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Supporting Students in the Transition to Higher Education: Evidence from a Mobile App in Accounting Education

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Abstract

High drop-out rates among students endanger the goal of improving the quality of higher education. In the student lifecycle, the "transition-in" phase is particularly critical, as most premature drop-outs happen in this phase. Thus, universities and society need to find solutions to help students manage the challenges of the "transition-in" phase. We examine whether a mobile learning app designed and developed for the particular needs of business and economics students can support these students in this crucial phase. Using two well-established models – the "five senses of student success" and "student approaches to learning", we document that the mobile solution proposed here is well suited to support success factors that are essential for the "transition-in" phase. Hence, we could show that app usage can positively affect students' sense of capability, resourcefulness, and the strategic approach while mitigating the surface approach.

Keywords: Student Approaches to Learning, Five Senses of Student Success, Student Lifecycle, "Transition-in" Phase, Mobile Learning, Accounting Education

Introduction

A high number of university graduates is both necessary and desirable for knowledge-based economies and societies (Chorev and Ball 2022; Opazo et al. 2021). Large drop-out rates pose a threat to economic and societal well-being, and effectively reducing the average attrition, which stands at about 30 % (OECD 2022), is critical. The "transition-in" phase is a large driver of attrition (Lizzio 2011). In fact, most students who leave university prematurely have already considered dropping out in their first year (Opazo et al. 2021).

Many universities offer additional support in early study phases, such as mentoring programs and counseling services (Gershenfeld 2014). With the ubiquitous availability of smartphones among students, higher education has recognized the potential (Criollo-C. et al. 2021; Diacopoulos and Crompton 2020) of using mobile applications to support students in their first year (Pechenkina et al. 2017; Rietsche et al. 2017). Several studies have examined whether mobile apps can improve students' exam performance (e.g., Beatson et al. 2020; Pechenkina et al. 2017; Voshaar et al. 2023; Zhao 2019). For student retention, improving exam performance is only one aspect.

A successful transition into higher education needs to additionally tackle other issues, such as self-organization and motivation, which have an equally substantial influence (Zehetmeier et al. 2014). Related studies covered the benefits of analog support programs such as mentoring (e.g., Chester et al. 2013; Harris-Reeves et al. 2022; Larsen et al. 2020; Zimmerman et al. 2019). These studies use a nuanced interpretation of "student success" (e.g., learning efficacy, connection to fellow students), while research on mobile learning has so far largely determined "student success" based on grades (e.g., Beatson et al. 2020; Pechenkina et al. 2017; Voshaar et al. 2023). We are bridging this gap and apply two well-recognized evaluation models for analog learning support to the mobile learning context. This brings a more multifaceted view on assessing student success with the help of mobile apps at an early stage in the studies.

Our study aims to examine whether a mobile app can broadly support students during the "transition-in" phase of the student lifecycle (cf. Lizzio 2011) and to become settled into the university system. For this purpose, we utilize data that was collected during the use of a self-developed app in a mandatory introductory first-year accounting course at a German university. The app builds on gamification elements (e.g., quizzes, leaderboards) and offers students a mobile learning experience with the purpose of assisting them in their learning organization as well as exam preparation (Johannsen et al. 2021).

The focus of this paper is to analyze whether the app broadly supports students in the "transition-in" phase. For that purpose, we use two well-established models in this field, namely the *five senses of student success* (Lizzio 2011) and the *student approaches to learning* (Marton and Säljö 1976; Ramsden 1979). We pose the following research questions: *(1) Does the use of a mobile learning app, which was particularly designed for first-year students, support students in terms of the five senses of student success and students' approaches to learning? (2) Which "senses" and "learning approaches" can be influenced by a mobile app?* While the design of the mobile app itself is described in a previous work using a Design Science Research (DSR) approach (cf. Johannsen et al. 2021), the research at hand provides insights into those "*students' needs and concerns*" (Lizzio 2011, p. 5) that can be beneficially addressed by a corresponding app on the one hand. On the other hand, it is examined whether students' learning strategies can profit from such a solution. Hence, this research contributes to universities' search for ways to support students early in the curriculum (cf. Baars and Arnold 2014) and to increase student retention (cf. Matheson 2018).

The remainder of this paper unfolds as follows: Section 2 summarizes theoretical and empirical work and presents a self-developed mobile app for first-year university accounting education. In Section 3, we explain our research methodology and describe the data. Section 4 presents our main results and several sensitivity analyses. In Section 5, we discuss our results and outline the benefits. Section 6 provides concluding remarks, potential limitations, and future research ideas.

Conceptual Basics and Related Work

Student Lifecycle and Challenges of First-Year Students

Lizzio (2011) identifies four key transitions in the student journey through higher education: "transition-toward", "transition-in", "transition-through", and "transition-up, -out, and -back". The "transition-towards" already starts before the studies. Information is gathered, and the decision about attending university and the chosen course of study are made. Future students prepare themselves, form expectations, and develop initial ambitions. The second phase is referred to as "transition-in". This stage begins on the first day of study when first-year students try to settle into their studies. Once a student has overcome the initial hurdles and developed a student identity, the "transition-in" is complete (Bates and Hayes 2017; Lizzio 2011). This marks the beginning of the third phase, namely "transition-through". Students increasingly strive for academic success, while a graduate identity gradually replaces the student identity. Towards the end of their studies, the "transition-up, -out, and -back" phase ensues. Prospective alumni focus on their non-university goals and how they might continue their association with the university.

In research, the "transition-in" stage is a frequent topic of discussion as there is increasing awareness of the need to provide more support for students when they settle into their studies to avert attrition (Chester et al. 2013; Coertjens et al. 2017). Previous research examined the various problems associated with the "transition-in" phase, such as: (I) false expectations (Hassel and Ridout 2018; Jansen et al. 2017), (II) a lack of self-organization in everyday life and learning as a recurring issue (van der Meer et al. 2010; Willems et al. 2021), and (III) inefficient learning strategies and thus a poor balance between university duties and spare time. This, in turn, may cause irregular class attendance, which has been identified as a further indicator of attrition (Ancheta et al. 2021). Collectively, these problems can lead to fear of failure, which further exacerbates the transition into higher education (Guzmán et al. 2021). Although these problems are not exclusive to the "transition-in" phase, they occur more frequently at the beginning of the studies than in later semesters (Coertjens et al. 2017; Tinto 1998). Even if students choose to remain at university, problems during the "transition-in" phase can increase the duration of studies and thus occupy capacity, which otherwise could have been assigned to new students. Against this backdrop, we discuss how the problems of the "transition-in" phase can be alleviated and what role mobile apps can play in this context.

