Users in the Driver's Seat: A New Approach to Classifying Teaching Methods in a University Repository

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Abstract. This article argues for a new, user-driven process of developing a classification for teaching methods. First, a previous literature review is summarized that verified the need for a classification of teaching methods. Then, types of classifications are introduced with their characteristics and typical uses in regard to the maturity of knowledge domains. After shortly reflecting the maturity of the knowledge domain "teaching methods", former classifications' approaches to mapping this knowledge domain are examined. We argue that previous classifications focused on analyzing the content and did not take user perspectives into account. In the third part of the article, a case study at the University of Vienna is presented. There, twelve representatives of four stakeholder groups were interviewed to determine their needs for organizing teaching method related objects in a repository. Interview results along with considerations on technology and knowledge domain suggested developing a facets classification at the University.

Keywords: teaching method, classification, taxonomy, pattern, repository

1 Incentive and Previous Work

The need for a classification of teaching methods has been often proclaimed, e.g. [1], [2], [3]. A teaching method is defined as a learning outcome oriented set of activities to be performed by learners and learning supporters. The current trend to establish federated repositories that store large numbers of digital objects related to learning, from learning materials to lesson plans and ready-to-play units of learning, has verified this need. This article revisits the issue of developing a classification for teaching methods, looking at previous approaches that classified items related to learning and teaching, showing inconsistencies and shortcomings of previous approaches in order to identify how the problem of a missing classification can be overcome, and how to approach a new development.

In a previous literature review, classifications related to learning and teaching were documented and analyzed for their potential to serve as a teaching method classification [4]. Data was collected regarding the origins, theoretical underpinnings, purposes and uses as well as degrees of documentation of these classifications. A two-step analysis was then performed having the first goal to group the classifications according to their topical focus, and having the second goal to identify the quality of these classifications according to taxonomy validation criteria.

As a result of the first analysis step, three groups of classifications were identified: narrow focus classifications (placing emphasis on singled-out components of a teaching method such as learning objectives or lecturing styles), holistic focus classifications (placing emphasis on the gestalt of teaching methods, or placing emphasis on an overarching learning theory view on teaching methods), and versatile focus classifications (placing no particular emphasis on any aspect of teaching methods, rather trying to cover a large set of descriptors for the same).

As a result of the second analysis step, only a small number of the reviewed classifications were identified as fulfilling more than one of the eight accounted for criteria of taxonomy validation; the most criteria any classification fulfilled was three.

The literature review concluded that a classification for teaching methods is still needed as the present classifications do not provide sufficient quality or purpose-related extensiveness. The review further showed that eventual users of the classifications were never involved during development. Suggestions were thus made for new developments of teaching method classifications to incorporate the classification users' experiences and usage procedures to ensure that the classification reflects their perspectives, their ways of organizing, and their language.

2 Classification Foundations

As foundation for the further discussion, some classification related concepts are now presented. Afterwards, these concepts are brought together with the knowledge domain that teaching methods represent as well as the approaches of former classifications of learning and teaching to map this knowledge domain.

Classification is defined as the meaningful clustering of experience [5]. Classification work comprises the 1) grouping of related entities and 2) making the relationships between the entities obvious and visible [6]. The term *taxonomy* has also become popular in the last decade, and Lambe states in this regard that taxonomies classify, describe, and map a knowledge domain [6]. He views the taxonomy as the product of classification work. The terms classification and taxonomy are seen as interchangeable; however, for this article, the term *classification* will be preferred.

Classification work becomes necessary whenever (a) there is a lot of content in one or more repositories and its accessibility needs to be improved; (b) stakeholders doing related work within an organization need to be coordinated more effectively to create synergies [6]. The goal of this work is to either simplify the access to, or the management of a knowledge domain [6].

Classifications have been built in several fields of study. Sciences that have produced widely accepted and used classifications are medicine (International Classification of Diseases, now in its 11th revision), biology (taxonomy of plants and animals), and chemistry (Periodic Table of Elements).

