# A SYSTEM DYNAMICS APPROACH TO TEACHING OF SETTLEMENT GEOGRAPHY

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ABSTRACT

This paper explains an effort to approach system dynamics as a tool for designing a curriculum and integrating experimental learning in a course titled Geography of Settlements. The course is offered for undergraduate students in the field of Social Sciences at Kasetsart University. Its contents deal with change over time and space and integration of physical and social contexts of change. The lectures incorporate experimentation in computer-based learning for understanding theories and information relationships existing in the spatial organization, settlement problems and developments. After students have learned system dynamics concepts and feedback system, they are asked to formulate the causal loops and simple models of settlement growth and urbanization with policies for environmental control, before coming up with physical planning and designing a town or a city. The responses of students in class and group discussion as well as exercise outputs are examined and compared to the control group of students who have no experience with this approach.

## Introduction

Settlement provides a focus for interdisciplinary study. The economist, sociologist, historian, psychologist and geographer are all able to examine a settlement from a clearly defined disciplinary base. Geography acts as an integrator, borrowing from the other disciplines but, at the same time, making its own distinctive contribution, particularly with respect to spatial organisation (Daniel and Hopkinson 1989, p.7).

In the past , geographers have argued that the physical condition in the area actively determined the pattern and organisation of settlement. Today the concept of 'physical determinism' has been superseded by the realisation that social factors are also important in the location and developing character of any settlement (Daniel and Hopkinson 1989,p.13). Development and change in human settlements can not be separated, either conceptually or analytically, from the processes of economic and social development (Habitat 1987,p.7).

The course on Settlement Geography offerred for undergraduate students in the field of social sciences at Kasetsart University has been traditionally taught static images of the settlement problems while they are dynamic. Most of the students in this course are hardly familiar with science and mathematics especially system concept. They learned by

remembering ,ignoring the interaction between the course contents as well as the relationship with the other subjects. They rapidly forgot what they have learned. This reminds Forrester (1990)'s statement that" the human mind grasps pictures, maps and static relationships in a wonderfully effective way. but in systems of interacting components that change through time, the human mind is a poor simulator of behavior."

The author has just joined Kasetsart University in the Department of Geography and has been teaching 3 subjects in applied geography namely Rural, Agricultural and Settlement Geography. It has been found that there is a repetition of some theories taught in these subjects. The student once learned a theory in one subject could not relate to another subject because of the fragmented teaching process. This results in disconnected adoption of the knowledge. This paper reports the feedback of the student after changing the teaching pattern by using system approach and system dynamics concept as a framework for curriculum design of Settlement Geography and cohesion to the related subjects based on the same major theories.

## Existing Study Environment

Faculty of Social Sciences at Kasetsart University provides 6 major studies as follows : Psychology, Sociology, Political Science and Public Administration, Law , History and Geography. Total undergraduate and graduate students account presently for 797 people. Although the Faculty has been promoted for 15 years, facilities as experimental laboratories for nourishment of social sciences study are insufficient compared to the number of students. There are psychological lab, cartographical lab and computer lab in which 3 microcomputers (PC compatible) are available for faculty staff and graduate students using statistical analysis and word processing.

Evaluation by the fourth year social sciences students done in 1990 shows the significant feature that much of what are taught in social sciences classes is repetitive and lacks intellectual stimulus and challenge to the students.It seemed to them that one teacher would lecture the same things even in different subjects. As Forrester (1990) states " education is fragmented. Social studies, physical science, biology, and other subjects are taught as if they were inherently different from one another even though dynamic behavior in each rests on the same underlying concepts...Humanities are taught without relating the dynamic sweep of history to similar behaviors on a shorter time scale that the student can experience in a week or a year. .....A student is expected to create a unity from the fragments of the educational experience. But the teachers themselves have seldom achieved that unity."

This supports Saeed (1990) 's paper discussing that "The teaching of social sciences, including that for the methodological courses forming part of a curriculum, is

nevertheless conducted predomenantly on the conventional lines of the lecture, emphasizing the learning of the theoretical premises or the mechanics of a method without necessarily going through an involved reflective process. Supervised laboratory or studio sessions are rares. An opportunity to reflect might occur while the student is working on the exercises often assigned in the course of the teaching, but it may not be taken full advantage of since there is often inadequate help in designing and interpreting experimentation relevant to exercise."