Literature mentions various factors of first-year students' success in developing a student identity and transitioning into the university environment. Some are beyond universities' immediate control, and those that can be exogenously facilitated should be of special attention. Therefore, the study at hand focuses on determinants that universities can influence. In order to identify success factors lowering attrition, we employ two models: (I) the five senses of student success (Lizzio 2011) and (II) the student approaches to learning (Marton and Säljö 1976; Ramsden 1979). Both models are used in many studies to measure the impact of support programs in the "transition-in" phase (Burnett and Larmar 2011; Chester et al. 2013; Harris-Reeves et al. 2022; Larsen et al. 2020; Zimmerman et al. 2019).

Five Senses of Student Success and Student Approaches to Learning

The *five senses of student success* model based on Lizzio (2011) is a conceptual framework addressing students' satisfaction and academic performance in the "transition-in" phase (Lizzio 2011). It is based on academic needs in five areas, namely: (I) *connectedness*, (II) *capability*, (III) *purpose*, (IV) *resourcefulness*, and (V) *culture*. The model is regularly used to evaluate programs to support first-year students. All five senses contribute to developing a student identity and thus lead to a successful "transition-in". First, the *sense of connectedness* is about students' relationships with peers and faculty members, which are essential for settling into university. Second, first-year students also have to put university requirements in relation to their own abilities to develop a *sense of capability*. They achieve this through good time management, self-organization, and understanding the assessment demands. Third, the *sense of purpose* is characterized by the existence of clear academic goals, intrinsic motivation, and an interest in new subject matter. Fourth, the *sense of resourcefulness* represents a successful balance between university responsibilities and spare time. Finally, the *sense of culture* drives satisfaction in the first year of study. Successful students appreciate learning and knowing how their studies are managed in a target-oriented manner. First-year students with a strong *sense of culture* are interested in learning and identify with their course of study. Panel A of Table 1 provides an overview of the *five senses of student success* and the associated student characteristics.

Panel A: *Five Senses of Student Success*	
Sense	Characteristics
Connectedness	Building relationships, identification with the university and course of study
Capability	Understanding requirements and assessment demands, mastering self-organization
Purpose	Setting academic goals, showing intrinsic motivation
Resourcefulness	Balancing work, life, and studies, being able to obtain support, organizing learning
Culture	Knowing and appreciating the value of higher education
Panel B: *Student Approaches to Learning*	
Learning Approach	Characteristics
Strategic	Good organization, consciousness of assessment demands, efficient learning strategies
Surface	Lack of direction, following the syllabus, rote learning, fear of failure in exam
Deep	Link ideas to knowledge and experiences, intrinsic motivation, critical thinking

Table 1. Five Senses of Student Success (Lizzio 2011) and Student Approaches to Learning (Marton and Säljö (1976); Ramsden (1979)).

A second important indicator of a successful transition into higher education centers around the *student approach to learning*. The concept based on Marton and Säljö (1976) and complemented by Ramsden

(1979) relates to students' methods of acquiring knowledge. As university differs from secondary education in how knowledge is acquired (van der Meer et al. 2010), a shift in learning style is required during the transition from secondary to tertiary education. Accordingly, prior studies have identified students' learning strategies as a powerful predictor of academic success in the first semesters (Duff 2004; Everaert et al. 2017). The concept of learning styles is illustrated in many variations across the literature. We consider three main approaches: (I) the *deep approach*, (II) the *strategic approach*, and (III) the *surface approach* (Entwistle et al. 1979). We present an overview of the *student approaches to learning* and the associated student characteristics in Panel B of Table 1.

The *surface approach* is essentially characterized by perfunctory learning. Students merely learn by rote (Booth et al. 1999). Additionally, students opting for this approach are characterized by disorganization and a lack of direction in learning. They strictly follow the syllabus without further delving into the topic, as there is no interest in the subject matter (Beattie et al. 1997). The fear of (potential) failure in the final exam is an extrinsic motivation for studying. In contrast, students who follow the *strategic approach* aim to optimize their grades through efficient learning methods (Ballantine et al. 2008; Walker et al. 2010). Strategic students are characterized by a high level of organization, good time management, as well as awareness of assessment demands but not necessarily by a deep-rooted interest in the subject matter. In the *deep approach,* the search for meaning in the respective subject is inherent (Everaert et al. 2017; Hall et al. 2004). These students are interested in the learning material and critically apply it to and amend their existing knowledge (Ballantine et al. 2008; Byrne et al. 2010).

Literature Review of Related Work

The *five senses of student success* as well as *student approaches to learning* are common frameworks for evaluating transitioning-in programs. The early study of Kulik et al. (1983) provides an overview of research about support programs for students at the beginning of their studies. More recently, Chester et al. (2013) discuss a mentoring program for first-year students. They document the program's success by finding three of the *five senses of student success* strengthened. They also observe improved learning methods through a significant increase in the *deep* and *strategic approach* and a decrease in the detrimental *surface approach*. Burnett and Larmar (2011) describe an advising service for students in their first year of study and note that student support is to be provided explicitly within the framework of the *five senses of student success* model. For specific programs, Larsen et al. (2020) report on evaluating the success of their so-called "Get Ready" program for the first semester using the *five senses of student success* model. The interdisciplinary program for about 14 Health Sciences degrees provides students with additional content, e.g., quizzes and learning videos. The results indicate that the program helps a highly diverse cohort to find their way into their studies. Zimmerman et al. (2019) find evidence that support services successfully reach most nursing students transitioning into a university, contributing to their academic success. Harris-Reeves et al. (2022) document similar results for a tailored transition initiative for Bachelor of Sport Development students. The relevance of *student approaches to learning* for the "transition-in" phase is also underlined by the findings of Duff (2004), while not exclusively focusing on this phase. Duff (2004) finds evidence that learning by using the *surface approach* negatively affects the academic performance of first-year students in an accounting course. At the same time, the *strategic* and the *deep approach* result in better performance and exam results, which is why they can be considered favorable (Yip and Chung 2005).

Mobile apps can also have several positive effects and enhance students' exam performance, which is outlined in the mobile learning literature. Focusing on accounting-related research, Pechenkina et al. (2017) examine mobile learning app usage for a first-year accounting course and find that app usage increases students' academic performance and lowers the drop-out rate. Beatson et al. (2020) refer to a mobile learning app for first-year accounting and management courses that enables students to complete assignments, watch learning videos, and receive course-related messages from instructors. The evaluated "Quitch" app relies on a gamification approach, including rankings for app users within the cohort. The study reports an increase in academic performance associated with app use. Zhao (2019) analyzes the impact of a similar app in an introductory accounting course.