The objectivist paradigm states that any entity can be described with its essential properties and then be placed in a category of entities that share the same essential features, and that these categories can be related to other categories defining the classification scheme [7]. However, reality shows that there remain entities, where no classification could be agreed upon to this day. Among them are smells and viruses [5]. The problem with smells is not that we don't understand how smells work in terms of perception, or what important role smell plays in human and animal life; but there is no "unit of measuring" smell, and there is no good way of talking about smells. In this sense, the basis for a development of a classification of smells is lacking [5]. The same is true for viruses, which often change and are rather ambiguous. No clear classification has been developed for viruses because of this.

The next sections will first introduce some classification types, which stem mainly from library science as this science has had a long tradition of organizing knowledge items. Then, a reflection on the maturity of the knowledge domain "teaching methods" is presented. To round up this second part of the article, selected classifications included in the preceding literature review (cp. section 1) are revisited in order to understand what classification types were previously used, and how these classifications approached the knowledge domain.

2.1 Types of Classifications

Lists. Lists represent the basic building blocks of classifications. Lists group related items together. The following relationships of items could serve as reasons for creating a list: commonality in attributes or purpose, collocation, sequence, chaining, genealogy, or gradients in attributes [6]. When lists get too long, i.e. when they exceed 12-15 items, or get too complicated, they are re-organized in either trees or maps. Lists are commonly used when the knowledge domain is simple and when the collection of items that need to be managed is not very large.

Trees. Trees divide and subdivide the contained classes based on rules of distinction [5]. Trees allow multiple relations between the items in it, for instance, part/whole, cause/effect, starting point/outcome, or process/product relationships, even including different relationships within the same tree [5]. This makes trees versatile and pragmatic [6]. Trees translate well to folder structures that are commonly used in digital organization.

Knowledge for building trees must be known and decided in advance, so that the important criteria for distinction can be determined [5]. This means that post-coordination of items is not possible in trees. Trees do not work well when the relationship represented in each level is not immediately apparent to users, when too many inconsistent principles of subdivision are applied in the same tree, where different user groups use alternate organizing principles to the same tree, and when there are too many (beyond three) levels of detail [6].

Hierarchies. A hierarchy is a specific type of tree structure. It is inclusive (the top category includes all subordinate groups), the relations are consistent (exactly one type of relation distinguishes all subordinate groups at all levels), subordinate groups inherit attributes from their superordinate groups, and it demands mutual exclusivity (an entity can only belong to one class within the hierarchy – there is no ambiguity in placement). These attributes make hierarchies popular [5]; however, not all things can be neatly arranged this way. Hierarchies work for animals (cp. Blackwelder [8], who states that perfect hierarchical organization has been achieved for vertebrates), but hierarchies often do not work for manufactured objects or mental concepts [6]. A difference between biology and, for instance, library hierarchies is that in biology taxonomy the animals are only classified in the lowest levels and categories, deepest down in the tree, while in library classifications, books can also be assigned at general levels that are high up in the hierarchy [6]. This effect appears because knowledge objects (products of the human mind) can be either general or specific, while physical objects can only be specific [6].

Hierarchies are well-suited for knowledge representation in those domains that are mature, meaning that the nature of the entities and the nature of their meaningful relationships are known [5]. A sign that it is premature to use hierarchy as the type of classification is that a category "miscellaneous" or "other" is needed, where items are placed that do not fit the logic of the classification as specified [5]. Hierarchical classifications do not accommodate well knowledge domains exhibiting complexity and ambiguity. This is especially true for entities that cannot easily be observed or analyzed, such as information or knowledge artifacts. Just like trees, hierarchies do not allow competing principles of organization.

Matrices. In matrices, two or three attributes are linked together in order to reveal the presence or absence of entities or the specific nature of an entity at the intersection of the attributes [5]. Matrices are also known as typologies in social sciences (Bailey cited in [6]), or as paradigms in library science [5]. Main features of matrix representations are that they support "sense-making" (quickly getting guidance within a knowledge domain), and that they foster the discovery and creation of new knowledge [6]. For instance, classification along multiple dimensions in matrices allows for comparison, the locating of issues, problems or opportunities, the creation of inventories or checklists, the identification of gaps, and the description of complex phenomena [6]. To compare, trees subdivide only along one dimension; therefore, trees only allow the location and retrieval of items, and do not support the above mentioned functions. While trees cannot represent alternative points of view effectively, matrices do so very well, up to three alternative approaches [6].

