to partaking in the study and then being given the opportunity to interact with the LAD without any input provided by the interviewer. During this period, students were actively able to explore all functions provided by the LAD and provide their own insights, ideas and conclusions pertaining to use cases for the LAD, purpose and conclusions to what benefits they might draw from use of the dashboard. After the interaction period which lasted approximately 10 minutes, students were given questions pertaining to and extending the TAM [61, 62] by evaluating seven
factors: perceived usefulness, perceived ease-of-use, behavioral intention, self-efficacy, perceived enjoyment, aesthetics and performance expectancy. These factors were evaluated by each student on a 3-point scale, ranging from the LAD having a low fulfillment of the factor, a medium fulfillment of the factor or a high fulfillment of the factor. A 3-point scale was chosen over a 5-point scale to minimize friction in conversation flow to allow more elaborate responses. The drawback to this however, is that the scale grading itself provides less information. The study participants were also asked to give further free-from feedback to what improvements, changes and future work they would like to see added to the LAD. In the next section, the developed LAD and evaluation results are presented.
Method
Chapter 4

Results

4.1 Ilopo

A result of this project is Ilopo (Figure 4.1), a student-facing dashboard built to assist students with their goal managing and learning progression tracking. Ilopo has four main components, the assignment handler, the learning outcome tracker, the learning outcome description box and finally the grade progression chart.
Figure 4.1: Ilopo, a ILO focused LAD, rotated.
4.1.1 Assignment Handler

The assignment handler (Figure 4.2) is responsible for providing the data which is visualized by the learning outcome tracker and grade progression charts. The visualized data is the completed assignments, a list which is displayed beneath the uncompleted assignments. Each assignment has a title, intended due date for completion, estimated time for completion and a checkbox. Clicking an uncompleted assignment’s associated checkbox will mark the task as completed, transferring it into the list of completed tasks. Clicking a completed assignments checkbox will mark the assignment as uncompleted, transferring the assignment into the list of uncompleted tasks.

![Assignment Handler Component](image)

Figure 4.2: The Assignment Handler component.
4.1.2 Learning outcome tracker

The learning outcome tracker (Figure 4.3) is the main visualization component of this project. It visualizes the ILO progression of students depending on which assignments they have marked as completed in the assignment handler. Each assignment has an associated percentage value for each of the intended learning outcomes. If an assignment provides no progression towards a specific learning outcome, the assignment’s percentage value towards that learning outcome is 0. The percentage based values are decided by the assignments significance in contributing to a student’s achievement of a certain learning outcome. The values range from 0-100 where a value of 100 indicates that the assignment is the sole contributor to a student achieving the learning outcome and a value of 0 indicates that the assignment is not connected towards the learning outcome at all. An assignment is able to have a value of 0 towards each of the learning outcomes, for example, group forming may be considered an assignment within a course which might not directly correlate to any learning outcome. The learning outcome tracker visualizes the cumulative progress towards each learning outcome, capping at 100%.

![Progression of Learning Outcomes](image)

Figure 4.3: The Learning outcome tracker component.

4.1.3 Learning outcome description box

The learning outcome description box (Figure 4.4) is located directly beneath the learning outcome tracker. This component contains the description for each learning outcome. The descriptions are organized into tabs which may
be toggled by clicking on the representative button for an unselected learning outcome. Once toggled, the description for the selected learning outcome is displayed.

Figure 4.4: The Learning outcome description box, LO 1 is currently selected.

### 4.1.4 Grade progression chart

The grade progression chart seen in Figure 4.5 visualizes the students’ progress towards the different grades available for the course. Each assignment has an associated percentage based grade value which is cumulatively added and visualized in the grade progression chart when the assignment is marked as completed in the assignment handler. The grades displayed are not set to an evenly distributed interval, but rather they each have a set value which when visualized provides a distance visualization of an estimated progression distance towards the next grade.

Figure 4.5: The Grade progression chart component, student is moving towards higher grades.
4.2 Acceptance of the LAD by students

The results of the student interviews are presented below by summarizing the five students’ (respondents R1-R5) responses to the interviews seven focal points and ending with a summarization of the students feedback for the LAD.

4.2.1 Perceived ease-of-use

All the students perceived the ease-of-use to be high for the LAD. During the free interaction phase of the interview, all the students were able to use the LAD without instructions. The students were able to correctly assess what each chart was displaying; how to interact and swap between learning outcomes in the learning outcome description box, and to gauge that there is a distance between grades portrayed in the grade progression chart to visually display grade distance. All the students were also able to use the select and deselect features of the assignment handler to explore learning outcome progression through the learning outcome tracker without any input or prompts from the interviewer.