Also beyond accounting, the potential of mobile student apps to support learning effectiveness is well-analyzed for various degree programs. For instance, Larkin (2015) evaluates apps to support the building of mathematical knowledge. Morris et al. (2016) point out the benefits of mobile apps in a neuroanatomy course by offering an "enjoyable learning experience". Mobile apps also have potential of enhancing learning in language studies (Steel 2012) as well as helping psychology students achieving their learning objectives

(Diliberto-Macaluso and Hughes 2016). Others provide overviews of apps beneficial for language education (Gangaiamaran and Pasupathi 2017).

While existing literature provides evidence that mobile learning apps improve students' exam performance, it does not examine the role of student apps in tackling typical challenges in the first year of study. We close this gap as our work aims to evaluate the impact of a mobile app – designed for first-year students in particular – based on the *five senses of student success* and *student approaches to learning*.

A Mobile App to Support Students in the "Transition-In" Phase and its Impact

We analyze whether a mobile app can support first-year students in their transition into higher education using a mobile learning app developed for a mandatory introductory first-year accounting course at a German university. The app aims to support students' learning process and enables mobile learning with a gamified approach. Further, the app supports students in preparing for exams. The app was developed with the help of a Design Science (DS) approach (Peffers et al. 2007), tested using a SUMI survey (cf. Kirakowski and Corbett 1993), and revised accordingly. In the following, the app development process with the help of DS is shortly summarized, with a particular focus on the steps "define objectives of a solution" and "design and development" (Peffers et al. 2007), while more details are given in Johannsen et al. (2021).

To specify the "objectives of a solution", requirements for our app were collected with the help of user stories, market research (of existing campus apps), a survey, and user journeys. The user story of a student using the app to learn for the introductory accounting course served as starting point for deriving requirements. To identify additional requirements, we searched for existing campus apps and critically scrutinized their functionality, considering their potential benefits for the "transition-in" phase. Besides, a survey was conducted among second- and third-year undergraduates ($N = 54$) to find further requirements by asking them for their expectations and needs regarding a corresponding app. This group was chosen because these students are still acquainted with the challenges at the beginning of their studies but are also experienced enough to propose beneficial app functionalities to tackle those problems. Finally, user journeys for students when interacting with the app served as an additional source for requirements. As a result, we came up with eight major design requirements (DRs), which we briefly summarize hereafter: (1) monitoring option for course attendance, (2) reminder for events and lectures, (3) provision of materials, (4) functionality to conduct performance tests (e.g., quizzes), (5) participation in peer group rankings, (6) design as a hybrid app, (7) distinction between front- and back-end, and (8) use of HTTP and JSON for data transfer (cf. Johannsen et al. 2021). The DRs 1 to 5 were particularly meant to support the *senses of resourcefulness* and *capability* according to the *five senses of student success* model based on Lizzio (2011). Though, these requirements could also promote students' appreciation for learning and, hence, the *sense of culture* (Lizzio 2011). Competing with fellow students in peer group rankings (DR 5) and reminders for academic events (DR 2) were supposed to motivate students to connect with one another but also with faculty staff (*sense of connectedness*) (Lizzio 2011). As a result of all these advances, an increase in students' intrinsic motivation (*sense of purpose*) was expected to be observed (Lizzio 2011). Additionally, DRs 6 to 8 were defined to enable the execution of the app on different platforms and the flexible management of content. Considering the app's "design & development" (Peffers et al. 2007), an architecture for the hybrid app comprising a front- and a back-end was created in a first step. The architecture was then realized with the help of the IONIC Framework (https://ionicframework.com/), the Spring Framework (https://spring.io/), and the Spring Boot solution (cf. Walls 2016). An overview of the design requirements, architecture, and the results of a SUMI usability study with a group of faculty members, school administrators, and students are provided in online appendix A-C (*https://tinyurl.com/248rs9ze*), while more details are presented in Johannsen et al. (2021).

We could show that more intense app usage results in significantly higher exam scores (Voshaar et al. 2023). However, even if especially developed to alleviate the problems of first-year students, the app's support in tackling challenges in the first year of study was not yet subject to research. In this context, the app provides various functions (to realize above DRs) that might be helpful in facing these challenges. For instance, the feature of tracking learning time could support students in their time management. Also, receiving immediate announcements from lecturers directly on the smartphone by push notifications or checking the latest news in the newsfeed could support day-to-day organization. These functionalities are complemented by a calendar function with reminders for lectures and important academic dates and push notifications for the availability of new learning content. In addition to self-organization and time management, the app offers the possibility to work on exercises and study independently of time and place, likely supporting learning efficiency. We show an overview of exemplary screenshots of the app in online appendix D.

Additional learning motivation through gamification was also considered to be beneficial by encouraging evenly distributed learning. Gamification has been recognized as a helpful means to overcome the lack of engagement in learning efforts (Hassan et al. 2021; Kiryakova et al. 2014). Accordingly, quizzes and competitions with the peer group are essential functionalities of the app, which support the pedagogical concepts of "freedom to fail" and "rapid feedback" (Thakur et al. 2020). These concepts reward students immediately, and the psychological barrier to give a wrong answer is reduced substantially (cf. Alberti et al. 2019; Gordon et al. 2021). Additional motivation promoted by these elements might also prevent disadvantageous learning styles, such as cramming and rote learning.

In recent years, there has been a lively discussion about Learning Management Systems (LMS), which are "*web-based software platforms that provide an interactive online learning environment and automate the administration, organization, delivery, and reporting of educational content and learner outcomes*" (Turnbull et al. 2020, p. 1). Although the functionalities of an LMS may be multifaceted (e.g., Mershad et al. 2020), a considerable amount still lacks gamification capabilities, and the technology may no longer be accepted by first-year students in case a system has not been optimized for mobile devices (cf. Koh and Kan 2021; Turnbull et al. 2020) or is merely used for sharing course materials (e.g., Turnbull et al. 2020) without an accompanying adaptation of teaching concepts (e.g., Ahmed and Ganapathy 2021). Considering this, the intention of our app is not to replace a traditional LMS but to purposefully complement existing systems to motivate students to engage with subject-related content and tackle recognized challenges in the "transition-in" phase. At our local university, we exactly observed abovementioned reservations against LMS from the side of students, which triggered us to develop an app to match the needs of first-year students. In summary, we assume a positive impact of our mobile app on the *five senses of student success* and *students' approaches to learning* (see Section 1 – RQs).