Matrices work well with a well-defined, cohesive body of content, whereby the content must be able to be consistently described by two or three facets, which make up the dimensions of the matrix. The best reflection of knowledge in the domain is achieved when the matrix dimensions are set up using a consensual framework with common vocabulary. In fields, where the fundamental relationships of concepts are not well understood, it is difficult to build a matrix that reveals essential knowledge [5]. Above three dimensions, matrices are not appropriate classification structures, mainly because the content can no longer be visually organized, which in turn impedes easy comprehension and navigation [6]. Diverse collections of content are not easily expressed in a matrix due to the lack of common attributes. Matrices also rarely give complete pictures of a phenomenon or knowledge domain [5].

Facets. Facets represent not merely a different type of classification, but entail a completely different approach to classification work. Facets provide a set of perspectives to have on content, whereby each facet has its own representation (one facet could be a list, while the next facet could be a tree) [6]. Each facet is mutually exclusive, i.e. the facets are orthogonal to each other. The representation in facets rests on the beliefs that there are always multiple perspectives on the world and on the entities in it, and that even seemingly stable classifications, like hierarchies, are in fact provisional and dynamic [5].

Facets and facet analysis are attributed to Ranganathan, who developed the system decades ago; however, his system of colon classification did not become popular until recently when digital objects could be saved in multiple places, contrary to the previous organization within the physical world of libraries where one book had to have exactly one place on a shelf [5]. Facets represent the predecessor of semantic taxonomies used today, and they allow post-coordination [6].

Facets neither require a strong theory as backbone nor complete knowledge; this makes facets useful for new and emerging fields, or fields that are changing [5]. Faceted classifications are ideal for working with the concept of metadata, because facets provide structured information on a piece of content. Facets work best when the main organization scheme of the facets is transparent and well understood by users [6]. No more than seven facets are included in a faceted classification; otherwise, users are not able to cognitively comprehend and manipulate the facets [6].

Facets do not work well where the base classification is not well understood or cannot easily be observed or predicted, for instance, in the case if specialist knowledge is presented to general users.

Additional Types. Lambe [6] additionally lists polyhierarchies and system maps as types of classifications. Polyhierarchies are essentially multiple hierarchies linked together at the top level. The linking allows multiple assignment of one entity, thus essentially breaking the stringent rules of hierarchy. System maps are visual displays of either lists or trees, providing a richer context for the knowledge being mapped. These two types are ignored in the further discussion of this article as they represent specialty classifications of the other introduced types.

Folksonomies are more recent types of classifications that involve the socially exposed personal tagging of objects [9]. Folksonomies often result in high ambiguity in the collective vocabulary as well as low precision, especially when the number of participants is not large and diverse enough, and when the number of content objects being tagged is anything but humongous [6]. We will disregard folksonomies here.

2.2 Reflecting on the Maturity of the Knowledge Domain “Teaching Methods”

As the above descriptions have shown, certain classification types like hierarchies work best with knowledge domains that have attained maturity, while others like lists work best with small knowledge domains, and facets work well for changing knowledge fields. This section serves to reflect the presumed state of maturity regarding the knowledge domain teaching methods. The reflection will take place using two perspectives: First, we regard the teaching method knowledge domain as an embedded part of the knowledge domain educational science, and second, we regard teaching methods as a stand-alone knowledge domain. Please note that the chosen aspects used in the reflection do not provide a complete description of the knowledge domains.

Teaching methods can be considered as belonging to the educational science knowledge domain. Educational science features multiple learning theories, pedagogical frameworks, and instructional design models, which exist in parallel and at times endorse competing positions. There appears to be a need to map these different frameworks, models, and vocabularies in order to compare, contrast and identify relationships between them (cp. recent initiatives described in [10] [11]). Although educational science aims to provide fundamental concepts that translate from theoretical assumptions to sound practical implications for teaching, the provision of such concepts has not been achieved [12] [13]. The educational science knowledge domain lacks a common consensual framework and may thus be regarded as complex and ambiguous.

Focusing just on the knowledge domain teaching methods, we recognize a range of terms used for "teaching method". Other terms used to describe concepts similar to teaching methods include, but are not limited to, *models of teaching* [14], *patterns* [15], *scripts* [16], and pedagogical, learning or educational *scenarios*, e.g. [17]. Finding common ground with this difference in terminology becomes difficult as supported by Beetham [18], who mentioned the lack of common terminology of instructors when talking about their teaching practice.