4.2.2 Perceived usefulness

All the students perceived the usefulness of the LAD to be high. A shared sentiment among the students seemed to be the lack of clarity provided by the currently employed LMS, Canvas. For R1, this meant that the grade progression chart in itself would be a strong addition to the current system where grade progression is presented strictly through text, leading to the student having to perform calculations for every combination of assignments in order to gain a satisfying understanding of what they were expected to perform to reach a certain grade. The student explained that by implementing a visualization for exploring grade progression they would better put grades into perspective of each other and more efficiently plan for what tasks they needed to complete. All students deemed the learning outcome tracker to, if implemented, be the most meaningful addition to the current system. The three main reasons given by the students were

1. The assignments given by teachers would have a more clear justification towards their alignment of the course’s intended learning outcomes.

2. Between all the given assignments in a course it is difficult to assess progress made towards the course’s learning outcomes which combined
with the lack of visualizations or direct references to assignments’ connection to the learning outcomes made for a frustrating experience when attempting to track their progress at all towards the courses’ learning outcomes.

3. At the end of a course would bring structure and understanding of the skills and learning outcomes they had achieved during a course.

### 4.2.3 Self-Efficacy

Four out of five students found the self-efficacy of the LAD to be high; R4 found the LAD to have medium support for self-efficacy but to have the potential of providing high self-efficacy if made more customizable in terms of setting and tracking personalized goals. The students who deemed the LAD to have high self-efficacy thought so for majorly the same reason, that the LAD would be an organizing tool which would help motivate them towards completing assignments and thus progressing towards the achievement of ILOs. While R4 who deemed the self-efficacy of the tool to be medium did share this sentiment, they expressed that their personal current planning and goals system would be difficult to integrate with the current LAD as there was no option to add their personal goals into the LAD.

### 4.2.4 Perceived Enjoyment

All 5 students perceived the enjoyment of using the tool to be high, with the most common sentiment, expressed by all students, was that the LAD felt satisfying to use. The largest contributing factor towards this sentiment differed between students: R1 and R3 expressed that the responsiveness of the interactability was the most enjoyable part of the dashboard, marking an assignment as complete and receiving instant positive feedback through the changing of the charts; R2 and R4 thought the most enjoyable part of the LAD was to see their progression visualized with R5 expressing that the most enjoyable part of the LAD was playing around with the assignment handler and figuring out how different assignments were related to the learning outcomes.

### 4.2.5 Aesthetics

All five students rated the aesthetics of the LAD as being high, with R1 giving extra praise to the graphs, explaining that they were easy to read and were not cluttered. R2 mentioned that there was a lot of ‘unused’ space on the
dashboard, and wanted to see the completed and uncompleted assignment lists of the assignment handler to use some of that space by being displayed side by side and made longer, which also had the functional implication of decreasing necessary scrolling through assignments. The common sentiment between students was that the layout was intuitive and the color scheme pleasant. R2 and R3 noted that there was no header/title text for the assignment handler to indicate that the list consisted of assignments, and that even though one could easily deduce that the handler was displaying assignments, it would be beneficial for overall clarity to add a descriptive text over the handler such as “Assignments”.

### 4.2.6 Performance Expectancy

Four out of five students deemed the performance expectancy of the LAD to be high, and R4 deemed the performance expectancy to be medium. Students deeming the performance expectancy of the LAD to be high shared how the dashboard could be integrated and change their current workflow for planning and goal setting in a course. R1, R2 and R3 noted that if the dashboard was implemented for current courses they would have had a better understanding of the assignments and lead to improved decision making for deciding which assignments they wanted to focus on. R1 explained that they perceived the biggest strength of the LAD to be its implementation into mandatory courses where they found their motivation to be lower as to provide extra value to assignments they felt forced to complete. R4 who perceived the performance expectancy of the LAD to be medium did so as they felt that the diary system they currently employ supports the ability to see their progress towards their own goals better than the LAD and that they were unsure if the LAD would have a significant impact on how those goals were set, but that they would appreciate the clarity provided by the LAD to what each assignment in a course intended to teach.

### 4.2.7 Behavioral Intention

All students deemed their behavioral intention to use the LAD to be high. However, R2 and R3 were unsure if they would use the dashboard consistently if it was provided through a standalone platform, and not through the current LMS (i.e., Canvas). While the other three students would use the LAD even on a standalone platform, all five students shared the sentiment that they would prefer the LAD to be integrated into the currently used Canvas’ infrastructure.
to minimize time navigating between interfaces.