Empirical Approach, Data, and Specifications

Empirical Approach

To answer our research questions, we conducted a survey among the students of an introductory first-year accounting course in which the developed learning app was used. We focus on the group of accounting students to evaluate the research questions for the following reasons. First, the authors are well acquainted with the study-related challenges of this group. Second, due to the large number of students attending the course, it lacks personal interaction, which can likely exacerbate problems with the transition to higher education. Therefore, addressing and reaching the students personally via the mobile learning app is crucial to mitigate the problems stemming from less intense in-class interaction. Hence, the examination of the raised research questions with the help of this sample is reasonable, as in smaller groups and courses of study, the problems of the "transition-in" phase are probably not as prominent, due to the closer connection between instructors and students. To conduct the survey and in line with related studies, we refer to success factors, which allow an assessment of the *five senses of student success* and the *student approaches to learning* of a given student (Chester et al. 2013). Subsequently, we measure these success factors, such as a student's time management, by using items established in the literature (e.g., Chester et al. 2013; Duff 2004; Lizzio 2011). In this respect, we survey whether students feel supported by the app in certain areas, for instance time management. Finally, we use the classification from prior studies (cf. Chester et al. 2013) to distribute the identified and measured success factors to the respective model elements of the *five senses of student success* and *student approaches to learning*. For example, the statements on students' time management correspond to the model elements of the *sense of capability*, the *sense of resourcefulness,* and the *strategic approach*. These allow us to draw conclusions about whether the app has supported the student in the "transition-in" phase. We present an illustration of the research design in Figure 1.[1]

[1] For readability, we present only an abbreviated illustration of the research design in Figure 1. In online appendix E we provide the complete and detailed illustration. Moreover, we show the full survey with included statements in online appendix F (https://tinyurl.com/248rs9ze).

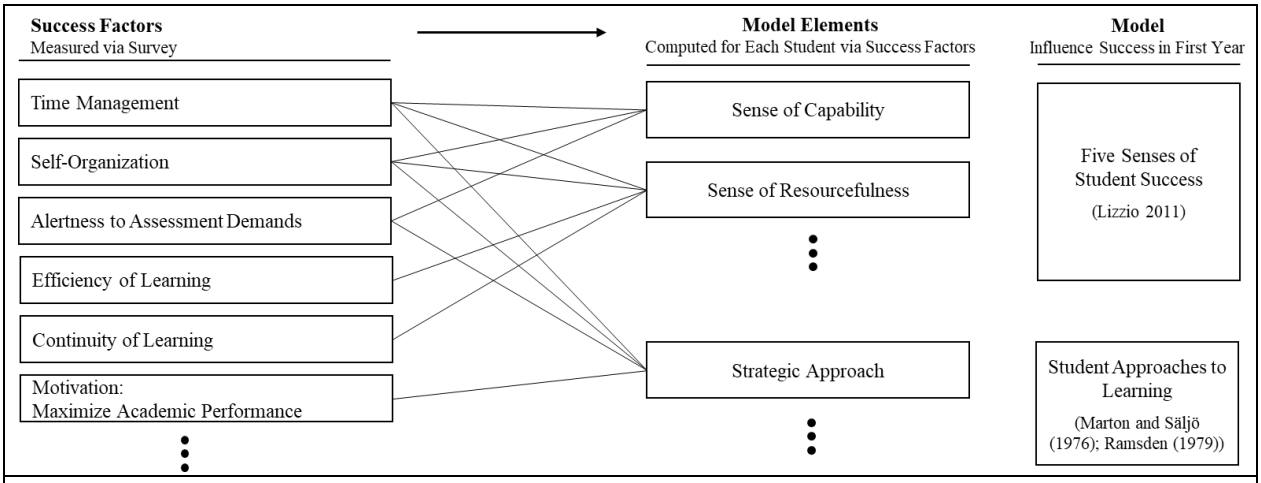

Figure 1. Schematic Illustration of Research Design.

For each statement, we use a 7-point Likert scale ranging from -3 (i.e., "I completely disagree.") to +3 (i.e., "I completely agree.") for two main reasons: First, it offers more response options than coarser scales (e.g., a 3-point scale), leading to a higher probability of matching the respondents' objective reality. Second, the increase in accuracy provided by an even finer scale (e.g., a 9-point scale) does not compensate for the additional effort participants would incur by having more answer choices. The response options of a Likert scale can be interpreted either as an ordinal or interval scale. According to related studies, we interpret our results as interval data (Chester et al. 2013). By doing so, the coded responses can be combined into scores using the arithmetic mean. These provide a quantitative measure of the extent to which the app usage supports certain senses of student success and learning styles.

Sample Selection and Descriptive Statistics

We draw on several data sources to obtain the needed data for the (I) group variables (i.e., gender, semester), (II) model variables, and (III) app usage measures. At the beginning of the semester, we asked the students to fill in a survey administered on the learning management system (LMS) to collect students' demographics and needed group variables (i.e., gender, semester, and high school diploma grades). Furthermore, we conduct an additional survey using survio.com to obtain the model variables of the *five senses of student success* and the *student approaches to learning* at the end of the semester. The survey was available online for all participants of the introductory accounting course. In a personal text message via the university's LMS, the students were informed about the study procedure, the purpose of the survey, the voluntariness of the participation, and the anonymized data processing. For participation in the second questionnaire, we offered the first hundred participants an incentive of 5 € in the form of an Amazon voucher or cash via PayPal. The data collection procedure was developed in close consultation with the university's legal office, and the study procedure was approved by the course coordinator and the faculty's dean to ensure that we met ethical, legal, and procedural requirements. So, while we collected group variables via the first survey, we obtained model variables through the latter one. Finally, we were able to retrieve the app usage measures directly from the mobile application.

We utilized the criterion of exam registration to distinguish serious course participation from mere course enrollment. Therefore, the initial sample consisted of 688 students who filled in the first survey on the demographics. Of these, 203 students participated in the second survey regarding the model variables. Since the study aims to evaluate whether mobile learning app usage can support students' "transition-in" by using the models of *five senses of student success* and *student approaches to learning*, we were ex-ante limited to those survey participants that used the app. Thus, we had to exclude data from 30 students who did not use the app but still completed the survey. Further, we dropped data from seven students who enrolled but did not seriously attend the course, as indicated by not participating in the exam. Finally, we eliminated eight observations due to a lack of variance in responses. Hence, the final sample consisted of 158 observations representing 33.98 % of the total underlying population of app users eligible to provide feedback on the

supportive nature of the app.[2] Notably, this percentage of representation of the underlying population demonstrates comparability with recent related studies (Johannsen et al. 2023). Furthermore, the sample represents 22.97 % of the entire course population. Table 2 summarizes the descriptive statistics. Our sample comprised a heterogeneous group of first-year students since the introductory accounting course is mandatory for students from several courses of study (i.e., business, economics, and combined courses of study in engineering and management and information systems and management).