Next to the diversity in terminology, the uncertainty is further enhanced by the differences that individual teaching situations present and that influence the decision whether a teaching method may be appropriate or not. For instance, the adequateness of the teaching method, no matter how theoretically backed, is dependent on the persons interpreting, modifying, and implementing the teaching method as well as dependent on the learners that participate during implementation. This creates a complex setup of often unknown variables and unpredictable factors impeding common understanding and interpretation. Further, practical implications of choosing certain teaching methods over others have only been presented as vague guidelines, for instance, by loosely connecting learners' knowledge levels and the task to be learned to types of instructional strategies promoted by the different learning theories [19]. This leaves teaching methods as a knowledge domain in a fuzzy state with ambiguous character.

This short reflection suggests that the knowledge domain "teaching methods", both as a stand-alone knowledge domain and as part of the educational science knowledge domain, does not yet provide sufficient consensus resulting in the use of classification types that rely on firm theories and models like hierarchies or trees.

2.3 Former Classifications' Approaches to the Knowledge Domains Educational Science and Teaching Methods

This section gives an additional view on the classifications included in the literature review described in section 1. This time, the focus is placed on the types of classifications used and how the classifications attempted to structure the knowledge domain. The purposes of building a classification varied widely, from articulating nature and scope of different learning designs [3], to providing search mechanisms in a repository for learning objects [20], guiding teaching practitioners through decision-making [21], classifying research in instruction and learning [22], establishing connections between theory and practice of teaching [23], and classifying instructional methods [24] to name a few. The types of classifications employed for these purposes are listed below.

Types of Classifications Used. Classifications of the literature review [4] were sorted according to the employed type of classification as introduced in section 2.1 above. Overall, there were 35 counts, which are distributed as shown in Table 1. Of the five main classification types introduced, previous classifications could be attributed to four types.

Trees were the most popular classification type used. Of the 20 classifications that represent trees, fourteen featured just a single level of division (the entire tree was represented in the top level). For instance, Ramsden [25] distinguishes three theories of teaching at the top level. This single level use strikes as unusual as trees allow structuring according to multiple relations, yet, only a few trees have taken advantage of this feature. Two classifications (Fuhrmann & Weck [24], and Currier [26]) went beyond the recommended maximum depth of three levels, making the tree hard to navigate.

Matrices were also popular. The most prominent representative of this classification type is likely the revised version of Bloom et al.'s taxonomy of educational objectives, namely, the Anderson & Krathwohl taxonomy for learning, teaching, and assessing [27]. Most classifications in this category used a three-dimensional representation, while one classification also opted for the unusual number of four dimensions [28].

Table 1. Distribution of classification types in previous literature review (total count = 35).

Type of Classification	Number of Count
List	3
Tree	20
Hierarchy	0
Matrix	7
Facet	5

Lists were not so common; however, it is worth mentioning that all classifications that used the type list were grouping teaching methods. These lists are Flechsig's twenty didactic models [23], the GEM teaching method controlled vocabulary[1], and the list of teaching methods by Sader et al. [29]. Lists of teaching methods can be found quite often on the Internet (cp. Glossary of Instructional Strategies[2] listing 988 strategies alphabetically), i.e. lists seem to be popular for organizing teaching methods. Choosing this type of classification especially often for teaching methods

[1] http://www.thegateway.org/about/documentation/gem-controlled-vocabularies/vocabulary-teaching-methods
[2] http://glossary.plasmalink.com/glossary.html

seems to suggest that classification development for teaching methods is in the beginning stages as lists represent basic classification building blocks. Since the knowledge domain teaching methods cannot be considered small, which would then make lists an adequate type of classification, this in turn suggests moving to more sophisticated classification types for teaching methods.

None of the classifications used a hierarchical classification structure. One of the reasons for this could be that neither educational science nor teaching methods are knowledge domains that are well-structured, a prerequisite to choosing this classification type. Another reason could be that these knowledge domains comprise predominantly mental concepts. Mental concepts are not necessarily best organized in a hierarchy, which allows the use of one organizational principle only [6].