### 4.2.8 General Feedback and Suggestions

The students made several suggestions for what they would like to see implemented in a future iteration of the LAD. Three students mentioned wanting to see more interactability added to the learning outcome tracker. R2 suggested one such feature to the learning outcome tracker which when a column would be clicked would display all associated completed assignments which have contributed to progressing towards the selected learning outcome. R5 suggested connecting the learning outcome description box with the learning outcome tracker so that clicking on a column would automatically select the corresponding chosen learning outcome in the learning outcome description box. The student also suggested changing the legend of the learning outcome tracker to capital letters to remain consistent with the rest of the component. Suggestions were also made for the assignment handler, one such suggestion which was also mentioned by R2 and R4 when asked about the aesthetics of the dashboard was to add a visible title to the assignment handler to better indicate what the list was displaying. R2 also suggested adding additional functionality to the assignment handler such as a deselect all feature to make exploring course paths less tedious when having to manually deselect assignments one by one. Another suggestion for the assignment handler was adding a filter option which would allow users to, for example, only view assignments in the handler relating to a certain learning outcome. R3 expressed that they wanted some feature added to the LAD which would better display which assignments were mandatory for completing a course, so that these would be differentiated from optional assignments which also provide progression towards the courses intended learning outcomes.
Chapter 5
Discussion

The aim of this study was to develop a tool aiming at supporting students in their goal setting, goal management and achievement of ILOs while also furthering the current field of LA research by providing a LAD which helps breach the research gap for LADs focused on course task interest and goal setting [20]. To achieve this, two research questions were posed. The first research question asked, How can students be supported in their achievement of ILOs with the help of LA in STEM higher education? In this thesis, one proposed solution for this question was a LAD which would be developed through a PDA used in conjunction with DSR in order to work with and meet student needs directly. The result of this was Ilopo, an LAD built to assist students with their goal management and tracking of their ILO progression. Through the lens of student perception and acceptance of the tool, how well has Ilopo succeeded in this?

The student response to Ilopo was overwhelmingly positive. The students in different ways noted that if the LAD was to be implemented in their current courses, their decision making for assignments would improve. The students were able to find implicit value in the visualizations such as perceiving the assignments given to them as being more justified when they are able to see how each assignment was connected to the ILOs. To answer RQ2, it is relevant to focus on the three categories provided by the TAM which are, perceived ease-of-use, perceived usefulness and behavioral intention. For the five interviewed students, the LAD was valued as high for all three categories, which according to prior TAM research [52] indicates that there is a strong possibility that the students would adopt the technology into their educational workflow.
Student response to their perceived usefulness of the LAD, self-efficacy and performance expectancy shows that they have an interest in using the LAD to track their progression of ILOs. They describe that the LAD will aid them in planning, organizing and setting goals for their courses. Through the lens of SRL, this indicates that the tool would assist students with previously unavailable or hard gained information of how ILOs connect to course assignments, leading to more thorough decision making in the forethought phase. Student response towards perceived usefulness also shows that students found value in the LAD’s ability to, at the end of a course, provide them with a more thorough understanding and reminder of the ILOs and skills they had achieved throughout a course. From a SRL perspective, this means that the students were able to use the LAD as a valuable tool during the self-reflection phase defined in Zimmerman’s model. Students finding the tool to help with organization and motivation gives some credence to the LAD having an impact in the performance phase of the SRL cycle. However, it might be reasonable to assume that this impact will be of lesser extent than the LADs impact on the targeted forethought phase. Kizilcec et al. [6] described goal-setting and strategic planning to be critical factors for academic achievement, the LADs focus on these aspects could be a contributing factor to the positive student response towards the LADs perceived usefulness, which hopefully then also leads to increased academic and personal results. This is further accentuated by the study conducted by Xu et al. [32], which emphasized the importance of goal-setting strategies. The positive interest shown in the tool through the interviews also demonstrate students openness to a goal-oriented SRL implementation with focus on ILOs, which in itself is a small contribution to furthering the research of the forethought phase which Xu et al’s study concluded there to be a need for.

The importance of ILOs for academic achievement and for the quality of educational experience was displayed in [29] and is further supported by the result of this study which demonstrates student desire to actively work with ILOs when the ILOs have a clear connection to course assignments. Implementation intentions which have been shown to provide an increased achievement of goals by closing the intention-behavior gap [35] might be supported implicitly in the LAD through the accessibility of the previously digitally unobtainable information of ILO progression provided by the LAD. By being able to monitor their progression towards ILOs and their connection to course assignments students might be able to make if-then plans when
prioritizing, completing or failing to complete certain assignments. This use of the LAD is somewhat implied through R1, R2 and R3 response to the LADs performance expectancy but is more likely to be dependent on students already existing goal-setting habits and strategies more than as an effect of the LAD itself which would act as more of an enabler.

