Developing an Evaluation Model for Information Systems Curricula

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Abstract. In this paper, we develop an evaluation model for Information Systems (IS) curricula. Existing evaluation models for curricula are analyzed and extended with IS-specific success criteria, such as a possibility to apply the learned skills in a student project. These success criteria are extracted from a literature review. As a result, we propose a model that can be adapted and applied to different curricula for Information Systems that cover various topics from IT, Business, Management, and Economics and include theoretical and practical learning methods. The findings can be applied in universities for evaluating new curricula as well as as serve as a starting point for further research. With this work, we offer a first step in defining an evaluation model that is specific for Information Systems by including the relevant success criteria.

Keywords: curriculum, evaluation, Information Systems, evaluation model.

1 Introduction

Quality assurance, continuous improvement, and optimization of the content and measures are important aspects of university curricula [1]. Therefore, curriculum evaluation is considered the last step of curriculum development. In many universities, a curriculum evaluation is conducted at the end of every semester and the reasons for this are manifold. While some institutions conduct evaluation to determine the success of a curriculum or a lecture [2], others perform the evaluation to assure that the topics covered in the curriculum correspond to the demands of the industry, as described by Snoke and Underwood [3]. Didactic researchers, such as Schaperunter et al. [1], Biggs and Tang [4], or Tyler [5] put a strong emphasis on curriculum evaluation. Thus, different evaluation models have been developed over the years. Stufflebeam and Coryn [6] define an evaluation model as "[...] idealized conceptualization for conducting program evaluations". These models address various aspects including the lecturers' behavior, spatial and structural aspects of the learning process, characteristics of the event [7], or the output of a curriculum [1].

However, the methods and frameworks mentioned are of a general and holistic nature. The authors suggest evaluation models by following the principle – one size fits all. They consider learning as an identical process in all disciplines and areas. Therefore, they suggest evaluation models that are universal and could be applied

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across disciplines [6]. While we agree that university learning is a cognitive process and people often learn in very similar ways independently from the discipline, we think that there are some differences through the disciplines in how the learning process is organized and conducted. This is especially true for interdisciplinary areas such as Information Systems (IS), where a combination of Computer Sciences, Business, Management, and Economics happens. University curricula in IS have specific requirements, since the discipline combines different areas of studies and includes a broad spectrum of teamwork as well as technical, and theoretical learning events. Therefore, the presented evaluation models are not perfectly tailored for the discipline of IS [3, 7].

This paper aims at addressing this gap by offering an evaluation approach that is suitable to the characteristics and needs of IS. We conduct a literature review to extract the success criteria of IS curricula. Based on these results, existing evaluation models for curricula are combined and extended in order to offer an evaluation model for IS curricula.

2 Background

The concept of a "curriculum" is broad and widely used in teaching and education. While some authors define a curriculum as the collection of learning and teaching materials for a single course, others include also the applied tools and methods in a course, or define a curriculum as the structure and content of a whole course of studies. For example, Ebert et al. [8] define a curriculum as "means and materials with which students will interact for the purpose of achieving identified educational outcomes". Another definition is provided by Offorma [9]: A curriculum is a "[...] document, plan or blue print for instructional guide, which is used for teaching and learning to bring about positive and desirable learner behavior change." For the purpose of this paper, we will use the following definition: A "curriculum typically refers to the knowledge and skills students are expected to learn, which includes the learning standards or learning objectives they are expected to meet; the units and lessons that teachers teach; the assignments and projects given to students; the books, materials, videos, presentations, and readings used in a course; and the tests, assessments, and other methods used to evaluate student learning." [10]

In order to evaluate a curriculum, measures and instruments are applied to judge or asses its level. Subah [11] describes evaluation as "a study that is designed and conducted to assist some audience to judge and improve the worth of some educational object". One of the definitions, provided by White [12], implies that evaluation is "a phase in the process of constructing and reconstructing curricula. Its purpose is to see whether curriculum objectives are being, or have been, achieved — so that modifications in them can be made if necessary." In contrast to this, in this paper, we will define evaluation as a process of collecting feedback about different aspects of the curriculum from the relevant stakeholders in order to assure the goal fulfillment and to identify the improvement potential.