Facets were also used to structure the herein examined knowledge domains. With facet classifications, the choice of the facets is most important [5]. In the following sub-section, special focus will be placed on how previous classifications attempted to choose facets to structure the knowledge domains.

Inconsistencies and Gaps in Previous Classifications. The above reflection on the knowledge domain teaching methods and the related knowledge domain educational science has shown that both domains can be regarded as complex and ambiguous. Despite this nature, the majority of the reviewed classifications chose the tree as their method of organizing knowledge. The appeal to use trees as classification type is apparent: Trees are pragmatic, and users can easily relate to the tree's organizing principles. However, the knowledge to building a tree must be known in advance [6]. A tree is built using a priori rules and cannot be changed after it has been established. It is not convincing to use a tree classification when the knowledge domain is changing and possesses complexity as well as ambiguity.

Matrices, which were the second most common type of classification used, work best for structuring a knowledge domain when there is a consensual framework with common vocabulary in place, and when a consistent description of the domain can be achieved by two or three facets. Again, neither of the two knowledge domains exhibits signs that a consensual framework or vocabulary is in place. Solely for particular elements of the knowledge domain, like educational objectives, matrices seem useful, as the knowledge on particular elements is confined and thus more likely to be agreed upon.

If the classifications had used empirical investigations as their foundation, the structuring exclusively focused on particular elements of teaching, e.g. Brown et al.'s lecturing styles [30], or Anderson & Krathwohl's increasing levels of learners' cognitive processes [27]. None of the classifications had used empirical investigations for more complex entities such as teaching methods.

Outside of empirical investigations, classifications were also built based on the authors' own understanding, because they have worked in the domain of educational science for a long time, such as Farnham-Diggory's paradigms of knowledge and instruction [22] and Squires' framework for teaching [31]. These classifications feature strong use of specialized expert language, which is not easily accessible to an outside community or general users.

Five classifications have used facets, which seem more appropriate for the type of knowledge domain being structured. The choice of facets, however, was often made arbitrarily as records of facet choice were hardly made. For example, Reeves set up fourteen dimensions of computer based education [32]. His inclusion of facets in the classification is hard to retrace. Additionally, Reeves' fourteen dimensions are double the recommended maximum number of seven facets, making his classification hard to comprehend and navigate. A more cognizant choice of facets may be attributed to Reigeluth & Moore [33], who established five dimensions to compare and contrast instructional theories (although the authors did not explain the process of choosing facets). The dimensions are assumed to be recognizable at least to the intended target audience (readers of the book describing instructional theories) such as type of learning and interactions for learning.

As was shown during the previous literature review, a good number of classification developers had altogether failed to make the process of creating the classification transparent. From the explanations made, however, it appears that none of the classifications have involved the target users of the classification in the development. Test users sometimes evaluated the classification after it had been set up (e.g. Carey et al. [20] and Currier [26]), but future users were never part of the actual development.

Final Remarks. In the classifications analyzed during the literature review, entities of the knowledge domains educational science and teaching methods were structured. The most often used classification type in this regard was the tree, a classification type that uses a priori knowledge and rules, and does not allow multiple representations or post-coordination of items. Because classifications were often developed by experts of the knowledge domains, the resulting classifications feature expert language, which is not suitable for all purposes. Furthermore, the developers focused solely on structuring the content, not focusing on or involving the future users and their perspectives in the classification development. Last but not least, teaching methods, whose classification is the focus of this article, were explicitly covered in a small number of the classifications and were often organized in lists suggesting a need to move to more sophisticated structuring.

Two goals are thus set up in reaction to these findings: (1) In order to solve the problem of experts' language represented in the classification, a user-driven method should be applied to classification development, and (2) the process of establishing this classification should be made transparent allowing insight for other initiatives. A new approach to developing a classification for teaching methods may thus be to socially negotiate a classification with the eventual users.

3 Case Study at the University of Vienna

The results of the previous discussion will now be used to demonstrate in a specific use case how a user-driven classification development is approached. The purpose of including this case study is to make the process of classification development during the initial phases transparent.

