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Recommendations for the Introduction and Usage of an Individual Digital Study Assistant, Open Education Resources, and a Teaching Network

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During Study	exam procedures	enrollment reminder & notification	automated enrollment	link to enrollment page
	scheduling of classes and exams	manual entry in calendar	automated entry in calendar	schedule optimization
	organization of exams / assessments	self-test: learning strategies during studies	individual checklist: learning strategies	individual learning tips of the day
	performance report	completed / open modules, grades, comparison to peers	SWOT analysis based on modules and grades with course suggestion	

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Abstract

Today's students are more heterogeneous and student numbers are rising, e.g., because of recent reforms in higher education. Thus, students become more diverse and require more individual counseling. However, this is hardly feasible due to a relatively constant number of lectures and university employees. The ubiquitous digital transformation results in new possibilities to face these challenges. Open education resources (OER) and inter-university teaching exchange networks (IUTEN) provide the opportunity to react to the increased student numbers. Individual digital study assistants (IDSA) further can provide functionalities that support students individually to strengthen their goal achievement, self-regulation and organization skills to react to the lack of personal counseling. Based on a literature review, we provide recommendations and incentives for IDSA development and operation, OER usage, and IUTEN participation. Thus, our results and findings reveal critical topics to consider for an IDSA introduction and can guide this process. They further provide a baseline for HEI strategies and advancements for OER usage and IUTEN participation. We thus extend the existing knowledge base of IDSA, OER, and IUTEN and enable further research opportunities within these fields.

Keywords: Individual Digital Study Assistant, Higher Education, Open Educational Resources, Inter-University Teaching Exchange Network

1 Introduction and Motivation

Because of various reforms in the higher education intuition (HEI) context, student numbers are rising and heterogeneity is increasing. This makes studying more individualized and requires more personalized and individual counseling and support (Clarke et al. 2013; OECD 2018; Van der Wende 2000; Wong and Li 2019). However, the number of lecturers remains comparatively constant (Hornsby and Osman 2014; Klammer 2019). New possibilities to meet these challenges are digital assistants, open educational resources (OER), and inter-university teaching exchange networks (IUTEN), resulting from, i.e., the digital transformation (Legner et al. 2017; Murphy 2020). OER are educational resources available digitally, globally, and free of charge for use and adaptation. They offer the possibility of expanding a lecturer's lecture while relying on already existing teaching materials (OECD, 2007; Seufert et al. 2019). IUTEN are networks between different universities that make lectures available to all network partners. They make it possible to expand one's own course offerings while focusing on own core competencies (Beiersdörfer et al. 1999; Hoppe and Packmohr 2007). Further, based on already existing personal data and information, individual digital study assistants (IDSA) offer the possibility to support students individually and

to give them situation-appropriate hints and recommendations. Their main goal is to increase a student's self-regulation abilities and goal achievement and improve study organization. IDSA can be used as a 1st level support of student concerns. Furthermore, they offer the possibility to react to the increased number of students and heterogeneity by providing automated individual support (Karrenbauer et al. 2021). The German-funded Siddata project (Study individualization through digital, data-driven assistants) (<https://www.siddata.de/>) develops such an IDSA and conducts research on it. The project addresses the question of how an IDSA can effectively and efficiently support students in achieving their own (learning) goals relying on existing data. Based on extensive requirement analyses of different stakeholders (lecturers, administrators, students), an IDSA will be prototypically developed and tested in several iterations at three universities in northern Germany. The study assistant can, among other things, suggest OER and course recommendations based on own interests, enables students to connect with each other to share their experience about already finished courses, and supports the planning of a stay abroad.

In this study, our goal is to identify general recommendations for an IDSA implementation and operation based on the results of the Siddata project. Furthermore, we want to derive additional general recommendations and incentives for the usage of OER and participation in IUTEN from the Siddata results. Our results are helpful for practitioners as well as for researchers. They clearly show which topics and aspects should be considered when introducing an IDSA and thus provide guidance for this process. The incentives and recommendations for OER usage and IUTEN participation also provide a basis for developing HEI strategies and advancing these topics within an HEI. We extend the existing knowledge base with our results and findings. Researchers can, e.g., use them as a foundation for future research on the topic of IDSA, OER, and IUTEN. Therefore, we focus on the following research question:

RQ: What are critical recommendations and incentives for an IDSA implementation and operation, OER usage, and IUTEN participation?

Therefore, in the following, we review the theoretical foundations of IDSA in HEI, student life cycle, self-regulation, OER, and IUTEN. Then, we describe the methodological approach of our literature review and introduce our results and findings. After that, we discuss them, and deduce implications and recommendations. Finally, we provide limitations of our study, an outlook, and conclusions.