## Curriculum Design in Settlement Geography

Traditionally, The Geographer examined cause and effect to describe the relationship between settlement and physical environment in a rather subjective and unscientific manner (Pattison, 1973). The search for common characteristics was gradually extended to include a search for order in both the spacing of settlements and their internal organization. The 'quantitative revolution', as it became known, meant that scientific method was adopted by the geographer in the search for a greater understanding of spatial organization. Underlying the quantitative revolution was the belief that problem-solving was a rational process, relying upon logical thought and accurate information for its success. While reliance upon economic theory, mathematically analysed data and a logical approach is attractive and appears eminently reasonable, many geographers have grown dissatisfied with the effectiveness and relevant of such methods when applied to real world problems (Daniel and Hopkinson, 1989).

Settlement theories generally available in the text book of settlement geography provide studies of internal and external structure of settlement or town. Internal structure theories named Concentric Zone developed by Earnest W. Burgess in 1925, Sector Theory by Homer Hoyt in 1939 and Multiple Nuclei Theory by Harris and Ullman in 1945, explain land use pattern, growth of a town as well as economic activities in terms of spatial organization within a town. While external structure focuses spatial organization between towns, the role and functions of each town. A well known study is Central Place Theory, developed by Walter Christaller in 1932, which explains a hierarchy and location of settlements based on a number, size, function and space between the central places.

Settlements change in size and form in constant, though usually delayed, response to the changing economic and social development of the surrounding areas (Everson & FitzGerald,1969 p.112). However, these theories cannot explain successfully the interaction between elements of a settlement system based on concept of change while the Urban Interaction Theory, a system dynamics model developed by Jay W. Forrester in 1969 can experiment through time the interaction between elements of an urban system with the advantage of forecasting long term trend. System Dynamics can provide that dynamic framework to give meaning to detail, facts sources of information, and human

responses (Forrester, 1990).