The case study is placed at the University of Vienna, where a classification for teaching methods is currently being developed. The University of Vienna is Austria's largest university with currently 72,000 students enrolled and 6,200 scientific personnel employed. At this point, the university is installing a digital asset management system called Phaidra[3]. The contents of this system will be searchable and visible to anyone, yet, only university related persons (students and employees) can upload into the repository. Next to learning materials and other content objects, Phaidra is also planned to store teaching method documentations and publications, as well as units of learning. In order to organize these types of assets, a classification is to be developed. The following section describes the initial user needs analysis that supplied information on the classification's purpose and scope, enabling us to decide on a specific type of classification to be developed.

3.1 Method

For this case study, the underlying methodology stems from Lambe [6]. We chose this methodology of classification development, because it is highly user-oriented, and specifically aims at bringing together stakeholders from different parts of an organization, which the University of Vienna is.

For the analysis portrayed in this article, only the portion of the methodology is presented that is relevant to identifying with stakeholders the purposes that the classification will serve and the classification's scope. Later stages in the methodology involve the decision on a specific design approach (how users will be involved during the classification's development) and the actual development of the classification including series of testing and validation.

The type of classification to be developed must be chosen based on three decisive inputs: the nature and maturity of the knowledge domain, the needs of the users in relation to their tasks in the work environment, and the type of technological system, in which the classification will be used [6]. The first step to attain this information was to brainstorm with the person, who initially requested the development of a classification, who the key stakeholders of the organization are, i.e. who will benefit from the classification, as well as their activities and tasks within the organization. Stakeholders and their activities were arranged in a concept map along with resources that play a role in the activities. The concept map, and respectively updated versions of the map, served as the communication basis with the stakeholders.

At the University of Vienna, the following four main stakeholders, who have a presumed interest in the classification of teaching methods, were identified in the initial brainstorming:

1. faculties/departments, along with study program leads
2. university instructors
3. (formally established) subject-specific didactics[4], who educate (future) school subject teachers, for instance, in chemistry or biology

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[3] Phaidra is an acronym for Permanent Hosting, Archiving and Indexing of Digital Resources and Assets, https://phaidra.univie.ac.at/ (in German)

[4] The German equivalent term is „Fachdidaktik“, usually relating to one specific natural science, for which subject-specific teaching methods are researched and then recommended, with which the subject can be taught well at schools.

4. the Center for Teaching and Learning, which supports university instructors with counseling in the use of teaching methods, and the use of technology in teaching.

The concept map constructed in the initial meeting was then discussed with representatives of the main stakeholder groups in individual sessions lasting between 45 and 90 minutes. During the interviews, differences in understanding were recorded directly in the concept map along with any comments that stakeholders had. Cues regarding the purpose and scope of the needed classification were filtered from these interviews. The adjusted concept maps were later meshed to create a coherent view representing all stakeholders.

We led twelve interviews with stakeholder representatives. The distribution of interviews according to the stakeholder groups is as follows: 2 faculty/study program representatives, 5 university instructors, 2 subject-specific didactics (one each for biology and chemistry), and 3 Center for Teaching and Learning representatives.

3.2 Interview Results

Purposes of the Classification. Study program development teams form for the duration of a curriculum development project; once the curriculum is complete, the team ceases to exist. If documentations of these teams could be preserved in the repository, then future curriculum development teams could benefit from their knowledge, e.g. regarding how learning outcomes were formulated and how teaching methods were assigned to learning outcomes and modules.

Often, the connection between curriculum and teaching methods is not apparent to instructors, who have to translate the curriculum into specific teaching methods used within courses. A representative from the faculty notes instructors would have an easier time if the connections between teaching practice and the curriculum were documented, for instance, by explicitly capturing the experiences of the curricular development teams and reasons behind curricular setups.

Center for Teaching and Learning representatives stated that instructors could use a classification of teaching methods to make the course creation for instructors more efficient, because instructors could then use methods that were used before for similar courses. Especially new instructors would benefit from such an installation as they often require guidance in teaching method choice and application.

The formally established subject-specific didactics at the University offer continuing education courses in biology, chemistry and physics. School teachers learn about teaching methods in these courses, which must have convincing instructional concepts in order to convey credibility and to allow participants to integrate the taught concepts in their own teaching. One goal of this stakeholder group is to document and communicate the successful course concepts they implement. Another goal for them is to move away from strict subject-driven didactics for each single subject towards joint teaching methods that inspire cross-subject use. A sensible organization of teaching methods and associated content in a repository would support this goal.