2 Theoretical Background

2.1 IDSA in HEI

Digital transformation (DT) affects structures, processes, and operations within a HEI (Legner et al. 2017). For example, DT enables new opportunities within an educational context, e.g., through digital and hybrid alternatives that minimize the need for face-to-face advising or lectures and thus increase flexibility (Bennett et al. 2015; Abad-Segura

et al. 2020; Telukdarie and Munsamy 2019). This enables simplified communication, accessibility, and teaching for large numbers of students with comparatively little effort (Funamori 2016). DT also promotes various digital systems and assistants' design, development, and integration, such as chatbots or personal conversational agents (PCA). The latter are chatbots applied specially in a learning-oriented context (Wellnhammer et al. 2020). Over the past decade, much research has been conducted on these topics in general and for higher education (Hobert 2019; Hobert and Meyer von Wolff 2019; Ranoliya et al. 2017). For example, a PCA has been developed that helps students learn to program (Hobert 2019) or a further assistant supports students to learn factual knowledge (Ruan et al. 2019). In this regard, Knote et al. (2019) identified five archetypes for smart personal assistants (SPA): chatbots, adaptive voice (vision) assistants, embodied virtual assistants, passive pervasive assistants, and natural conversation assistants. SPAs are "smart service systems [that] interact with the user via natural language and offer many opportunities of service and information provision to reduce effort and complexity of users' everyday tasks" (Knote et al. 2019, p. 2025).

An IDSA is another example of a digital system that is enabled through the DT. Depending on its functionalities, design, and architecture, an IDSA can also be assigned to one of the five SPA archetypes (Knote et al. 2019). Following Karrenbauer et al. (2021), an IDSA provides various functionalities that enable students to improve their self-regulation skills, goal achievement, and study organization, taking into account their individual interests, competencies, and goals. For example, it supports students in managing their courses and exams, offers individual learning strategies, or suggests OERs and teaching networks (Karrenbauer et al. 2021). In doing so, it relies on various information sources, e.g., obtained from students themselves, from a content or learning management system (CMS, LMS) (e.g., performance reports, completed/open modules), or from external resources (e.g., OER platforms). An IDSA differs from a PCA that it does not directly support students in learning content. It rather supports this process on a reflective level. Through appropriate functionalities, the IDSA helps, for example, to structure the learning process, improves self-regulation, and provides individual recommendations.

2.2 Student Life Cycle

Each stage of study has different requirements and presents students with new challenges and opportunities. All relevant tasks and areas of students, lecturers, and HEI administrations in connection with courses are part of the student life cycle (SLC) (Sprenger et al. 2010). In general, the following phases can be highlighted (Lizzio et al. 2012): (1) orientation, (2) application for a university place and enrollment, (3) participation in courses and examinations, (4) graduation and de-registration, as well as (5) alumni activities. We see the SLC as suitable for knowing in which student phase the potential users are. That means, whether in the study entry phase, the longer phase

during study, or after study. Each phase has its characteristics that an IDSA and its specific functionalities can support. The decision in which phase to offer an IDSA depends on different factors (Karrenbauer et al. 2021). Structure and focus of SLC differ in teaching (Harlan 1994; Schulmeister 2007), quality management (Pohlenz 2020), and cost of a CMS (Sprenger et al. 2010). Bates and Hayes (2017) note that students need more intensive support in the transition phase for important and sustainable decisions. Wymbs (2016) emphasizes that much electronic data is already collected during the enrollment process. This data can be used for example to provide individual support for the decision-making process in the search for a suitable degree program by matching self-assessment data with artificial intelligence (AI) data. Overall, the focus is to act student-centered within the study stages. Therefore, different requirements for an IDSA can be concluded.

2.3 Self-regulated Theory

In order to go through this study process, it is necessary to set one's own goals, take distance, reflect on the offer with regard to the goal, and then decide. Independent study is considered key (Wolters and Hussain 2015) to successfully completing a university degree, as it requires far more pronounced self-regulation skills than in school (Virtanen et al. 2013) In addition to study skills, independent learning is becoming increasingly important in the context of more individualized studies (Zimmerman and Moylan 2009). Pintrich (2004) divides this key stage into four phases: Thinking Ahead, Planning, and Activating (Phase 1), Monitoring (Phase 2), Controlling (Phase 3), and Responding and Reflecting (Phase 4). Kitsantas (2013) has described how certain technologies support each of the phases. This should guide teachers on how to promote self-regulation in learning. Digital technologies provide an open gateway to new learning alternatives and options that promote the acquisition of self-regulation skills (Bernacki et al. 2011; Schneckenberg et al. 2011). In their study, Yot-Domínguez and Marcelo (2017) find that students make limited use of technologies to support self-regulated study skills. They indicate that the digital technologies they use are more likely to be used for simple activities such as searching, storing, or sharing information. At this point, teachers are challenged to provide offerings that support the discovery of effective use of this technology.

