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Short communication

Use of radar plots for curricular mapping: Defining cape-2013-compatible conceptual regions in a radar-plotted curriculum map

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Abstract

Purpose: To expand on the concept of using radar plots for curricular mapping and assessment by defining regions within the plot based on the three learning domains of Bloom's revised taxonomy: cognitive, affective, and psychomotor.
Methods: Each of the ten core competencies (Core Comps) of our program were categorized as cognitive, affective, or psychomotor by aligning their associated learning outcomes with Bloom's taxonomy of learning. The Core Comps were then re-ordered to define regions within a circular radar plot. The radar plot was used to map the curriculum to the Core Comps and Bloom's learning domains. Similar radar plots were used to map the Center for the Advancement of Pharmacy Education (CAPE) 2013 outcomes to our Core Comps and Bloom's learning domains.
Results: Reordering the Core Comps around a radar plot by grouping them into one of three learning domains (cognitive, affective, or psychomotor) enhanced the mapping process by defining three distinct regions within the circular plot.
Conclusions: A strategically ordered radar plot is a visually descriptive framework for curricular mapping—not only for mapping courses or standardized learning outcomes to programmatic competencies, but also to conceptual learning domains.
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Keywords: Assessment; Curriculum; Mapping; Bloom's taxonomy

Introduction

Previously we described the use of radar plots as curricular maps to assess the "lay of the land" in a new Doctor of Pharmacy program (PharmD), with a focus on measuring perceptions of where and to what extent our learning outcomes and core competencies (Core Comps) are assessed within the curriculum.[1] We showed that radar plots are visually descriptive and make patterns and trends within data readily apparent.[1] Herein, we expand on the advantages of using radar plots for curricular mapping and assessment by demonstrating how conceptual regions, such as those defined by Bloom's taxonomy of learning, can be defined within the plots.[2]

Radar plots are two-dimensional graphs designed to plot one or more series of values over multiple common quantitative variables by providing an axis for each variable, arranged radially as equiangular spokes around a central point.[3] Radar plots are circular rather than linear, and when the plotted variables are connected with a line, an enclosed shape results. Radar plots have been effectively used to display multivariate data in a variety of fields, including health care.[4] While not appropriate for displaying all types of quantitative data, we believe radar plots are very well suited for curricular mapping as they provide an efficient and effective way to display a wide variety of data (and patterns within the data) in a single image. More specifically, with regard to curricular

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mapping, we have found radar plots to provide a convenient way to visualize how individual courses contribute to the programmatic "big picture."

A review of the primary literature regarding the use of radar plots for curricular mapping and assessment, demonstrated this topic has been only minimally explored. For example, Ikuta and Gotoh[5] reported using radar plots as a means for students at Niigata University in Japan to visualize learning outcomes. Additionally, Keister et al.[6] demonstrated the use of radar plots as a promising tool for resident feedback and competency assessment in medical education. Further, a Best Practices Guide from *one45*, a software product specifically designed for medical education, espouses the use of radar plots to visually represent competency.[7] Within pharmacy education, the College of Pharmacy at Western New England University was the first to report using radar plots for curricular mapping, specifically in mapping the curriculum to ten programmatic core competencies (Core Comps, Table 1).[1]

In our original study, we surveyed instructors regarding their perception of the extent to which their courses assess the learning outcomes associated with each of the ten Core Comps on a four-point Likert scale: 0 = outcome is not assessed; 1 = outcome is assessed at an introductory/foundational level as part of a classroom session, assignment, or exam; 2 = outcome is assessed at a higher level as part of a classroom session, assignment, or exam; 3 = outcome is assessed in an experiential or simulated setting. We then calculated an average for each set of learning outcomes and graphed the mean response values for each Core Comp as a radar plot, such as the one shown in Figure 1 for our medicinal chemistry course. Radar plots such as this one readily show parts of a whole, and it is easy to see, for example, that the Medicinal Chemistry course is perceived to align with Core Comps I (thinking and learning) and VI (knowledge base).

While every course mapped to the Core Comps in this way displayed its own unique shape, trends, and patterns were readily apparent among similar types of courses (e.g., the foundational science courses). We soon recognized, however, that the particular shape any course displays on a radar plot is also largely a function of the order in which the Core Comps are arranged around the graph; *if the order changes, so does the shape of the plot.*[8] Although this might initially be considered a limitation of radar plotting, with a little ingenuity it can be used as an advantage. Namely, the grouping of like variables allows for regions to be defined within the circular plot, imparting an even more visually intuitive sense of order. Thus, it is our objective within this article to expand on our original report by defining regions within the plot based on Bloom's revised taxonomy.

Table 1
Core competencies

General	
I	Thinking and learning
II	Social and cultural awareness
III	Active citizenship and leadership
IV	Ethical and legal judgment
V	Communication
Professional	
VI	Knowledge base
VII	Patient-centered pharmaceutical care
VIII	Populations-based pharmaceutical care
IX	Systems management
X	Public health and wellness

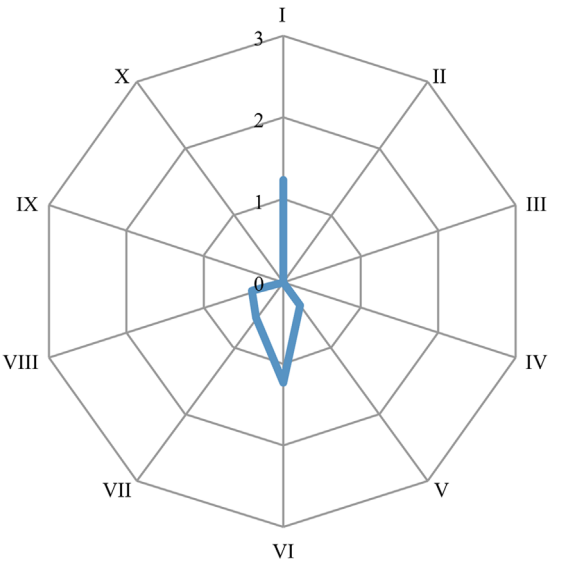

Fig. 1. Sample Radar Plot.

Bloom's revised learning taxonomy encompasses three learning domains, the cognitive, affective, and psychomotor.[9] Although many PharmD programs have traditionally focused on the cognitive and psychomotor domains of learning, the inclusion of the affective domain in the 2013 Center for the Advancement of Pharmacy Education (CAPE) educational outcomes emphasizes the importance of recognizing attributes beyond knowledge base and technical skills that contribute to the development of professional pharmacists.[10] Indeed, the CAPE 2013 educational outcomes holistically define what entry-level practitioners of pharmacy should know, how they should act/feel/behave, and what they should be able to do upon successful completion of a PharmD program that is accredited by the Accreditation Council for Pharmacy Education (ACPE). Thus, we felt it would be useful to develop a curricular mapping system that would allow us to at once visualize connections between our courses, Core Comps, and Bloom's learning domains. By carefully grouping and reordering our Core Comps we were able to do this using radar plots as described below.

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