Visualizing Curricula

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Abstract. The poster presents an approach for curriculum mapping through the use of data visualization techniques. A sample set of six courses is selected to study the potential of this method. Primary course data is mined from syllabi and assignments and then organized in a database format. The structure leverages course content as data to visualize information about learning objectives, competencies, and sequencing. Course content and sequence-based mapping examples provide evidence of this approach.

Keywords: Mapping · Visualization · Data · Education · Curriculum

1 Introduction

Curriculum mapping is a widely accepted practice in education: a curriculum map cross-references course or program level outcomes against course content to reveal gaps or redundancies. Curriculum maps follow a schedule to locate where and when the learning of specific topics will occur. This format maps curricula linearly, as a path to follow, and presumes that each student will follow that particular route and learn at the same rate. These maps separate knowledge and abilities into individual cells, taking stock of the learning outcomes in a binary way. However, to cross-reference outcomes, such as concepts and skills, within a course requires more nuance. Visualizing connections across a curriculum, whether in or out of sequence, is essential. This type of assessment is especially useful for faculty teaching in architectural education, where skills, concepts, standards, and critical thinking support the integration of knowledge in comprehensive design outcomes.

The poster presents an approach for curriculum mapping through the use of data visualization techniques. Generating visualizations from data reveals unknown patterns and potential connections through “mapping” rather than “tracing” or documenting expected outcomes [1]. Tracing course outcomes defines points in time when all students realize a specific skill or concept—traditional curriculum maps present course information as a matrix, reinforcing a binary visual language and linear structure. Organizing course content as a database allows for filtering and sorting per metadata, supporting a myriad of visualization types. For instance, sorting curriculum data by learning outcome and then by course assignment yields information about which assignments build on one another over time. A different strategy may look at learning outcomes over time to identify which patterns or rhythms emerge in the repetition of topics.

2 Method

A sample set curriculum of six courses is selected. The classes are sequential and taught over two years of a Bachelor of Architecture program. The courses cover a range of learning outcomes for architecture students, including skills, concepts, standards, and processes [2]. These range from freehand drawing to three-dimensional digital modeling. The complexity of the course content is especially relevant to this study because it provides a rich set of data to explore. Each assignment is multifaceted and teaches students fundamental concepts along with the necessary skills to execute the work. Primary course data is mined from syllabi and assignments and then organized in a database format.

Three categories organize the data: information, outcome, and structure. Information data defines vital information such as the title, date, and course number. Outcome data lists information related to learning outcomes such as outcome topics, level of difficulty, and cognitive processes. Structure data lists specific considerations of the assignment or learning outcome, such as the format or medium used. Each course and assignment are input with a unique ID in a stacked format (Table 1). This format lists each incidence of a learning outcome topic as a unique component of the course sequence. This arrangement allows for sorting the content in various ways, such as isolating the sequencing of concepts versus skills in the curriculum.

Table 1. Abbreviated database sample

Information		Outcome					Structure	
ID	#	Topic	Level	Type	Process	x	Tool	Source
001	211	Composition	1	Concept	Reproduce	1.1	Model	Analog
002	211	Modeling	1	Skill	Produce	1.3	Model	Analog
003	212	Photography	1	Skill	Translate	1.2	Camera	Digital
004	211	Hierarchy	1	Concept	Identify	1.4	Model	Analog
005	213	Lineweight	2	Standard	Reproduce	1.1	Drafting	Analog

Some qualitative categories included in the database are assigned numeric values. The category “level” applies a number based on the incidence of that topic occurring in the course sequence. Because most outcomes recur in the sequence, their level increases over time. A multiplier (x) weights the incidence of each topic by the process applied within the cognitive learning levels [3].

The database structure leverages course content for visualizing information about learning objectives, competencies, and sequencing [2]. Functions such as comparison, distribution, flow, and patterns are possible to generate using this method. Once the data is stacked, visualization tools such as RAWGraphs, an opensource software, facilitates the translation of data into visual form. Subsequent graphic refinement and composition in Adobe Illustrator highlight the information presented.

3 Results

The poster presents the curriculum in two visualization forms, content and sequence-based mapping [4]. Curricular content visualizations examine the learning objectives and their distribution. Curricular content is presented here as an alluvial diagram [Fig. 1]. This visualization type sorts the four primary learning objectives (skill, standard, concept, and process) by course, then by topic and again by analog versus digital medium. Density in particular areas tracks emphasis on a topic or medium in the curriculum as a whole. Color tracks the incidence of digital tools within the connections.

Fig. 1. Content mapping as alluvial diagram.

Fig. 2. Sequence mapping as a contour plot, comparing skills and concepts over time.

Sequence visualizations document the courses over time, considering them as a series. Mapping flow in curricula provides insight into connections across various categories; a contour plot is presented here as a sequence-based mapping [Fig. 2]. The contour plot assesses individual assignment difficulty (y-axis) over time (x-axis) and displays density through the distance between contours. This visualization type provides evidence of course content and anomalies within each course. The density of points in a particular area reveals a consistency in the level of difficulty and cognitive processes required in each course.

4 Conclusions

The results support the potential of data visualization in curriculum mapping. Future work may examine best-fit visualization types, corresponding student assessments, and use of a database to support curriculum mapping as an ongoing, internally motivated process rather than a singular exercise [5].

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