

Transformative and integrative dimensions of identified threshold concepts in geographical information systems

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Threshold concepts are known to transform students' understanding in various disciplines (Cousin, 2008). Identification of key threshold concepts is imperative for the new and rapidly growing discipline of Geographical Information Systems (GIS) which is now included in university curricula across diverse fields of study. GIS began as a technique in 1960s but in recent decades it has evolved as a field of science and recognized a distinguished graduate attribute (Goodchild, 1992). Recent technological breakthroughs have made GIS easier and more affordable to use. Examples include Google Earth and global positioning systems.

The curriculum for GIS education is still evolving although there are model curricula available. These models identify several key areas of the discipline (DiBiase, et al., 2006), but they are not organized in any appropriate hierarchy leading to curriculum overload. Further, the available models do not identify the difficulties that students have in GIS learning and how best to transform their prior knowledge into the new discipline. This study identifies two threshold concepts of the new discipline and explains their transformative, integrative, and troublesome qualities. These threshold concepts are data model and interoperability, both of which are well-recognized concepts of the discipline. The study presents details of students' experiences with one of these threshold concepts.

A data model represents real-world geographic features as a digital *spatial layer* and stores associated *attributes* in a *coordinate system*. These features, depending on *data collection and creation* techniques, are represented either as pixels or points, lines and polygons. The data model is linked to other key concepts of the discipline, including *map scale, errors and uncertainty, spatial autocorrelation, cartography and geo-visualisation, metadata information, queries, overlaying, and geo-processing*.

Many multidisciplinary research and application projects now depend on the integrative and analytical power of GIS. Advanced GIS analyses require programming, mathematical, and statistical knowledge. Similarly, display of GIS data on the web for a general audience requires web-designing knowledge. These knowledge areas can be applied on GIS data only if they are interoperable or compatible with other systems. Understanding the concept of interoperability, which is mashing-up of data from different sources in a digital medium, can transform students' understanding to utilize the integrative and analytical power of GIS.

To explore the transformative dimension of data model, one of the threshold concepts, students' interviews (n=68) were conducted during the final stage of an introductory GIS course at the University to record their experiences. The interviews showed that, while some students were able to demonstrate a transformation and able to integrate this concept with other concepts, other students were still in the liminal phase and were finding this concept troublesome.

Grasping these concepts facilitates students' journeys through the liminal phase with conceptual and ontological gateways to understand and integrate other core concepts of GIS. Only after acquiring and integrating these concepts students can proceed to GIS analyses, else they will simply be mimicking the understanding. Being integrative, the two concepts serve as a portal which opens-up the subject in crucial ways. The consequences for GIS pedagogy and curriculum design across universities are discussed.

References:

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