2.4 OER and IUTEN

To respond to the changing conditions within a HEI, OER and IUTEN offer possibilities to meet the, e.g., increasing number of students. In a conference hosted by the UNESCO in 2000 the term OER was firstly mentioned. Thereby, OER offer the opportunity for free and global access to educational resources as they can be easily shared via the internet (Butcher et al. 2015). OER are “digitized materials offered freely and openly for educators, students and self-learners to use and reuse for teaching, learning and research” (OECD 2007). The main differences between OER and

traditional educational resources is their license. While for the traditional learning resource a permission for the usage and adaptation of the original content from the copyright holder is required, it is not necessary for OER (Butcher et al. 2015).

An additional way to respond to the changing conditions within a HEI are IUTEN to make teaching materials available to other students and lecturers (Beiersdörfer et al. 1999). There is no universal definition for IUTEN. Rather, the term "barter" can be used as a guideline which describes moneyless market exchange (Dalton 1982). In contrast to OER, within an IUTEN educational resources are not made available globally, but only within a defined network. There were already some research projects in the 1990s and 2000s, such as ULI or RION. After the end of the funding period, however, these networks were often discontinued. It thus requires decided recommendations to increase OER usage and participation in such networks to respond to the challenges and changing conditions HEIs are facing.

3 Literature Review

We performed a literature review following the guidelines of Webster and Watson (2002), Watson and Webster (2020) and especially vom Brocke et al. (2009, 2015) to answer our research question.

Review Scope. First, we defined the characteristics of our review based on the taxonomy of Cooper (1988). Our goal and focus is to aggregate knowledge and recommendations for the introduction and operation of IDSA in HEI, OER usage, and IUTEN participation on a conceptual level. Thus, we concentrated on research outcomes and research applications, from a rather espousal perspective. Our focus is to identify a central coverage of the already existing literature on the specified topic. Our results and findings can support practitioners as well as researchers to advance the field of IDSA, OER, and IUTEN.

Conceptualization of the topic. We used the definitions of an IDSA, OER, and IUTEN from the theoretical background. Based on Karrenbauer et al. (2021) and König et al. (2021) we got first insights on these topics.

Literature search. We analyzed already published articles and presentations within the Siddata project from their website (<https://www.siddata.de/publikationen/>). We here analyzed 38 papers and presentations in more detail and excluded those that did not name or describe topics to answer our research question. This selection resulted in 12 scientific papers, that we finally considered for our study.

Literature analysis and synthesis. After we identified the key literature for our review, we analyzed and synthesized them focusing on the recommendations and incentives for an IDSA implementation and operation, OER usage, and IUTEN participation.

4 Results and Findings

During the research project Siddata, several different recommendations and implementation strategies for introducing and operating an IDSA were identified. We classify them into general recommendations and functional and non-functional recommendations for an IDSA. Furthermore, we identified several general recommendations and incentives to use OER and participate in IUTEN.

4.1 Recommendations for an IDSA

4.1.1 General Recommendations

Integration of students – Students are the main target users of an IDSA. Thereby, an early integration can increase their acceptance. A duality characterizes their role: During the development process, they are part of the development team to consider their requirements and enable an early inclusion as a tester. Once an IDSA is developed, students' role shifts to main users or customers of an IDSA (Tenspolde et al. 2019). Thus, it is recommended to develop an IDSA end-user-centered, i.e. student-centered.

Integration of instructors – Due to their regular contact with students, teachers need to be involved in the IDSA development at an early stage. Thus their requirements and wishes should be taken into account during the IDSA development process. Eventually, instructors can be a driver to communicate the IDSA and provide content and ideas for it (König et al. 2020a).

Top management involvement – To gain a wide acceptance of an IDSA, it is crucial to involve an HEI's top management in an early stage. They need to drive the change to use such an assistant and enable inter-university structures for it (König et al. 2020a).

