An Experiment of Teaching and Learning System Dynamics with Aids of Action Research Tools

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Abstract

This paper tries to introduce an experiment we conducted in teaching system dynamics at an undergraduate (junior) level at the Department of Business Management, National Sun Yat-sen University. A step-by-step feedback-learning concept is employed. We guide the students into the field of system dynamics gradually and make the learning environment quite enjoyable and challenging for learning. In our design, besides learning in class, students can also enhance their learning after classes through the environment of the Cyber University here, and it can increase the quality of education and students' interests dramatically. We employ some action research tools in the class to facilitate learning. The class scheduled for four months, covered thirteen units. Data were collected in the class, from interviews and students' reports, documents collected, and from feedback questionnaires. From the process of actions and self-examinations, we have continued to improve our teaching and raise students' interests and enhance their learning effects. In our teaching activities, we set up very challenging learning goals, identify questions and provide proper assistance to improve their performances. Finally, we check the results of action and introspect the actions of the whole process.

Keywords

System Dynamics, Action Research, Feedback Learning

Introduction

In fast changing age, a teacher has to change his way of teaching; he must adjust his content of courses and pedagogy. It is very helpful for teachers to improve students' learning effects, to raise students' learning interests, and to promote oneself by analysing his teaching. In the past, for students' learning status, they will develop polarized due to the difficulty of programs. So, we hope to study this phenomenon further and make a teaching experiment by the tools of action research and the experience in the past.

This paper attempts to introduce an experiment we conducted in teaching system dynamics at an undergraduate (junior) level at the Department of Business Management, National Sun Yat-sen University. A step-by-step feedback-learning concept is employed. In the past, the content of courses is almost designed by goal-orient methods, and we can roughly classify them in four types: (1) to learn model building through classical models, (2) model building for actual companies, (3) to imitate the Management Flight Simulator for exercise, for example, People Express, B&B, etc., and (4) to practice for systemic archetypes.

In this experiment, we employed action research tools to aid the learning of system dynamics. Action research in education is conducted in a school setting to improve instruction (Carl Glickman, 1992). Action research is a three-step spiral process of (1) plan, which involves reconnaissance; (2) taking actions; and (3) fact-finding about the results of the action. It is trying to find out what can be done in the events and interpret it.

Methodology

Action Research

The action research contribution began in the 1940s' with studies conducted by social scientists John Collier, Kurt Lewin, and William Whyte. They discovered that research needed to be closely linked to action if organization member were to use it to manage change. A collaborative effort was initiated between organization member and social scientists to collect research data about an organizations' functioning, to analyze it for causes of problems, and to devise and implement solutions (Cummings & Worley, 2001).

In view of "a teacher is a researcher," this experiment uses the action research to explore that how to blend theories of the step-by-step learning with existing matters

for teaching and exploit the feedback learning to improve students' learning attitudes. Moreover, we also discuss the difficulty and how to overcome in the process of carrying out the step-by-step learning, and analyze researchers' growth and gains.

Action Research is a form of self-reflective enquiry undertaken by participants in social (including educational) situations in order to improve the rationality and justice of (1) their own social or educational practices, (2) their understanding of these practices, and (3) the situations in which the practices are carried out. It is most rationally empowering when undertaken by participants collaboratively" (Hopkins, 1985).

Kemmis' model follows the cycle of: Plan, Act, Observe and Reflect. "Planning" involves the determination of the question that needs answering and the strategy to be used in answering it. During the "Acting" stage, the practitioner tries out the strategy. The "Observation" stage includes recording data on the results of the strategy and also keeping a journal on the practitioner's thoughts and reactions to the entire experience. Finally, during the "Reflection" stage, conclusions are drawn and the original plan revised based upon the conclusions so that a new cycle can begin (Kemmis, 1982).

Process

According to the method and spirit of action research, there are three stages in this study, a stage of preparation, a stage of practice, and a stage of writing. This research is action research for method, with an eye to teaching of proceeding process that set up. The purpose of this research is to do some innovation of teaching. According to action research, we would like to create an educational innovation as following:

1. Preparation (July to September 2001)
   (1) Draw up research topic: Aiming at the course of system dynamics, we present a new thought of teaching innovation and further draft a subject of study that will agree with the teaching thought.
   (2) Read related literature: We will begin to study the related literature after we establish topics of research and then drawn up the teaching plan.
   (3) Preliminary plan of research: The plan of research, what is called, aimed at the motivation and purpose. We tried to make out this plan. Through this plan can help this research to take more successfully.
   (4) Design the content of courses：According to the plan of research, we start to design this content of courses. In fact, this original content of courses was base on assumption.