Variables	*N*	*Mean*	*Median*	*SD*	*P25*	*P75*
Usage Time	158	1,944.83	1,330	1,876.14	542	2,929
Semester	158	1.95	1	1.82	1	3
Grade	158	4.14	5	1.20	3.3	5
A-Level Grade	156	2.36	2.25	0.54	1.90	2.70
Serious User	158	0.50		0.50		
Female	158	0.50		0.50		

Table 2 shows the descriptive statistics of the student characteristics. For binary variables, only means and standard deviations (SD) are presented. *Grade* is a measure of performance in the introductory mandatory accounting course equal to the grade earned on the final examination, from best = 1.0 to worst = 5.0. *A-Level Grade* is a measure of pre-university performance equal to the A-level grade, from best = 4.0 to worst = 1.0.

Table 2. Descriptive Statistics.

Gender was equally distributed regardless of the heterogeneity of our sample concerning the courses of study. Moreover, as the median usage time of the app is about 22 hours (1,330 minutes), the participants could be considered to be familiar with the app. However, it may be assumed that primarily heavy users participate in the survey and thus self-select into the sample. In that case, the survey results would be biased towards frequent users. Having said that, these concerns can be alleviated as the higher mean indicates a slightly positive skewness so that rather few heavy users and many occasional users participated in the survey. The sample thus has a similar distribution to the population of all app users. Most students are in the first semester, indicated by the median of 1. Especially these students might face problems in the "transition-in" phase. Overall, the descriptive statistics of the survey participants are essentially the same as those of app users, indicating that we were able to collect a representative sample.

Results

Initial Results of the Survey

We document the results of our survey in Table 3, including the measured success factors (column 1), the mean and standard deviation (columns 2 and 3), as well as the corresponding model element (column 4). The values based on the Likert scale indicate participants' degree of agreement on whether app usage supports students in the corresponding area. Higher values correspond to a greater impact on the respective success factor, while values below zero hint that app usage tends not to support the students in the respective area. The high mean values indicate that app usage supports students in various areas, such as efficient, autonomous, and self-organized learning and time management. However, other results are less noticeable. There is, for example, no clear evidence of whether students' alertness to assessment demands is increased. Besides, the survey hints that the app does not support students in other areas, like communication with faculty members.

[2] To ensure the representativeness of our sample, we conducted two-tailed t-tests for differences in means between the sample and the total underlying population of app users (Appendix H). We only find that the proportion of students (almost) never attending class, performing insufficiently in the final exam, and being in the second/third semester is lower in our sample than in the underlying population. In turn, the share of first-semester students is higher in our sample, which is even in favor of our research purpose as we specifically aim to support students in the "transition-in" phase. However, the significance level is only slightly pronounced ($p < 0.1$ or 0.05). Therefore, we consider the sample to represent the population well.

Surveyed Success Factors	*Mean*	*SD*	*Element*
Time Management	0.918	1.671	Capability, Resourcefulness, Strategic Approach
Self-Organization	1.409	1.260	Capability, Resourcefulness, Strategic Approach
Alertness to Assessment Demands	0.579	1.934	Capability, Strategic Approach
Relationship with Peers	-0.981	1.721	Connectedness
Relationship with Staff	-1.572	1.152	Connectedness
Identification with Degree Program	-0.591	1.630	Connectedness, Culture
Existence of Academic Goals	-0.849	1.384	Purpose
Interest in Subject Matter	-0.182	1.773	Deep Approach
Interest in Learning	-0.176	1.714	Culture, Purpose, Deep Approach
Efficiency of Learning	1.409	1.177	Resourcefulness
Continuity of Learning	0.843	1.821	Resourcefulness
Interdependence of Learning	1.409	1.290	Culture
Less Unrelated Memorizing	0.654	1.621	Surface Approach
Directionlessness of Learning	1.723	1.233	Surface Approach
Syllabus-Boundless	0.189	1.543	Surface Approach
Motivation: Internalize Subject Matter	0.157	1.725	Purpose, Deep Approach
Motivation: Maximize Academic Performance	1.239	1.486	Strategic Approach
Motivation: Fear of Failure	0.698	1.804	Surface Approach

Table 3 presents the survey results. Column 1 shows the item queried in the particular question. Column 2 presents the mean and column 3 the standard deviation based on a 7-point Likert scale. Column 4 indicates the corresponding model element.

Table 3. Survey Results by Questions.

Model-Specific Results

In order to be able to make a statement regarding the employed models (i.e., *five senses of student success* and *student approaches to learning*), we calculated the mean values of the model elements for each of the 158 survey participants. The aggregation of the survey results allowed us to examine whether app usage supports first-year students' transition into higher education. Figure 2 shows the extent to which students felt supported by the app regarding both models under investigation. A high mean value was desirable for each model element, indicating that the *senses of student success* were supported, the *deep* and the *strategic approach* were encouraged, or the *surface approach* was counteracted. Negative values indicated that students did not feel supported in the particular area. Values close to zero were indicators of indecision.

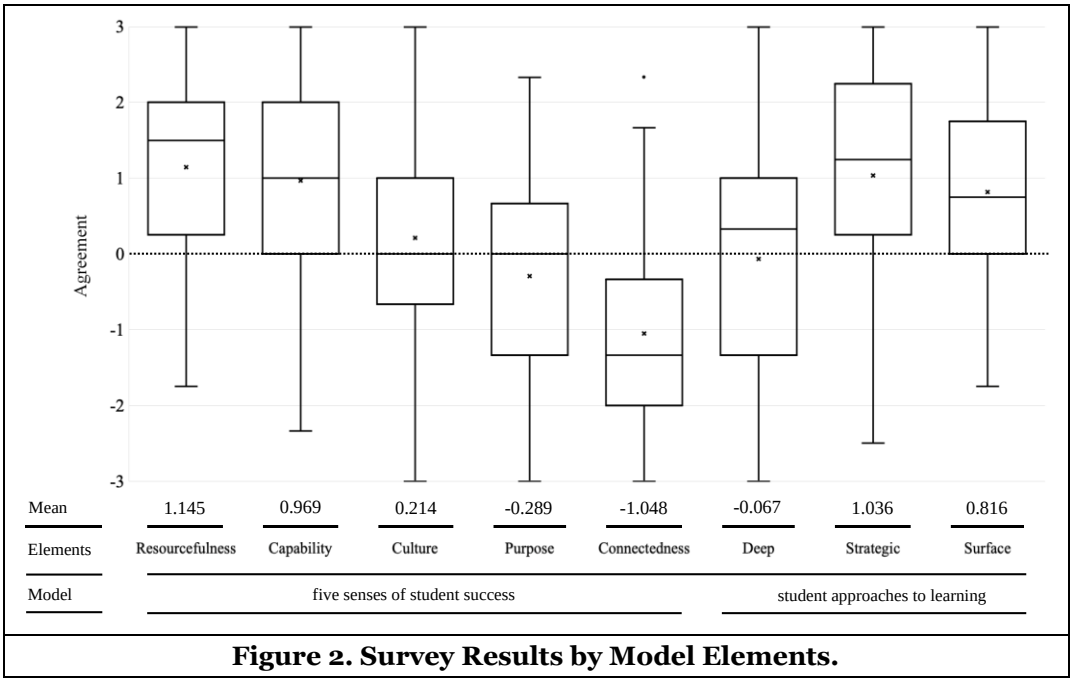

Figure 2. Survey Results by Model Elements.