Early marketing activities – Before releasing a first prototype, it is recommended to implement a project marketing team and develop marketing measures. Thus, an IDSA becomes known to potential user and supporter groups (König et al. 2020a; Reinken and Greiff 2021)

Structuring and integration of already existing data & systems – Many student-specific structured and unstructured data already exist in internal university information systems (IS), e.g., LMS and CMS. It is necessary to integrate these data, systems, and platforms into an IDSA and to create interfaces. Early contact with the responsible departments of these IS is recommended. An integration avoids redundancies of systems. Based on these data, an IDSA can provide individualized recommendations and enable special first and second level support (Greiff et al. 2020; König et al. 2020; König et al. 2020b; Reinken and Greiff 2021). However, the heterogeneity and use of

these data pose a major challenge related to data privacy (Thelen 2021). It is also difficult to adequately integrate the complex, inconsistent, and always changing structure of the examination regulations to make recommendations based on them (König et al. 2020b).

Target group-specific – Before a development of an IDSA starts, the target group must be precisely defined. HEI responsibilities often recommend rather to focus on specific target groups instead of a general IDSA. Often named target groups are an IDSA for incomings or a study-specific IDSA, e.g., for engineering or social science students. Especially an IDSA's study-specific expertise is of high importance for students (König et al. 2020a).

Fairness – Independent of an IDSA's target group, it must be accessible by all students within this group and treat them equally. Thereby, perceived unfairness is a barrier for students to use an IDSA (Greiff et al. 2022).

Provide added value – An IDSA must provide added value for all stakeholders involved. For students, this can be ensured by an attractive design, linking existing data, and offering helpful functionalities. Care must be taken to ensure that an IDSA differentiates itself from existing systems and apps and offers different, better, or more functionalities to avoid redundancies (König et al. 2020a; Reinken and Greiff 2021; Tenspolde et al. 2019). For lecturers and managers, added value is given if an IDSA represents a workload reduction and support, contributes to a reputation improvement, or increases the awareness of their tasks and services (König et al. 2020a; Reinken and Greiff 2021).

Individualization – An IDSA should be as individualized as possible. Information and recommendations should always be made based on existing individual information (interests, courses attended, etc.) and in accordance with the respective study course and examination regulations (König et al. 2020b; Reinken and Greiff 2021). However, these regulations often restrict individualized study paths and pose cultural challenges (Thelen 2021).

Data Protection and Privacy – During an IDSA development, the user's data protection and privacy must be considered (König et al. 2020b). The users need to be informed on how their data is used and processed. Students describe a lack of data protection and privacy as one of the most significant barriers to use an IDSA. It must be ensured that no unauthorized third party has access to personal data, whether intentionally, unknowingly, or due to the absence of (technical) security (Greiff et al. 2022; Tenspolde et al. 2019; Reinken and Greiff 2021). It is recommended to formulate a data protection concept and consult an HEI's respective data protection officers. Data protection requirements may also differ between individual HEI.

Brief and concise information – In order to reach a large number of students, messages and information should be kept short, otherwise, they will not be read (König et al. 2020b).

Financial support – The development and operation of an IDSA is cost-intensive. Therefore, this should be financially supported to enable and ensure the content's timeliness, reliability, and attractiveness (König et al. 2020b).

Stable system without error-proneness – Before an IDSA is rolled out, it must be extensively tested. Thus an error-proneness system with, e.g., performance problems, bugs, or slow data processing can be prevented (Tenspolde et al. 2019).

4.1.2 Functional Recommendations

In addition to the general recommendations, there are many other functional opportunities for an IDSA, see Table 1. In accordance with the SLC (Sprenger et al. 2010) functionalities can be classified in the three study phases: functionalities for the phase before the study starts, during studies, and after studies. There are different numbers of opportunities for each study phase.

Before University Study

Recruitment – During the recruitment process, an IDSA can assist future students and guide them through this process. For example, it can display information about faculties, studies, modules, and corresponding credit points. Furthermore, it can provide or link to a self-assessment to suggest a suitable study, institutions, or majors based on qualifications, competencies, and interests (Karrenbauer et al. 2021).

Application – An IDSA can also guide the application process by, e.g., answering admission-related FAQ. Whether dialog-oriented or rule-based, it can further provide information, a linkage to the admission process, requirements to apply, or contact details for further information (Karrenbauer et al. 2021).

Enrollment – Regarding the enrollment, an IDSA can assist and inform its user about this process in general or link to the corresponding enrollment page (Karrenbauer et al. 2021).