2. Practice (September 2001 to January 2002)

   It included drawing up the action plan, to perform the action, to collect the feedback data, to analysis data, self-reflection, and to modify the assumption.

3. Writing the paper: (December 2001 to January 2002)

This study adopted the action research; we hoped to conduct a series of research of this course at undergraduate. We expected to through review and improve continuously and caused the interest of students and enhance their learning result. Finally teacher can get some growth about the teaching. The action research we used had five steps: assumption, Plan, action, observation, and self-reflection.

Figure 1 shows the process of action research, we addressed an assumption when we drawn up the action plan. First, we addressed an assumption. Second, we made some action plan from this assumption. Third, teaching, observation, recoding. Finally, we began to reflect and evaluate this assumption. Continuously circulated and repeated process, as same as made experiments again and again, we could do some assumption and identification repeatedly.

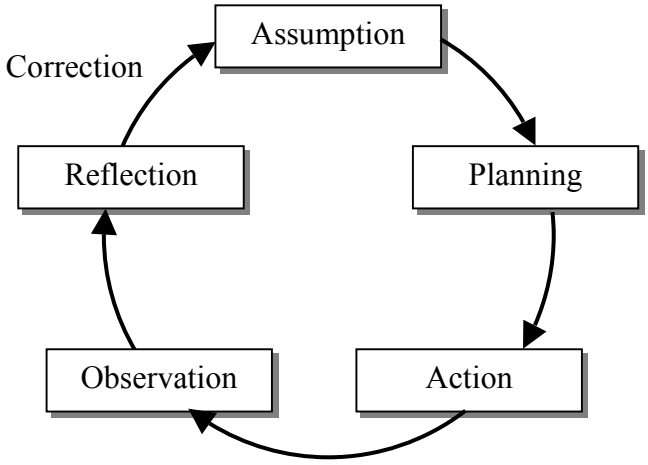

Figure 1. Action research Cycle

Data Collection and Data Analysis

1. Data Collection:

   According action research, we had collected dates by research diaries, observation materials, students' self-estimation, students' study records in Cyber University, and homework, etc.

a. Research diaries: We wrote the research diaries after teaching in each week. It was recorded about the teaching circumstance, interaction circumstance, and the problem what we find. It can help us reflect the teaching.
   Observations: We arrange an assistant to observe in this class. Assistant must observe about attitude, learning circumstance, and learning response. And keep records of observation.
b. Students' self-estimation: After the ending of very bigger unit, we will have students make a self-estimation to weigh his learning condition and share every students' experience in the course.
c. Students' study records in Cyber University: Using our Cyber University system, we can known well students' learning status that includes studying period, studying items, and the ranking of studying.

2. Data Analysis
   a. Data reading
   b. Data selecting
   c. Data explaining and make a conclusion

Discussion

This research used the action research tool, and proceeds the experiment of the teaching. Each teaching step has an implicit assumption. From these assumptions, we will design and plan further. In the past, the method of teaching in system dynamics, it included building the classical modeling, reading literatures, learning in Management Flight Simulator, building Management Flight Simulators.

This research used action research, and it address five circulating steps: Assumption, Plan, Action, Observation, and Reflection. In this text, we proceed action research to be a main stalk, and start this research sequentially from assumption, it shows as follows:

This study tries to introduce an experiment we conducted in teaching system dynamics at an undergraduate (junior). It addresses four assumptions about the experiment of instruction: (1) to do from easy to difficult, to teach with patience and skill, (2) structure influences behavior, (3) feedback learning.

Assumption 1: According to the experience in the past, the best learning is to do from easy to difficult.

1. Plan:

a. To do from the easy to the difficult and complicated: On the design of the course, we began to introduce this course through the Beer Game. From this game, students could learn by play this game, and then teach them to build the model: reinforcing feedback loop, balancing feedback loop, one positive and one balancing feedback loop (Archetype of Limits to Growth), one positive and two balancing feedback loops (Archetype of Growth and Underinvestment). Finally, we assign a project which to build up the model of PE.
b. To teach with patience and skill: For increasing learning interests, we introduce students step by step and mainly employ "the parable of the bolded frog" to do from the easy to difficult.