In [36] the first step of allowing students to make effective performance goals is to make their progress monitorable to them as a source of direct feedback on their progression. The descriptive LAD developed in [40] improved student academic achievement by displaying their grade progression in relation to other students attending the same course. Ilopo makes student progression towards ILOs visible to them, which opens the avenue for students to make such performance goals for their achievement of course ILOs. In the literature study conducted by Valle et al [20], it was concluded that there was a need for LADs which support student goal setting and interest in course tasks to be developed. This implementation contributes to the field of LADs by providing students with a clear connection between ILOs and assignments and making their progression towards the ILOs monitorable.

5.1 Limitations

This study had limitations that should be considered when evaluating the result of this thesis. The most straightforward limitation is the relatively small sample size of students for evaluating the behavioral intention to use the developed LAD. While the TAM does have strong support in previous studies to be a reliable indicator of users adopting new technology, it is not empirical evidence that shows student ILO achievement increasing. In other words, there is currently a strong case based on the results of this study that the tool would improve the quality of the educational experience for students, but to definitely know if the tool would increase student ILO achievement the LAD would need to be used and tested by students throughout one or several courses. This is something it does not have the capacity to do in its current stage, and even if it did, such a study would take a considerable amount of time longer than what was available for this project. This leads to another limitation of the project which would be that there is no LMS integration. To integrate Ilopo to work with Canvas would take more development time, access to the institute’s LMS’ infrastructure and a focus on privacy by design as more ethical questions would need to be considered when interacting with student data.
5.2 Future Work

Since the LAD was developed through two DSR cycles, one path forward could be to continue with a third cycle, implementing the ideas and suggestions provided by the students. An example would be to implement R3’s suggestion of better displaying which assignments are mandatory for course completion. In [38] it was shown that students who were given the tools and opportunity to set their own learning subgoals had an increased ability to regulate their own learning and improved academic achievement. As displayed through R4’s response to the self-efficacy of the LAD, this is not something which the LAD has been able to fully provide in its current iteration and is something that could be explored in the design for the next cycle. Another possible path forward for future studies would be to implement the current iteration/functionality of the LAD to be used by students throughout a course period. Through this, metrics such as or relating to grades, course goal achievement and personal achievement could be gathered and used to evaluate the effectiveness of the LAD in increasing these metrics. Another possible route for future work could be to explore the possibility of implementing a teacher-facing LAD which in an accepted way between teachers and students allows teachers to monitor student progression, which could allow them to more effectively intervene with students that are currently not on the trajectory to meet course ILOs.

5.3 Conclusion

The results of this thesis suggest that students’ perceptions of the developed tool, Ilopo, are overall positive, and they are also likely to adopt it in their future studies, ultimately leading to their academic success in the setting of STEM higher education. This study contributes to the field practice by offering a theoretically underpinned student-centered learning analytics dashboard aiming to assist students in the achievement of course-intended learning outcomes. Also, the findings contribute to the learning analytic field of research by demonstrating student desire and adoption of a participatory design developed and intended learning outcome achievement focused LAD. The LAD also serves to further the field of research by addressing the gap in goal-setting and task-interest focused LADs presented in previous research.
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References


With the continued digitization of higher education, students ability to self-regulate their studies in online and blended learning settings has become critical for their academic success. Goal-setting strategies are an important aspect of self-regulated learning which universities aim to support through the implementation of the intended learning outcomes (ILOs) of courses and programs. These act as a promise for students of the knowledge and skills which they are expected to acquire. However, students often perceive an absence of clear connection between ILOs and course assignments that creates a disconnect between students course progression and their progression toward course ILOs. To assist students in this task, a student-facing learning analytics dashboard (LAD) allowing students to track and plan their learning progress toward the achievement of the selected course’s ILOs has been developed and evaluated in the context of STEM higher education. The LAD was developed using a participatory design approach combined with design science research methodology. Thirty-seven students contributed to the design of the dashboard through a F2F workshop and later a student feedback session in Spring 2023. The tool was evaluated through five semi-structured interviews informed by the Technology Acceptance Model. The results show students having a behavioral intention to use the dashboard in their everyday university studies. The thesis contributes with a LAD focused on student ILO achievement and task-interest.