During University Study

Planning/scheduling – An IDSA can assist students in their study planning and organization. It can, e.g., display already taken and open mandatory courses, display their current schedule, optimize it based on their individual time and subject preferences, or enroll a student to a course (Greiff et al. 2020; König et al. 2020b; König et al. 2020c; Lübcke et al. 2020; Reinken and Greiff 2021). Furthermore, for already completed courses, an IDSA can request feedback and make

recommendations for further courses based on that. In addition, it is possible to use an IDSA to make appointments with lecturers (Karrenbauer et al. 2021).

Push notifications – Based on enrolled courses and lectures, an IDSA can notify and remind its users about appointments, upcoming courses, deadlines, exams, submissions, or the cancellation or postponement of lectures (Greiff et al. 2020; Karrenbauer et al. 2021).

Information and experience exchange – An IDSA offers the opportunity to connect students and offers the possibility of a platform for exchange. Thus, students can exchange experiences about lectures, seminars, or labs with each other. Based on interests, courses already taken or enrolled, it is also possible for the IDSA to make suggestions for learning partners or groups, thus enabling social networking. Students also express the desire for the possibility of data exchange through an IDSA in addition to social and experience exchange. This includes, for example, a central platform on which exercises, summaries, or other documents can be posted for the individual lectures (Greiff et al. 2020; Karrenbauer et al. 2021; König et al. 2020b; Reinken and Greiff 2021).

Learning assistance – An IDSA can also support students in preparing for tests or exams. It can offer functionalities that support the learning of information and data on and the structuring of learning. For example, a to-do list or a list with learning objectives can be used to record tasks that still need to be completed. This can be additionally provided with deadlines until when individual tasks should be completed. Regular reminders of the IDSA of these tasks and deadlines can support students' self-regulation (Greiff et al. 2020). Further, based on self-tests and individual student data, an IDSA can get to know a student and how he/she learns. This allows an IDSA to suggest individual learning strategies or to provide appropriate learning tips (Karrenbauer et al. 2021; König et al. 2020c).

Educational resources – In addition to university-specific lectures, there are OER. An IDSA can support students individually to inform them about OER and in their search for suitable ones. For example, common OER platforms can be linked, or these platforms can be integrated into the IDSA through interfaces. This enables the display of suitable cross-platform courses by means of a keyword search within an IDSA (Greiff et al. 2020; Karrenbauer et al. 2021; König et al. 2020b; König et al. 2020c; Reinken and Greiff 2021).

Performance report – Based on either existing LMS or CMS data or individual entries, already attended lectures and their results can be integrated into an IDSA. An IDSA can show the progress of studies, how many credit points are still missing, and display a grade overview and average. This data allows on the one hand a comparison with students from their peer group and on the other hand suggestions for further lectures based on the courses already taken (Karrenbauer et al. 2021; König et al. 2020c).

After University Study

Alumni – An IDSA can support alumni to stay in contact with each other or be informed of each other's career paths. For example, it can, e.g., link to an alumni network's website or list an alumni's name with the corresponding employer (Karrenbauer et al. 2021).

(Sub-) Dimension		Characteristic		
Before Study	recruitment	personal guidance	degree selection system	link to faculty / field information
		link to self-assessment with recommendations		majors and institution suggestion
	application	guidance through application	contact details	questions & problems answering
		link for further information		FAQ admission
	enrollment	link for further information	information where to inform	proactive demand for status
During Study	exam procedures	enrollment reminder & notification	automated enrollment	link to enrollment page
	scheduling of classes and exams	manual entry in calendar	automated entry in calendar	schedule optimization
	organization of exams / assessments	self-test: learning strategies during studies	individual checklist: learning strategies	individual learning tips of the day
	performance report	completed / open modules, grades, comparison to peers		SWOT analysis based on modules and grades with course suggestion
	changing course of studies	self-assessment with a persona template	majors and institution suggestion	link for further information
	distance lecture	outside one's own HEI with OER and other media	within one's own HEI	outside one's own HEI with participation of different HEI
After Study	alumni	link to list of graduates		link to alumni network

Table 1: Morphological Box for IDSA Functionalities by Karrenbauer et al. 2021

4.1.3 Non-Functional Recommendations

There are also many different non-functional recommendations for an IDSA which decision-makers can choose from. These mainly refer to an IDSA's technical conditions, see Table 2.

Communication mode – An IDSA can differ in its communication mode, i.e., how it communicates with its users. It can either be text-based, speech-based, or multimodal and combine both options (Koenig et al. 2020c).

Intelligence – IDSA can vary in the degree of intelligence. On the one hand, decisions and recommendations can be based on underlying expert systems, i.e., rule-based, and follow predefined if-then rules. On the other hand, an IDSA can also make these decisions and recommendations based on integrated AI and an underlying knowledge base. The knowledge base is continuously improved by the use of the IDSA and extensions of the data basis (König et al. 2020c).