2. Action:

   About this plan, we implemented it through action plan and proceed smoothly such as the content of course plans. For arranging students' homework, we still did it from the easy to the difficult, including rip the paper, shower, archetypes, and PE.

3. Observations:

   In the class, we observe all of student. We found some interesting thing. We found that they were very interesting in Management Flight Simulator. During the course, we observed students' reaction and found that they were interested in Management Flight Simulator. About the homework, most of the students could accomplish on time.

4. Self-reflection:

   To survey and analyze of data, we found that students could easily adopt this kind of course arrange and design and completed homework before due date. But it was not so good in the volume of homework. After investigation, we realized it was because students don't get used to the way of handing is an assignment. So, we had control the degree of difficulty well but must adjusted the way of handing in homework.

5. Correction：

   In order to improve the percentages of hand over, we applied an online course on Cyber-University's Web. Through the Cyber-University's System, teachers can set

up the system by themselves, and make some control, which included online discussion, online reading, and online hand in assignment, online record.

Assumption 2: structure influences behavior: Different people in the same structure tend to produce qualitatively similar results (Senge). Curriculum design can help students' learning.

1. Plan:

   According to the purpose of curriculum, system dynamics emphasize the importance of modeling. Therefore, whatever in the class or after the class, we must let students to exercise practically, and homework can make them do it more perfectly. Under the help of homework, it can make students and teachers know the effects of learning. By the way of arranging homework, students could form a habit to review and practice what have learned. About handing in homework, we make use of Cyber-University's System that could automatically manage the due date. Before the dead line, students must upload their homework successfully.

2. Action:

   About the practices and exercises, we would have students have practice chances in principle or let students who learned better to show as an example. When students practice archetypes, we also express them by real cases.

3. Observations:

   After the beginning of the school term, the rates of practicing homework and handing in assignment are still high. But the situation became worsen after one to two weeks. When we queried and observed, we found that the way of handing in the assignments makes students feel inconvenient.

4. Self-reflection:

   When we found the phenomenon of students' inconvenience, we began make a self-examination and thought that how to reduce the inconvenience.

Assumption 3: Feedback Learning，For Argyris and Schön (1978: 2) learning involves the detection and correction of error.

1. Plan:

Learning is a process of continually feedback. When we design the content of teaching, we would let students review their homework in a class. W e found that students would raise learning effects and enforce learning behaviors by the peer interaction ◦

2. Action:

   We would let students share their experience of doing homework and what they have learned in the beginning of every class and by the way we could understand students' learning status. When we discussed students' options and assumption, we grouped into heterogeneous that could encourage students who had learn better.

3. Observations:

   Feedback Learning does validly to students' learning effects. We noticed that students concentrate more attention after the feedback and discussion. Especially when students encounter difficulty, we immediately adopt Appreciative Inquiry (AI) to explore their best experience of resolving problem in their lives. Finally we brought up the method and confronted problem together to make them accomplish successfully.

4. Self-reflection:

   We should equally apply some theories of system dynamics to the design of the course, for example, balancing feedback loop and setup the goal. If the learning isn't a mechanism of feedback, we will not understand what the learning situation is and if we should adjust it. The feed back from the class is not only the examination to students, but also a check to teachers.

Conclusion

No theory, no learning (Deming). It is a good thing that teacher use action research for his teaching. It not only can help students' learning but also himself. This research may have three contributions. First, we found it is possible to challenge our undergraduate students to build People Express Management Flight Simulator in their first time system dynamics class. Second, through the action research, we can control the situation of learning. Third, we can make students study a difficult subject joyfully. When students had learning difficulties, AI skills can be used. AI seems like magic, it generates enough energy to make all students want to try their best to face the challenges of learning a difficult subject.

In order to get better results, we used some skill of organizational learning. These activities, which help us growth, occur good effects. It proves that design of curriculum is more important than content of curriculum. To be a teacher, it will be very meaningful to do this research. In the future, it can improve the quality of teaching continuously.

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Back to the Top