Over the years, various evaluation models to assess curricula have been developed. Alazani and Fardoun [13] have described an evaluation model they use at their university. It focuses on evaluating the IS program based on student outcomes. For the direct measure, they map the student outcomes to the exam questions and look at the percentage of the students that answer it correctly. They also give a survey to the students for an indirect assessment. However, this survey is mainly focused on the student outcomes as well. While this model is used for this one specific IS curriculum, its application is very narrow. It is useful for evaluating the achieved level of learning objectives, but does not consider any other possible success criteria such as evaluation of the learning materials or the evaluation of the instructor.

Another evaluation model is proposed by Martínez-Caro et al. [14]. This model is not specific for IS, and can be used broadly. The authors claim, based on a literature search, that the student satisfaction can be evaluated with four dimensions: student-student interaction, student-teacher interaction, content, and system flexibility and convenience. They also provide a questionnaire that they gave to their students during the evaluation, with an exact mapping between the questions and the dimensions. This model is applicable in our context, but it is focusing only on feedback from students, without taking into account any objective measures, like grades, into consideration.

Other authors focus on evaluation models that do not consider the whole curriculum or its learning units, but only specific elements. For example, Wilson and Randall [15] evaluate a newly designed learning room where the course takes place. The model of Escudeiro and Escudeiro [16] focuses on evaluating the software. Its application has been shown by Reis and Escudeiro [17]. The authors suggest evaluating the learning software based on three dimensions: functionality, adaptability, and efficiency. For each dimension, they also provide a set of factors, such as ease of use, to be analyzed and the survey questions they use to perform the evaluation. Both models are not specific for IS, and can be applied broadly. However, like the one that we have described first, they are too narrow and do not evaluate the whole curriculum. Despite that, we can use them, if we determine that learning software or the learning room are among the success criteria.

Another evaluation model is the Kirkpatrick's 4-level evaluation [18]. It suggests evaluating the curriculum based on four levels: reaction, learning, behavior, and results. *Reaction* evaluation aims at determining how well the participants did, how the students, lecturers, and other involved stakeholders feel about the course as well as their reactions to it. It is possible to ask them about their satisfaction with every aspect of the curriculum. The second level is *Learning* and the evaluation on this level aims at determining whether the participants have mastered the learning objectives of the course and to what extent they did. The third level, *Behavior* aims at understanding to what extent the participants were capable to apply the knowledge in their job areas. The evaluation at *Result* level measures the effect of the training on in the working environment. The effect is captured by various key performance indicators such as non-compliance decrease or standard achievements. Since this model is flexible and easily adaptable, it was taken as a basis for this work and adapted and extended with elements of the other models as well as with success criteria, elicited from literature. These criteria are mapped to the corresponding evaluation level of the Kirkpatrick's model.

At each level, we provide the evaluation methodology that is extracted from the specialized models mentioned above.

3 Methodology

To determine the success criteria for IS curricula, we conducted a systematic literature review, following the recommendations of vom Brocke et al. [19] and Webster and Watson [20]. We searched in major databases, namely IEEE, ACM Digital Library, EBSCOHost, AISeL and SpringerLink. The reason for this choice is that these databases cover many IS publications. Furthermore, they also include relevant education outlets. By doing so, we could cover the research areas both, of IS and education.

Next, we defined a search query, which we than used throughout all the databases. This query is (curriculum OR teaching OR learning OR training in abstract) AND (success in abstract) AND ("Information Systems"). The first two parts of the query included the keywords that should occur in the abstract, as they describe the actual content of the publications that we were looking for. Thus, they should be included in the short summary. For the term “Information Systems”, we searched the whole text, as there are publications that describe the success criteria of a course that is taught to IS students, but this is not explicitly mentioned in the abstract, e.g., Ikonen and Kurhila [21].

After choosing the databases and keywords, we started with the literature search process. Searching the mentioned databases produced 3,290 hits. After the first screening, which included reading the paper titles and the abstracts and considering whether they were relevant in our case, only 79 papers have been considered for the further analysis and synthesis. Such a small number can be explained by the fact that the words “learning” and “training” are often used in other contexts, such as machine learning. In a second screening, we read the complete articles and decided if they handled success criteria and therefore should be considered relevant for our research. After this step, only 43 papers that contained statements that can be interpreted as success criteria for a curriculum were selected.