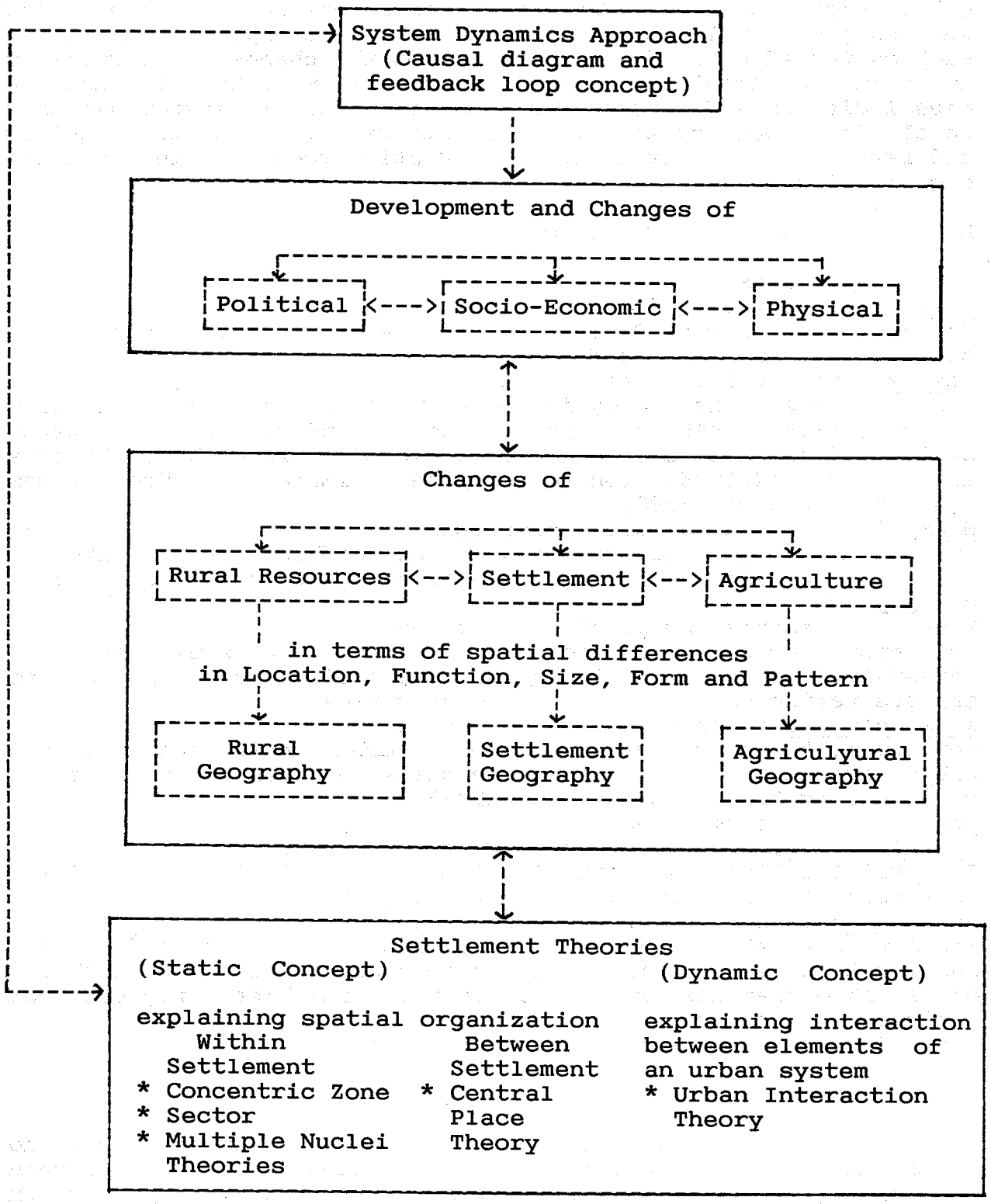


Fig.1 Structure of Curriculum Design for Settlement Geography

Fig.1 shows the structure of curriculum design in settlement geography course by incorporate the system dynamics concept as a framework of teaching process and a linkage to the other related courses. The interactions between the development and changes of political, socio-economic and physical factors as well as the effects of these factors on the changes of settlement in terms of location, function and size, will be explained in causal diagram and feedback loop concept. Simple system dynamics model in urban system is experimented to get the better understanding of traditionally static theories in spatial organization.

An Outline of Course Contents

4 hours per week
Week 1 : Lecture.
Concept of Settlement Geography as a system approach, definition of system, simulation and models.
Week 2 : Debate & lecture.
Debate on a life in a city is better than an upcountry? Lecture on causation, feedback, and system boundary using contents arrived from the debate and some exercises from Nancy Roberts and et al :Introduction to computer simulation: The system dynamics approach (1983).
Week 3 : Lecture and group discussion.
Graphing and analysing the behavior of feedback system linking casual loop and graph. group discussion on topics from daily newspapers.
Week 4 : Lecture and group work survey.
Settlement origin and growth. To survey a slum near the university and construct the casual loops of a system in order to capture variables for interviewing next time.
Week 5,6,7,8 : Lecture and model experiment.
Settlement theories, growth of town, urban center and rural and urban system. Experiment to the class on urban dynamics model developed by Alfeld and Graham (1976).
Week 9 : Mid- term exam.
Week 10,11,12,13 : Lecture and group discussion.
Industrialization & urbanization (case studies on Asian coutries), action for human settlement problems.
Week 14,15,16,17 : Field trip and group work report.
Field trip to slum in Bangkok: comparison between the old and new ones. Data collection and analysis on a case study : The problems of a slum near Kasetsart University and policies proposed for environmental control.
Week 18 : Report presentation and final exam.

Evaluation of the Course

This class consisted of 16 second year students with no background of a system thinking. A traditional learning pattern was taking notes all words from a lecturer or projection transparencies without understanding since the students were afraid of having nothing to overcome the examination. The first week of introducing a change to learning by thinking with system

concept, there was a question from the class why they had to recognise this since it was not relevant to the settlement course based on the settlement geography text books. Before mid-term exam some students were worried whether the exam might be loaded, because the lectures covered all the topics of the text book, and what to do for the two months left and the final exam.

However, it was observed that there was a vital participation in the group discussion and working group presentation and report. The students found that they could capture the problems in the real world on a survey exercise quite rapidly and have wider perspectives in terms of the relationship among variables as well as save time to design the questionaire for data collection and analysis after they had some experience in system thinking and construction of causal diagram and feedback loop concept. The big change is that most of them could assimilate knowledge of the subjects by understanding not only remembering which can be shown in the final exam evaluation and group work presentation compared to the group learned this course in the traditional process.

## Conclusion

Since this was the first change of learning process with inadequate computer laboratory session, though the students lacked an opportunity to cultivate 'reflective practice' which should allow the practitioner to engage with self experiment, the outcomes of a change could be a promise for the future development of learning facilities and more participation to this approach from the faculties.

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