The survey results showed that app usage might strengthen students' *sense of resourcefulness* and *capability,* as the mean values were 1.145 and 0.969, respectively. Likewise, an influence on learning styles

could be documented. With mean values of 1.036 and 0.816, students agreed that app usage encourages the *strategic approach* and counteracts the *surface approach*. In contrast, the negative mean of the *sense of connectedness* (-1.048) indicated that this sense was not supported. However, other results were less definite as their means barely deviate from zero. On average, students were undecided about the app's support in building a *sense of purpose* (0.289) and *culture* (0.214), as well as encouraging a *deep approach* (-0.067). In summary, the data hints that app usage can positively impact students' *sense of capability*, *sense of resourcefulness*, and the *strategic approach,* while the *surface approach* can be mitigated. The results align with prior studies on the impact of support programs, which also find strengthened *five senses of student success* (e.g., Burnett and Larmar 2011; Chester et al. 2013; Larsen et al. 2020). However, since a mobile learning app as a technological solution has other strengths than social mentoring, we find time management, learning organization, and help-seeking (i.e., *sense of resourcefulness*) as well as understanding requirements and assessment demands (i.e., *sense of capability*) to be particularly improved, while studies regarding mentoring programs also find students supported in their *sense of connectedness* and *sense of culture*. This finding is attributable to the design of such programs since they commonly focus on social interaction and are developed to build relations between students and faculty.

Further, we tested whether the positive results can be ascribed to the app after all. We applied a median split utilizing students' app usage intensity to create two subsamples ($N = 79$). To proxy for usage intensity, we used students' time spent on the app for the following reasons: In contrast to the app score (i.e., the gamification element), the usage time is a more global proxy as the score only increases by completing exercises, while the usage time also includes using complementary (organizational) app functionalities such as the calendar function which helps to organize students' everyday lives. Serious users had at least 22.17 hours of usage time, while occasional users used the app less.[3] Table 4 presents the differences in terms of the *five senses of student success* and the *student approaches to learning* across both subsamples.

	Five Senses of Student Success					*Student Approaches to Learning*		
Groups	*Resource-fulness*	*Capability*	*Culture*	*Purpose*	*Connect-edness*	*Deep*	*Strategic*	*Surface*
Serious User	1.43	1.22	0.37	-0.24	-0.99	-0.01	1.33	1.08
Non-Serious User	0.88	0.73	0.08	-0.31	-1.10	-0.09	0.76	0.65
|Diff.|	0.55 ***	0.49 **	0.29	0.07	0.11	0.08	0.57 ***	0.43 **
	(3.14)	(2.46)	(1.61)	(0.34)	(0.65)	(0.33)	(3.10)	(2.57)

Table 4 presents the survey results by model elements for the groups of serious ($N = 79$) and occasional users ($N = 79$) based on a median split. The last line reports the differences and the t-values of a two-tailed test between both groups. ***, **, and * indicate statistical significance at 1 %, 5 %, and 10 % level, respectively.

Table 4. Model-Specific Results by App Usage.

The comparison shows higher mean values for serious users for each model element, suggesting that more intense app use increases the identified effects. The differences in means are significant for the *sense of resourcefulness*, *sense of capability*, *strategic approach*, and the *surface approach*. Therefore, more intense use seems to amplify the benefits in these areas. We assumed no improvement due to using the app for the categories *sense of culture*, *sense of purpose*, *sense of connectedness*, and the *deep approach*. The results show a relationship between the intensity of app use and the magnitude of the observed positive effects, implying that these effects are attributable to the app.

We note a positive impact in regards to the *five senses of student success* framework associated with retention in higher education. App usage seems to strengthen success factors related to the *sense of capability*. Thus, students' ability to acquire academic knowledge and skills is enhanced. These findings might be due to the app guiding students through the learning and assessment tasks. App users also seem to develop a *sense of resourcefulness* associated with the utilization of university infrastructure to balance work and spare time. This is expected, as functionalities are provided to help students manage everyday

[3] Alternatively, we rely on students' app scores to conduct a split-sample analysis regarding the app usage intensity. The results remain essentially unchanged (untabulated). To tackle concerns of selection bias in split-sample groups for additional analyses (Table 4 and 5) and robustness checks (Table 6), we perform two-tailed t-tests for mean differences in student characteristics (online appendix G). As we do not document any suspicious differences, we believe the selection bias to be no pressing issue in our analyses.

student life. We also assumed the app to support desirable learning styles. Indeed, we note a significant association between app usage and the employment of the *strategic approach*. Moreover, the app's functions seem to counteract the detrimental learning style of the *surface approach*.

However, the app usage does not seem to assist students' transition in other areas. We observed no enhancement of the *sense of connectedness*, *sense of purpose,* and *sense of culture,* as well as the *deep approach*. These areas are related to developing academic goals, interest in course subjects, and the like. The app's features apparently cannot support these skills sufficiently to generate a statistically significant effect. However, potentially, students who were well prepared for academic life before entering university could still benefit from the app in these areas. Accordingly, while these students may already possess important skills, such as time management, they are more likely to benefit from app use in other areas, such as interest in learning. To test this assumption, we utilized A-levels grades as a proxy for general preparedness for the academic transition. In this setting, our sample size was reduced by two observations ($N = 156$) due to missing values in the A-levels grades. By dividing our sample into two subsamples, we separated exceptionally good students (A-levels grade of 3 or better) from other students and compared the mean values of the model elements for both groups. Table 5 presents the results.