Based on the analysis of these papers, we elicited 19 success criteria for IS curricula. These criteria were combined, categorized and further used to extend the evaluation model of Kirkpatrick’s. In the next chapter, we will present them and suggest measures and tools for the concrete evaluation.

4 Results

4.1 Success Criteria

We elicited a total of 19 success criteria from the literature. In this section, we will explain them, and provide a short summary for every success criterion in Table 1. Many authors mention that the *Student Performance* in terms of grades is an important success

criterion [22-32]. It intends that students have achieved grades with a higher mean than a given threshold. Other authors have the opinion that just looking at the grades is not enough. They consider *Mastering of the Learning Objectives* of the curriculum, that have been defined while developing the curriculum, a success criterion [25, 33, 34]. Anderson and Krathwohl define learning objectives as: "[...] both the kind of behavior that has to be developed in a student and the content in which this behavior is to operate" [35]. *Improvement of the Student Skills*, meaning that the students are able to solve the problems that the curriculum addresses better than before, is also considered a measure of curriculum success by some authors [36-38]. Another mentioned factor is the students' overall interest in the course, measured by the *Enrollment Numbers* [22, 39]. A curriculum can be considered successful, if the enrollment numbers in the subject where the curriculum is applied are rising, e.g., from year to year. All these mentioned factors can be measured directly and expressed with numbers.

This is, however, not always the case. Some of the success criteria can be only determined by collecting the opinions from the relevant stakeholders. For example, if the course involves working with external partners, such as companies, feedback should be gathered from those as well. Roseman and Maurizio mention the contacts and support from the industry among the success criteria [22]. Khmelevsky explains this idea by mentioning that in order to satisfy the industry partners that actually provide the students with the project work, it has to be assured that their requirements have to be fulfilled [40]. Feedback should also be gathered from the administration or a faculty, responsible for the curriculum [22, 41, 42]. It has to be assured that they have fulfilled their own goals that they have set before the curriculum rollout. This provides two more success criteria: *External Feedback*, and *Administrative Feedback*.

Table 1. Success Criteria for IS Curriculum

Success Criterion	*Explanation*
Student Performance	The students have achieved the grades with a higher mean than a given threshold.
Mastering of the Learning Objectives	The students have achieved the learning objectives, defined before rolling out the curriculum.
Improvement of the Student Skills	The students show the better ability to solve the addressed problems after taking the course, than they did before.
Enrollment Numbers	The enrollment numbers in the course, where the curriculum is used, are rising.
External Feedback	The external partners have fulfilled the goals that they have set for this collaboration.
Administrative Feedback	The responsible persons from the university/faculty administration have achieved the goals of teaching the subjects.
Student Engagement	Students feel themselves engaged in the learning process and find the course interesting.
Content Integrity	The contents of the single learning units fit to one another; the content is well structured in general.

Success Criterion	*Explanation*
Reasonable Workload	The content of the course can be mastered in the specified time.
Practical Application	The learned material is applicable in practice.
Pedagogical Underpinning	The course provides a deep enough view into its contents.
Learning Materials	The materials, like lecture slides, used in learning are understandable and of a good quality.
Learning Software	The software used in learning supports the content and helps in applying the gathered knowledge into practice.
Lecturer Teaching Skills	The lecturer is capable of delivering knowledge to the students.
Lecturer Competence	The lecturer masters the subject he teaches.
Lecturer Teaching Approach	The lecturer interacts with the students in a way that supports the knowledge transfer and learning process.
Hands-on Approach	The students have the ability to apply the learned skills and knowledge.
Collaborative Work	The students have the possibility to work with each other by supporting one another in projects and learning improving their social competencies.
Student Projects	The projects the students have been working on, delivered a desired outcome.