Common Issues and Themes (Scope). Several stakeholders at the University of Vienna produce similar information, which could be of benefit to other groups within the University's structure. For instance, instructors that teach similar courses could exchange items regarding their teaching, such as their course concepts or materials. Study program development teams could communicate outcomes of discussions on teaching methods, so that other study program development teams and instructors can benefit from them.

An emerging theme at the University is also that different subjects wish to exchange teaching-related knowledge. Not only the established subject-specific didactics (biology, chemistry etc.) have mentioned this, but other departments seek exchanges between departments. They have established a "didactics research platform" to organize their efforts. The goal of this platform is to cross the boundaries of the subjects to improve teaching.

All stakeholder groups reported that the communication about teaching methods is nearly "non-existent". Even when courses on the same topic are taught in parallel, instructors of these courses do not necessarily communicate about their teaching approaches. Stakeholders recognized that instructors possess a lot of implicit knowledge even if instructors are not necessarily keen or able to talk about teaching. This knowledge, however, is expressed in diverse documentations, such as instructional concepts prepared for lectures and seminars, course descriptions (which include learning outcomes, teaching methods, and references) as well as the implementation of teaching methods within the learning management system. Instructors and subject-specific didactics further compose publications about teaching method use. All these resources could be stored and organized within the repository to provide systematic access to a wider community – within and external to the University.

3.3 Translating Cues into Type of Classification to Be Developed

Needs of Stakeholders. Lambe [6] provides guidelines for translating cues from stakeholders into types of purposes and suggested classification types. An overview of these guidelines is shown in Table 2.

Table 2. Interview cues, purpose of classification, and type of classification [6], pp.137 & 158.

Sample Cues	Indication of classification's purpose	Probable classification type needed
"We have a clear workflow that everyone follows."	Structure and organize	Trees
"We share folders but they are a mess; everyone does their own thing, and we can't find the information we need."	Establish common ground	Trees
"Different divisions replicate the same information; they don't know what exists in other parts of the organization. If we shared we could be more effective."	Span boundaries between groups	Facets
"This is a new area for us. Our domain is changing too quickly and our specialists don't agree."	Help in sense-making, or Aiding the discovery of risk and opportunity	"Disposable" frameworks, matrix, maps

Although stakeholders may give conflicting cues that match several categories, recurring cues that appear across stakeholder groups provide the tendency for the classification's purpose and type. We have identified the purpose "spanning boundaries between groups" from the common themes at the University of Vienna because many comments focused on helping different groups share their knowledge.

Since the purpose of the classification is to span boundaries, it is recommended to develop a faceted classification [6]. This type of classification is best suited to fulfill the need of multiple representations that have to span across several boundaries.

Knowledge Domain. What further supports the choice of facets is that teaching methods represent a knowledge domain that lacks consensual frameworks and exhibits ambiguity. For this characteristic, a faceted classification is recommended as it does not require strong underlying theories or models [6].

Technology. The University of Vienna's repository Phaidra features a sophisticated system of metadata that governs how entities in the repository are retrieved and organized. For this type of technological environment, classifications can be larger and more complex such as facets [6].

Overall, the information collected during the analysis suggests that the University of Vienna should develop a facets classification for use in its repository. A problem that might occur because of this decision to use facets is that the user communities represent different expert levels, namely that subject-specific didactics have expert knowledge in educational science while university instructors, who are often not formally educated in pedagogy, may not use this highly specialized expert language. A thesaurus that maps variant terminologies may thus be used in the initial phases to accommodate different user groups within the same facets classification.

4 Summary and Outlook

This article presented a new, namely, user-driven method to developing a classification for teaching methods. This method was favored because none of the earlier classifications took user perspectives into account during classification development. The user-driven method was then applied within the initial development phase at the University of Vienna, where specific stakeholder needs in regard to classifying teaching methods were identified. The results showed that the needs of the users are far from theory-driven frameworks, but rather represent needs related to common teaching tasks at the University. The process was made transparent, how a classification type was chosen for development based on user needs, the technology in use, and the requirements of the knowledge domain.

Next steps are to refine the purpose of classification development. Following that, we design the approach to the classification's development. Using iterative trial and error, the classification will then be built, tested, and validated with the stakeholders at the University of Vienna.

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