	Five Senses of Student Success					*Student Approaches to Learning*		
Groups	*Resource-fulness*	*Capability*	*Culture*	*Purpose*	*Connect-edness*	*Deep*	*Strategic*	*Surface*
>= 3.0	1.08	0.76	0.67	0.28	-0.79	0.65	0.88	0.82
< 3.0	1.14	0.99	0.13	-0.40	-1.10	-0.20	1.05	0.81
|Diff.|	0.06	0.23	0.54 **	0.68 ***	0.31	0.85 ***	0.17	0.01
	(0.31)	(0.96)	(2.26)	(2.85)	(1.39)	(3.22)	(0.78)	(0.04)

Table 5 presents the results of a split-sample analysis based on students' A-levels grades with students with A-levels grades equal or better than 3.0 (>= 3.0*; N = 25*) and those with lower grades (< 3.0; N = 131). The last line reports the differences and the t-values of a two-tailed test between both groups. ***, **, and * indicate statistical significance at 1 %, 5 %, and 10 % level, respectively.

Table 5. Model-Specific Results by A-Levels Grades.

While for the entire sample, the *sense of capability* and *resourcefulness,* as well as the *strategic* and *surface approach*, were affected by app usage (Figure 2), we found that students with better A-levels grades were not significantly strengthened in this respect. At the same time, we noted that students with better A-levels were significantly more supported than their peers in other areas. This suggests that students who are better prepared for academic life already possess these basic skills; hence, the app supports these students in other, more advanced areas, such as developing academic goals. However, the effect was relatively small, as even students with greater academic aptitude tended to report low levels of support for these areas.

Robustness Checks

We aim to explore whether app use supports students' transition into higher education. In order to further enhance the reliability of the results, we perform three robustness checks, which use split-sample analyses as presented in Table 6. First, the high mean values for the model elements in areas for which support by the app was expected and documented in Figure 2 underscore the measure's validity. Following similar studies, we base the analysis on integrating the survey results into model elements (Chester et al. 2013). The validity is essential for the interpretability of our results and is thus discussed in the following with the help of robustness check 1.

Robustness check 1: The positive app usage effects should be more pronounced for first-semester students. First-semester students face greater demand for support in settling into their studies than students in higher semesters. Considering this, we expect the effects of using the mobile learning app on the model elements of student success to be more pronounced for first-semester students. To assess this, we conduct another split-sample analysis. The treatment group includes all respondents in their first semester ($N = 112$). The students of higher semesters ($N = 46$) comprise the control group. We find higher mean values for the treatment group across all model elements (Table 6; Panel A). For the *sense of resourcefulness* and *capability,* as well as the *surface* and *strategic approach*, we expect an enhancement by app usage. Except for the latter, we find a significant difference in the mean values for each category, suggesting that the observed effects are even more pronounced for first-semester students. In contrast, we do not document significant differences for the remaining model elements. This aligns with our expectations because we do not assume positive effects in the first place. In summary, the results show higher means for first-year

students, who tend to have a greater need for support. This further confirms the validity of the model elements to assess the supporting capabilities of mobile apps for first-year students.

Robustness check 2: Additionally, we examine whether the results are robust to variations in the initial parameters. The literature hints at heterogenous learning styles and first-year retention across different courses of study (Goldfinch and Hughes 2007). Thus, one could assume that our results are solely driven by one particular course of study and do not hold for other groups. To assess this, we divide our sample into two subsamples. The first consists of business students ($N = 99$). The other includes all students from the remaining courses of study (i.e., economics, production engineering and management, electrical engineering and management, as well as information systems and management ($N = 59$)). We do not find significant differences across all categories, suggesting the effects apply equally to business students and those enrolled in other courses of study (Table 6; Panel B).

	Five Senses of Student Success					*Student Approaches to Learning*		
Groups	*Resource-fulness*	*Capability*	*Culture*	*Purpose*	*Connect-edness*	*Deep*	*Strategic*	*Surface*
Panel A								
First Semester	1.27	1.09	0.31	-0.22	-0.99	-0.05	1.13	0.94
> 1. Semester	0.88	0.70	0.00	-0.42	-1.17	-0.07	0.83	0.56
|Diff.|	0.39 **	0.39 *	0.31	0.20	0.18	0.02	0.30	0.38 **
	(1.99)	(1.75)	(1.57)	(0.88)	(0.94)	(0.07)	(1.43)	(1.99)
Panel B								
Business Students	1.13	0.95	0.22	-0.27	-1.04	-0.04	1.02	0.80
Other Students	1.14	0.96	0.22	-0.28	-1.04	-0.05	1.03	0.81
|Diff.|	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.01
	(0.68)	(1.28)	(0.28)	(0.88)	(0.69)	(0.08)	(0.67)	(0.01)
Panel C								
Female	1.13	0.96	0.21	-0.29	-1.04	-0.06	1.03	0.81
Male	1.12	0.94	0.22	-0.27	-1.05	-0.04	1.01	0.78
|Diff.|	0.01	0.02	0.01	0.02	0.01	0.02	0.02	0.03
	(0.83)	(0.72)	(0.37)	(0.34)	(0.02)	(0.75)	(0.89)	(0.88)

Table 6 presents an overview of the robustness check results. In panel A, we split the sample into the two groups of students in their first semester ($N = 112$) and higher semester students ($N = 46$). In panel B, we split the sample by using the course of study resulting in the two groups of business administration students ($N = 99$) and students in other courses of study ($N = 59$). Finally, in panel C, we present the results distinguished by gender resulting in the two groups of female ($N = 79$) and male students ($N = 79$). For each panel, we report the differences and the t-values of a two-tailed test between the respective groups in the last line. ***, **, and * indicate statistical significance at 1 %, 5 %, and 10 % level, respectively.

Table 6. Overview of the Results from Robustness Checks Using Split-Sample Analyses.

Robustness check 3: Finally, several studies show gender-specific differences in academic success in accounting (e.g., Massoudi et al. 2017; Tan and Laswad 2015; Voshaar et al. 2023). Thus, it might be that the support by app use is only present for one gender. Both subsamples show similar results to the aggregate sample and document no significant differences (Table 6; Panel C). Accordingly, the mobile learning app can be considered supportive for students in general irrespective of gender and the concrete course of study.

Discussion and Benefits

First, our findings contribute to the question which tools universities can use to reduce drop-out rates among first-year students. We could show that the evaluated mobile learning app can positively impact students' *sense of capability*, *sense of resourcefulness*, and *strategic approach*. Furthermore, it helps to mitigate learning with the *surface approach*. The app strengthens students' abilities to understand university requirements and assessment demands as well as to organize efficient learning and time management. Moreover, their competencies in understanding the subject matter are developed further. Hence, mobile apps can play a role besides mentoring programs and similar analog services. They are even complementary: Previous literature shows that mentoring and student support programs strengthen students' transition to higher education, especially by building personal relations (i.e., *sense of connectedness*) as well as understanding and appreciating the value of studying (i.e., *sense of culture*; Chester et al. 2013). Our results suggest that support by our mobile learning app primarily enables students to master self-organization, improve independent learning (i.e., *sense of resourcefulness*), and understand

the requirements and assessment demands (i.e., *sense of capability*). This makes mobile learning apps a complement to personal mentoring. Accordingly, future studies may analyze the optimal balance between mobile apps and analog services to reduce drop-out.