Initiative – The interaction between an IDSA and its users can differ. IDSA can either interact proactively with students or wait for students to take the initiative to engage with an IDSA, which can then provide appropriate recommendations or answers. Depending on the situation or function, a combination of both is also possible (König et al. 2020c).

Interaction – An active interaction with the system can increase students' motivation to use an IDSA. Thereby the level of interaction can be different. For instance, an IDSA can only give answers to questions, participate in a discussion, or develop different topics. A situational combination is also possible (König et al. 2020c).

Channel – There are different ways to access an IDSA. It can be accessed through a standalone website, integrated on the university homepage or in the CMS/LMS, accessible through existing social media, e.g., Facebook Messenger, or developed as a standalone app. A combination of these options is also possible (König et al. 2020c).

Mobile access – Regardless of the channel, an IDSA must be mobile accessible. This can be possible, for example, by optimizing the website for mobile use or by the availability of a standalone app (Greiff et al. 2020; Tenspolde et al. 2019).

Authorization – IDSAs can differ in the degree of openness. It can be open to all users, i.e., accessible without registration, or it can require authorization, for example, based on a student's matriculation number and password. A combination of some functionalities requiring a login while others do not is also possible (König et al. 2020c).

Usability – An IDSA must be well structured, easy, and intuitive to use with an applicable degree of complexity (Reineken and Greiff 2021). Students request factual usage without many gamification elements (König et al. 2020b). A usage must be possible without studying manuals or tutorials in advance (Tenspolde et al. 2019).

(Sub)Dimensions		Characteristics			
Non-Functional-Recommendations	communication mode	text-based	speech-based	both	
	intelligence	rule-based if-then sequences	intelligent, e.g., with AI		
	initiative	proactive	reactive	both	
	interaction	turn taking	topic development	discussion	multiple
	platform	web-based	social media	apps	multiple
	Type	standalone	platform	both	
	authorization	log in	none	both	
	privacy protection	data protection button small placed and bottom left	detailed and prominently placed	educational sensibilization	
	handling of non-answerable questions	recommendation to contact employee	employee answers automatically	no recommendation/ forwarding	

Table 2: Morphological Box for Non-Functional Recommendations by König et al. 2020c

4.2 Recommendation for OER Usage

Based on our performed literature review, we were also able to identify general recommendations and incentives for OER usage. These are mostly based on the findings of König et al. (2021) and Reinken et al. (2021). Furthermore, König et al. (2021), introduced an incentive model that shows where and how an HEI can take measures to influence the willingness to import OER. The original model is shown in Figure 1.

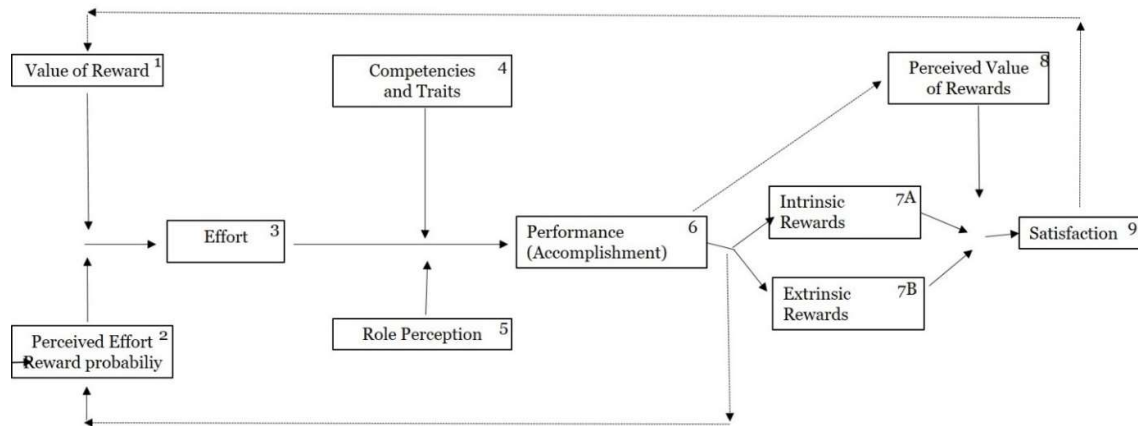


Figure 1: Incentive Model adapted from Porter and Lawler (1968)

4.2.1 General Recommendations

Top management involvement – As with developing and introducing an IDSA, top management involvement and support are also highly relevant for OER. It enables the advancement of the topic and the creation of structures for OER (König et al. 2021).