Most of the authors focus on collecting feedback from the students, since they are the actual target audience for the curriculum. Some authors evaluate the *Student Engagement* in the learning process [22, 27, 37, 39, 43, 44]. Others focus more on the *Content Integrity* of the curriculum, which means that it is well structured in general and the contents of the single learning units fit to one another [25, 45, 46]. Wong and Cheung also mention the *Reasonable Workload* [25] among the success criteria to be evaluated. It means that the content of the course can be mastered in the specified time. Another two success criteria are *Practical Application*, meaning that the learned knowledge can later be applied in praxis [22, 47, 48], and *Pedagogical Underpinning*, meaning a deep view into the curriculum content [49]. The *Learning Materials*, which are delivered to the students [37, 41], as well as the *Learning Software*, used in course to support the content [22, 37, 50, 51] are also considered as success criteria. The literature also suggests to evaluate the lecturer: his *Teaching Skills*, how well he or she is doing when transferring knowledge to students [52, 53], *Competence*, how well he or she masters the taught subject [22, 44, 54], and the *Teaching Approach*, the way he or she interacts with students [44]. Two of the reviewed authors also value the *Hands-on Approach*, the ability to apply the learned skills and knowledge during learning, e.g., by integrating an enterprise software [45, 55]. Finally, the degree of how well the curriculum inspires *Collaborative Work* [41, 44], or group work on *Student Projects* [21, 56], are also proposed as success criteria in the literature and should also be evaluated.

4.2 Development of an IS Evaluation Model

After eliciting the success criteria for an IS curriculum, we developed the evaluation model. As mentioned in the Background section, we use Kirkpatrick's model [18] as a basis. The reason for this is that this model offers flexibility and allows adaptions. We adapted the model for the purpose of the IS curriculum evaluation and used the first two levels of the model, *Reaction* and *Learning*. These categories cover all the needs and features of IS curricula and give a compact and manageable evaluation model that can be adapted for specific IS curricula and is easy to use for lecturers. The other two levels of Kirkpatrick's model, *Behavior* and *Results*, focus specifically on the skills for the job and the influence on the work environment. These factors could be measured in the scope of industry trainings and courses by evaluating the application of the learned skills in the employee's everyday work. However, it would be very hard to evaluate these in the case of university students.

We categorized the defined success criteria and assigned them to the levels of the Kirkpatrick's model. Factors such as *Student Performance, Mastering of the Learning Objectives, and Improvement of the Student Skills* can be measured and describe the effectiveness of the learning. Therefore, we categorized them under the level *"Learning"* of the Kirkpatrick's model (Fig 1).

Further factors such as: *Content Integrity, Reasonable Workload, Practical Application,* and *Pedagogical Underpinning* are connected to the curriculum content. Therefore, we grouped them together into the *"Content"* category. The factors *Learning Materials* and *Learning Software* are connected with the learning environment. Therefore, we aggregated them in the *"Environment"* category. Another three factors that describe the lecturer, *Lecturer Teaching Skills*, *Lecturer Competence*, and *Lecturer Teaching Approach* can be categorized as *"Lecturer"* category. Success criteria such as *Hands-on Approach*, *Collaborative Work*, and *Student Projects* are related to the method of learning. Therefore, we grouped them together in a category called "*Learning Method*". *Student Engagement* and *Enrollment Numbers* are two further factors that describe the students' motivation with regards to the curriculum. Therefore, we grouped them under the category *"Students' Motivation"*. Considering the feedback related criteria *External Feedback* and *Administrative Feedback*, they describe feedback received from other curriculum stakeholders. Therefore, we assigned them to the category *"Stakeholder Feedback"*.

All the elements of the categories *"Content"*, *"Environment"*, *"Lecturer"*, *"Learning Method", "Students' Motivation"* and *"Stakeholder Feedback"* describe how the students, lecturers or third parties feel about the curriculum, their overall satisfaction with the curriculum and its content. Therefore, based on the Kirkpatrick's model, they match to the level "*Results"* (Fig 1).

For every success criterion, we propose an evaluation mechanism. For the curriculum content evaluation, we suggest extending the model proposed by Martínez-Caro et al. [14], which provides survey questions to explore the *Pedagogical Underpinning* and the *Workload* of the course with the question samples from Kirkpatrick and Kirkpatrick [18], who propose questions to evaluate the other two factors, *Content Integrity* and *Practical Application*.

The model proposed by Martínez-Caro et al. [14] also can be applied in the *"Environment"* category to evaluate the student satisfaction with the *Learning Materials*. This can be extended by applying the Quality Evaluation Framework from Escudeiro and Escudeiro [16], for the evaluation of the *Learning Software*, since it allows to perform a full evaluation based on the different criteria.

