COMPONENTS OF MODEL CURRICULA DEVELOPMENT FOR GIS IN UNIVERSITY EDUCATION

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ABSTRACT

The tremendous growth and interest in geographic information systems (GIS) motivates a need for the development of model curricula in university education. Identifying components for model curricula development helps clarify the issues that need to be addressed. Six panelists discuss the components of model curricula for GIS in university education.

INTRODUCTION

Interest in geographic information systems (GIS) is growing exponentially as many local, state and national organizations in both government and business are investigating better ways to manage and analyze geographically oriented data with the use of computers. GIS development and use in all sectors of society motivates an examination of curricula for GIS education, especially model curricula in university education. Now more than ever, identifying components of model curricula for GIS education in universities is critical to assist in educating those individuals becoming interested in GIS, including faculty members having only limited interest in the past. The approach at the current time is on curricula components rather than a single curriculum, since GIS education exists in many different contexts, However, the goal for the future should be a curriculum from which educators could draw to develop instructional programs, and be confident that most issues in GIS education would be addressed.

This panel has been convened to discuss the components of model curricula for GIS in university education. Components involve the more conceptual issues of model curricula rather than the details of exactly what is to be done. Hopefully the latter will come at some time. As such, the focus in the panel discussion is on "education" rather than "training". Education is taken to be more fundamental and broader in scope than training which tends to focus on the use of a particular system.

All panel members have at some time written about issues involving model curricula for GIS or a closely related topic. The panelists are:

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ISSUES IN MODEL CURRICULA DEVELOPMENT

Panel members have been asked to address several issues related to model curricula development. Several of these issues were identified during two recent workshops. The first was a two-day workshop held at the Ohio State University on April 30 and May 1, 1988 called "GIS in University Education" organized Duane Marble and sponsored by the IGU Committee on Geographical Data Sensing and Processing. Over eighty teaching faculty, researchers, staff, and students participated.

The second was a one and one-half day workshop organized by the author called the "Northwest International Geographical Information Systems Forum on Teaching and Research" held October 28-29, 1988 in Friday Harbor Washington. Approximately thirty faculty, staff and students from universities in British Columbia, Oregon State and Washington State as well as Michael Goodchild from the National Center for Geographic Information and Analysis attended. In some way or another all attendees at these meetings contributed to the development of this list.

In addition, several panelists provided comments and additions to the list. The following issues, and undoubtedly others, need be considered when exploring the development of model c for GIS education:

1. **Mission.** Recognition of an organization's mission with respect to teaching can be focused on: a) basic principles - service to the university, b) how to use tools in applications, and c) how to build tools. These issues need to be addressed in the context of intra-institutional departmental cooperation, inter-institutional orientation and relationship of regional cooperation with national research centers. The tasks to be addressed are: a) undergraduate education, b) graduate level education, c) extension center education, d) instructor education, and e) researcher use of GIS.

2. **Conceptual Framework.** Frameworks to help conceptualize topics and courses might be useful. Matrices might be useful to help organize discussion for missions, topics and courses. This results in three matrices, one with topics and missions as the dimensions, another with topics and courses, and another with missions and courses as the dimensions as outlined below. (Remembering that particular courses fit particular missions - more or less).

Table 1. Missions and Topics

	MISSIONS (as in 1. above)				
	a	b	c	d	e
TOPICS					
1.					
2.					
3.					
4.					
5.					
etc.					

Table 2. Courses and Topics

	COURSES					
	first year			second year		
	1	2	3	4	5	6
TOPICS						
1.						
2.						
3.						
4.						
5.						
etc.						

Entries in Tables 1 and 2 would represent a certain depth of presentation and expected outcome in terms of understanding a topic. The levels can be: 1) exposure to topic 2) understanding of principles behind topic 3) use of tools 4) able to build own tools. An approach like this has been taken in (Nyerges and Chrisman 1989) to develop an integrated instructional program in computer-assisted cartography and GIS.

The entries in Tables 1 and 2 can be used to generate a summary of courses such as depicted in Table 3.