Ensure creditability – The creation of educational materials for distribution as OER is time-consuming. It includes, among other things, conception, technical preparation, recording, and follow-up. In order to reward this effort, it should be credited to the teaching obligations (König et al. 2021).

Provide technical equipment – In contrast to common local lectures, more technical equipment is required for the creation of lectures for OER. HEIs have to provide sufficient technical equipment for the respective lecturer as well as responsible persons for technical queries and support (König et al. 2021).

Recommendation by instructors – Lecturers are major multipliers to increase the awareness and acceptance of OER among students. Therefore, they should recommend platforms, providers, and individual OER corresponding to a lecture's respective topics (König et al. 2021).

Content relevance – When integrating OER into one's lecture, the content and methodology should address the learning objectives (König et al. 2021).

Ensure quality – Lecturers are often more likely to distribute and share their teaching materials than integrate OER from others into their lectures. One reason for this is current concerns about the quality of OER. Therefore, an OER's quality should always be ensured for the creation and integration. OER should be prepared didactically and professionally and the data and information of the content should be up-to-date. Another relevant quality criterion, in addition to a good scientific basis of the content, is the availability of metadata. This should include, among other things, contact information and descriptions and information of the content (König et al. 2021; Reinken et al. 2021).

Legal aspects – Before providing teaching materials or integrating them into one's lecture, legal aspects such as copyright and publishing law should be clarified and understood (König et al. 2021).

Target group focus – OER should be created according to its target group. However, it should also be noted that the OER demand can differ between individual target groups (König et al. 2021).

4.2.2 Incentives to use OERs

Digital format – OER are digitally available. This enables ubiquitous access, simplifies adaptation to own needs and teaching goals, and allows to combine different OER from various sources (König et al. 2021).

Supplementation of lessons – OER enable to expand and supplement one's own teaching materials with little effort (König et al. 2021).

4.3 Recommendation for IUTEN Participation

Our results and findings also reveal further recommendations and incentives to participate on an IUTEN. These are mostly based on the research results of König et al. (2021) and Reinken et al. (2021). As with OER usage, König et al. (2021), designed an incentive model to deviate measures to increase IUTEN participation, see Figure 1.

4.3.1 General Recommendations

Ensure performance certification – Within a university, structures must be created that allow an academic achievement from IUTEN to be credited. This applies to both students (credit points) and teachers (teaching responsibilities) (König et al. 2021).

Technical framework – As with OER, technical support (e.g., responsible persons for queries, assistants for support) must be made available for the lecture creation for an IUTEN as well as for the import of a lecture of a partner of an IUTEN (König et al. 2021).

Distribution – Both, the provision and the usage of lectures within an IUTEN must be relatively balanced so that there is no unilateral advantage. This also includes relatively uniform participation by students in lectures at locations other than their home university (König et al. 2021).

Top management involvement – For the success of an IUTEN and successful participation, top management involvement and support are needed to establish and promote IUTEN structures (König et al. 2021).

4.3.2 Incentives to Participate in IUTEN

Variety of offers – Participation in an IUTEN allows students a broader choice of courses to select from and covers a broader range of topics (König et al. 2021).

Discipline specificity – The respective providers of a lecture can better focus thematically on their core research. This can promote the specialization of individual universities on specific research topics (König et al. 2021).

Collegiality – Collaboration and exchange between colleagues from different locations can yield several benefits and is seen as an incentive to participate in an IUTEN (König et al. 2021).

Quality standards – Sharing and using teaching materials with known colleagues ensures that specific quality standards are met (König et al. 2021).

Networking – The exchange and cooperation of different universities increase the familiarity with each other. It enables to exchange ideas and, if applicable, to apply for and carry out joint research projects or to write joint publications (König et al. 2021).