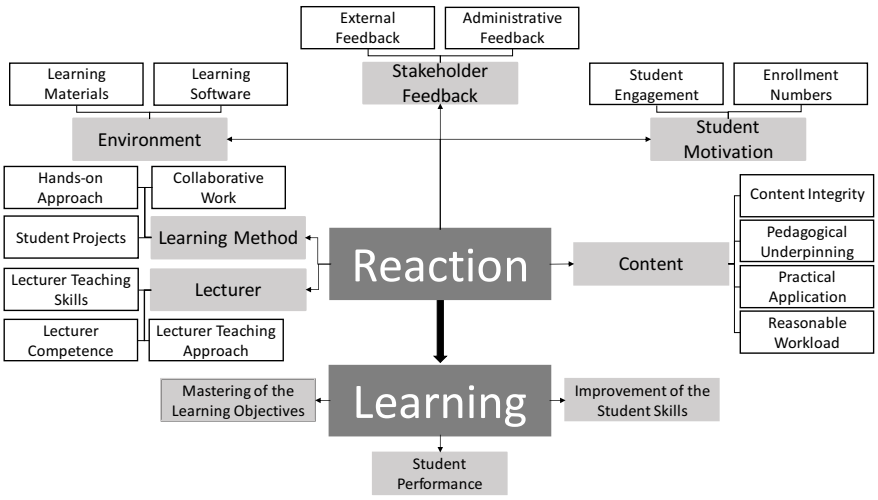

Figure 1. Evaluation Model for IS Curriculum (Source: own representation based on Kirkpatrick and Kirkpatrick [18])

For the lecturer category, we suggest a combination of the survey questions from Martínez-Caro et al. [14] to evaluate the *Lecturer Teaching Approach* and *Teaching Skills* and the survey questions from Kirkpatrick and Kirkpatrick [18] in order to evaluate the *Lecturer Competence*. For the evaluation of the *"Learning Method"* we suggest to apply the model of Martínez-Caro et al. [14] in order to evaluate the *Collaborative Work* of the students and combine it with the model from Kirkpatrick and Kirkpatrick [18] for the *Hands-on Approach* and the *Student Projects*. We also propose to measure *Student Engagement* by using the survey suggested by Martínez-Caro et al., and to use the questionnaire samples, proposed by Kirkpatrick to gather the *"External Feedback"* and the *"Administrative Feedback"*.

For evaluating the success criteria on the *"Learning"* level, the exam results can be applied: While exam results can be a measure of learning, as described in paragraph 4.1, it is suggested by Alghazzawi and Fardoun [1] to break them down with regard to single learning objectives. This way, the percentage of students that mastered a certain learning objective by checking the correct exam answers can be measured. The same approach can be applied to the students' skills improvement evaluation. This way, it is possible to evaluate, which part of the curriculum has not been mastered by the students and thus needs improvement.

5 Conclusion and Outlook

In this paper, we developed an evaluation model for IS curricula based on success criteria for IS curricula. We conducted a literature search and extracted 19 success criteria. With regards to these factors, we adapted and extended the evaluation model offered by Kirkpatrick and Kirkpatrick [18]. Furthermore, based on existing evaluation approaches, we suggest a methodology for the evaluation of each of the evaluation elements.

The proposed model can be applied by academic institutions that teach in the IS area to evaluate their curricula or by other institutions that develop academic IS curricula. Lecturers can choose which success criteria they want to evaluate and adapt the model as well as the suggested evaluation mechanism for their own purpose. E.g., if a curriculum does not include any group work or collaboration, that part of the model can be removed, and the other factors can be evaluated.

While there have been many studies on evaluation approaches over the years, there is no contribution that addresses the evaluation needs of the IS discipline, although this is an interdisciplinary area that has special requirements concerning curriculum evaluation. Therefore, with this paper, we make a first contribution in this area of study that can serve as a basis for further research. The model can be adapted for specific curricula. Furthermore, a practical application of the curriculum evaluation model in practice could deliver new results.

As every other work, this work also faces some limitations. Curriculum evaluation is a topic with a long tradition of research. Therefore, this work is based on well-known theories and evaluation models that make the results valid. However, the results in this paper are purely based on the literature search while we did not collect any empirical data in order to evaluate and extend them. Enhancing our research with empirical data could be a possible future research topic.

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