Table 3. Courses and Missions

	COURSES					
	first year			second year		
	1	2	3	4	5	6
MISSIONS						
a.						
b.						
c.						
d.						
e.						

3. **Prerequisites.** Identification of the prerequisite courses for a GIS program can be performed only after the topics in issue 2 above have been documented. Courses and topics in mathematics, computer science, mapping sciences with perhaps others must be addressed.

4. **Course Integration.** What is the appropriate mix of integrating mapping sciences with GIS, especially cartography and remote sensing?

5. **Tutorials.** Reduction of the amount of startup time for students to learn a concept is important. Having the appropriate tutorial environment can be very important. What is the appropriate length of time with regard to:
a) user interface learning
b) database development

6. **Software/hardware Tools.** A need for pedagogic tools is evident. Tools are needed for a) demonstration of principles, b) tools for use in GIS project development, and c) tool building. Different software and hardware might be required to suit the general needs of different program orientations. A list of the functionality of such tools that are available would be necessary to satisfy the needs of these orientations. A list of could be useful, but more than one tool might be required to satisfy the orientations.

7. **Regional Cooperation.** The basis for developing cooperation within and among institutions for offering courses needs to be explored. Is it useful to develop regional forums for discussion of GIS teaching and research issues? Local funding for training and research could enhance programs.

8. **Laboratory Funding.** A need exists to develop a collective statement about problems with the funding of laboratory space. Perhaps several case studies can be developed that describe laboratory maintenance. Staffing, software, hardware, and data maintenance should be included.

9. **Balance of Theory and Application.** The best way to deliver a theoretical message in an application setting is in need of exploration. Identify the appropriate mix of theory and application. This depends upon the orientation and level of the course. Perhaps a balance as suggested in Tables 4 and 5 might be appropriate.

Table 4. Topic Balance for Concept Presentation and Tool Use Instruction

Tool Use Level	Theory	Application
Beginning	25%	75%
Intermediate	25%	75%
Advanced	25%	75%

Table 5. Topic Balance for Tool Building Instruction

Tool Building Level	Theory	Application
Beginning	25%	75%
Intermediate	50%	50%
Advanced	75%	25%

10. **Standard Data Sets.** Standard data sets would help with the delivery of fundamental issues in a tool use environment and testing of software/hardware in a tool evaluation environment.

11. **Course Linkages.** Identification of the linkages with topics in social science, environmental science, physical science, mapping sciences, etc. is needed to broaden the perspectives of students. Integrating GIS with these topics can prove to be demanding, but necessary, to provide students with a framework that goes beyond the tools. This might be a difficult task because it is often idiosyncratic to any given instructional program.

12. **Learning Environments.** Determining the importance of a collegial community in the learning process of GIS, e.g. group work sessions and discussion sessions can be important in the delivery of instruction.

13. **Instructional Evaluation.** Identification and preparation of evaluation criteria for GIS instruction can be useful as instructional, performance indicators.

SUMMARY and CONCLUSION

Several model curricula development issues must be considered for GIS in university education. Several of these issues have been presented in the panel session and others will surface as discussion continues on this topic. Perhaps the most effective way to proceed is to identify instructional missions, set goals and to then identify

topics to be included in the instructional program. These topics could be developed using the mission by topic and course by topic frameworks presented in Tables 2 and 3, respectively. Filling in the matrices involves identifying an appropriate level of exposure to a topic for introductory, intermediate and advanced courses.

The National Center for Geographic Information and Analysis has been preparing a three course sequence which perhaps can be used as the initial ground work for a model curricula development. Prerequisites, laboratory environments and cognate courses need more directed discussions than can be accomplished in forums such as a conference panel session. Discussions on these topics can only be effective through broad-based participatory effort on the part of the professional societies involved. Hopefully the issues discussed by this panel can continue in the future through more directed efforts.

REFERENCES

Nyerges, T. L. and N. R. Chrisman 1989. A Framework for Model Curricula Development in Cartography and Geographic Information Systems, *Professional Geographer*, in press.