Second, we contribute to discussing which learning app functionalities affect students' cognitive processes related to student success (Damyanov and Tsankov 2018), focusing on the "transition-in" phase. Out of the *five senses of student success* model and the *student approaches to learning*, the mobile app particularly supports the *senses of capability* and *resourcefulness* as well as the *strategic* and *surface approaches to learning*. It turned out that the option to track course attendance (DR 1) along with reminders for events and lectures (DR 2), the availability of training material (DR 3), the opportunity to test one's knowledge (e.g., via quizzes; DR 4), or the prospect to compete with the peer group via rankings (DR 5) do not only help students to familiarize with the student role and to process academic knowledge *(capability)* but also to become acquainted with the university procedures and to improve their self-organization (*resourcefulness*) (cf. Chester et al. 2013; Lizzio 2011). Though, similar effects on students' appreciation for the academic culture *(culture)* or their commitment to study *(purpose)* were less pronounced or could not be observed. This holds true for the support of students to connect with one another or the faculty *(connectedness)*. Based on the findings, we propose four Design Principles (DPs) (Gregor and Hevner 2013; Kruse et al. 2022; Kruse et al. 2016) for mobile learning apps targeted at first-year students. In line with Kruse et al. (2016), the DPs aggregate our design requirements to cumulated knowledge, which may be used to create similar artifacts. The DPs are: (I) Principle of fostering course attendance management (DRs 1 and 2), (II) principle of using self-learning control functionalities (DRs 3-5), (III) principle of assuring a widespread availability (DR 6), and (IV) principle of easy content management (DRs 7 and 8). Thereby, particularly the lack of self-organization in everyday life and learning (van der Meer et al. 2010; Willems et al. 2021) as well as inefficient learning strategies, which are mentioned as central problems during the "transition-in" phase, can be purposefully addressed by DPs I and II and corresponding mobile solutions. In future, app developers may propose additional functionalities to support the *senses of culture*, *purpose*, and *connectedness*, giving rise to further design principles, which may tackle the problem of developing false expectations at the beginning of studies (Hassel and Ridout 2018; Jansen et al. 2017).

Third, the study may be used as a first step towards the development of a theory for mobile learning in the "transition-in" phase, which – to the best of our knowledge – does not yet exist (e.g., Bernacki et al. 2020; Curum and Khedo 2021). Different theoretical approaches are discussed in this context, like the transactional distance theory (Moore 1991) or the dual coding theory for message design (Wang and Shen 2012), while a widely-accepted and self-reliant mobile learning theory has not been proposed yet. Therefore, the model elements (e.g., senses), which are positively affected by the mobile app, could be central components of a corresponding theoretical foundation (e.g., Grover et al. 2008). In this study, the corresponding elements were *sense of capability* and *resourcefulness*. Based on that, the influence of these elements on one another could be analyzed. Moreover, the model elements may be decomposed to receive components on an even more granular level. Considering this, we believe that the results presented here may be a promising starting point for the development of a mobile learning theory.

Fourth, even though the development of a mobile learning theory is an open topic yet, our research brings beneficial insights regarding the "pedagogical framework of mobile learning" as introduced by Park (2011). The framework uses "high or low transactional distance" and "solving an individualized or socialized activity" to cluster mobile learning apps. According to this framework, our solution represents an instance of a "type 2" app, which focuses on the support of individuals' learning strategies and self-organization, while promoting students' autonomy at the same time (comparably high transactional distance) (cf. Park 2011). For this type of app, knowledge about the *senses of student success* and support of learning approaches are largely missing to the best of our knowledge. Hence, this study provides knowledge that may purposefully complement the proposed framework by insights as to what degree corresponding app types (type 2) may support first-year students and which functionalities these may comprise.

Fifth, the literature indicates that many students entering the university system have a *"prejudice against accounting"* (Kutluk et al. 2015, p. 1683). Therefore, the learning methods are considered decisive for this course to enable students to understand and appreciate the subject-related content (Kutluk et al. 2015). Prior literature provides teachers with suggestions on making face-to-face or online accounting lectures more interesting (Fajardo 2014; Watters and Paul 2009). Considering this, further research may analyze the optimal balance between face-to-face teaching and content delivery via a mobile app in greater detail.

Conclusion, Limitations, and Future Research

We were able to show that using a specific mobile learning app we developed with the help of a DS approach supports accounting students' transition into university in several areas, such as time management and self-organization. Students who already possess these skills are more likely to be supported in other areas, such as developing academic goals. Therefore, the evaluated app supports students' transition to higher education in terms of the *five senses of student success*. By examining the *student approaches to learning*, app usage encourages desirable learning styles and prevents negative ones.

There are some possible limitations to this study. One limitation could be the use of a survey which could fuel concerns about subjectivity problems. Having said that, the uniformity of the questions in the survey was intended to prevent this bias as far as possible. Further, the results represent students' perceived support through the app. Therefore, it requires further testing whether the support can indeed reduce the premature drop-out rate of first-year students. A further shortcoming could be that the presented results stem from an ex-post survey after using the mobile learning app throughout the semester and not from testing the two models before (semester start) and after using the app (semester end) with a control group of students who did not use the app. This approach can be adopted in future research to extant our findings. Moreover, even if we did not find a systematical selection bias in our split-sample analyses, we cannot completely rule out the possibility of a certain selection into the groups as well as potential reversed causality (i.e., strategic learners using the app more intense instead of app usage fostering strategic learning). Additionally, generalizability could be limited since the app has only been used in a specific accounting course at one university during one semester. However, the course's topic, setup, and exam are essentially similar to most introductory accounting courses in Continental Europe.

In the next step, we would like to complement the findings of the research at hand by optimizing the balance of mobile app usage and face-to-face teaching as suggested in the literature. On that base, it can be subsequently evaluated whether and to what extent the rebalanced teaching style improves students' exam and course performance. Furthermore, future studies could examine the relationship between app usage and support in the "transition-in" phase from a multivariate perspective. Also of interest is whether app support in the "transition-in" phase manifests in a reduction of drop-out rates. However, further data has to be collected to answer this question, which we will pursue in upcoming steps.

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