5 Discussion, Implications, Recommendations, and Further Research

In this study, we focus on recommendations for a successful IDSA implementation and operation, OER usage, and IUTEN participation. For this purpose, the publications produced during the Siddata project period (42 months) are used to extract critical recommendations and also incentive systems. The Siddata project's intention was to develop an IDSA together with the students to integrate them. This gave reason to ask the target group first about the requirements and wishes for an IDSA. For instance, this feedback resulted in "we already use many apps for study relief, it has to have useful functionalities" or "we want a platform/system, and an intuitive usability" "data protection is important to us", as well as the "direct exchange with fellow students". These first insights contribute crucially to the development of an IDSA. One goal of the project - and with this Siddata is in line with the trend of interdisciplinary developments towards self-regulated learning - is to motivate the students to self-organized studying through our functionalities. They should set their own goals, define their areas of interest and support them, e.g., with the selection of seminars and lectures. Following the study of Yot-Domínguez and Marcelo (2017), students report using many digital tools. However, this study sheds light on this trend they indicate that students are only used to a limited extent, for simple activities such as searching, saving or sharing information. Technologies are still underutilized to support self-directed study or collaborative working. Our results and findings made it clear that the involvement of upper management in the development process is essential and that the President's Office is committed accordingly, e.g., by providing financial support or recommending the resulting product. Overall, it is crucial whether a presidium creates a cultural change at HEI, e.g., more openness for innovative formats in lecturing, such as OER and IUTEN. The added value should be made clear to the top management level. With this clear focus, marketing activities should be initiated at an early stage, so that in the general overkill of new and good digitally supporting apps, a new digital offering is perceived. The end users should perceive an added value, e.g., that they have all their university information on one platform and that the information is short, in a "Twitter format", useful functionalities, such as finding out which learning type one is, a memory function, or get to know interesting fellow students which pursue similar interests, or also serve as a learning group. It is important to look at individual functionalities in the sense of which sub-goals can be served with them. In a next step, the overall strategy is important - the view from a meta-level because then you realize, let's take a focused group, like incoming students or law students. That is where the first data protection hurdle arises, when the first step is to get access to existing HEI systems or data in order to be able to use the IDSA fully. Results of the interviewed lectures on the topic of OER and IUTEN indicated that they did not have the time to care or, more frankly, that they could imagine incorporating OER into teaching but not producing content

themselves. They argue that the fear of criticism from colleagues was too great and that every written word would be weighed. This feedback was used to develop an incentive system tailored to individual faculty needs, see Figure 1. Participation in IUTEN is similar in reasoning. Either lecturers do not know about existing exchange networks, distrust their colleagues or do not consider it as added value but as additional work to be considered for a new implementation of an IDSA or OER and IUTEN to ensure successful operation. This feedback was used to develop an incentive system for IUTEN participation tailored to individual faculty needs.

It is important to look on the following guiding question at the beginning of a launch of an IDSA, respective promotion of OER usage and IUTEN participation:

1. Do we have the technical infrastructure?
2. What stage of the student life cycle and target audience do we want to support?
3. Shall the IDSA provide first level support to organizational units?
4. Shall our HEI increase its use of OER?
5. Shall our lecturers participate in teaching exchange networks?
6. Is the technical and methodological-didactical support provided?

We see further research needs in the area of specific target groups. What exactly are the needs of incoming students, for example? Or thinking about the SLC, is it feasible to address only incoming students or students who are in higher semesters with an IDSA. It would also be interesting to take a closer look at the cooperation within IUTEN: to what extent are the lecturers motivated by the incentive system to exchange ideas with colleagues or to show as much appreciation for the expertise of colleagues as for their own research? Are joint research projects also initiated through the teaching alliance? Does the incentive system also help overcome fears about producing OER and making it available internationally? An exciting field is the cultural change of the HEI. How do those responsible transport/communicate the change? How is the cultural change being implemented in the own ranks?

6 Limitations, Outlook, and Conclusions

We used a literature review to identify recommendations and incentives for an IDSA development and operation, OER usage, and IUTEN participation. Our results and findings show various topics to consider and decisions to make during the design, development, and implementation phases of an IDSA. For example, there are different possible functionalities during all phases of a study lifecycle that can support students to strengthen their self-regulation and organization skills, ranging from, e.g., enrollment support, information and experience exchange to alumni networks. Decisions must also be made about, e.g., the interaction and communication mode and the accessibility. It is further recommended to, e.g., integrate all stakeholders in the IDSA development and operation process and provide an added value. Also, for OER usage

and IUTEN participation, our results and findings reveal several recommendations and incentives. To increase OER usage, it is recommended to, e.g., provide adequate technical equipment and ensure creditability. In addition, a performance certification and a balance distribution can increase the willingness to participate in an IUTEN. The recommendations and incentives together with the incentive model by König et al. (2021) can increase the willingness to use OER and participate in IUTEN.

However, as with all studies, our results and findings are not without limitations. Our recommendations and incentives are restricted by a literature review of the Siddata project publications only. However, more research exists in the field of digital assistants and chatbots in an educational context. In addition, the publications feature studies from German HEI. A glance at international studies would broaden the perspective. Further research can broaden the scope and analyze these publications and further extend our recommendations and incentives. All in all, our study extends the knowledge base of IDSA implementation and operation, OER usage, and IUTEN participation.

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