

The Proposal of PAI Adaptive Learning Model Inspired by US Application-oriented Graduate Program —— Use Northeastern University as an Example

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ABSTRACT

It is necessary and urgent for the universities to explore innovative ways of talent training and to provide qualified talents to the market with the increasing demand for application-oriented talents. Most of the existing studies explore the good practices of talent training from the teaching perspective. Inspiring from the application-oriented master program of Northeastern University, this essay proposes a new adaptive learning model from the students' perspective. The essay utilizes many management concepts such as the PDCA cycle, Stacey Matrix, and learning curve to analyze the statistics obtained from observation and questionnaire. Through statistic analysis, the essay verifies two assumptions and develops the learning model. The PAI adaptive learning model uses a combination of development approaches during different phases of the learning curve to help to maximize the effectiveness and efficiency of talent training. In addition, the essay discusses how to utilize the enterprise environmental factors of the model to promote learning growth. To conclude, the PAI adaptive learning model provides an actionable approach that can be used for application-oriented talent training and common systematic learning.

Keywords: project development approach, Stacey Matrix, learning curve, PDCA cycle, continuous improvement.

1. INTRODUCTION

With the development of higher education, training the application-oriented postgraduate with the most updated tools and techniques becomes a remarkable topic in the education field. Some of the good practices are, for example, offering interdisciplinary courses, using practical teaching, and establishing a major-minor system [6]. Remarkably, Northeastern University has ranked consecutive year of 1st place in Co-ops and Internships, 11th place in Most Innovative Schools, and 49th place in 2021 U.S. News National Universities (tie). The ranks indicate that the university has potentially created a set of methodology to train and to offer professional talents to the market. This essay introduced a new adaptive learning model named PAI that was inspired by the Master of Science Program, Project Management major at Northeastern University.

There are existing researches on application-oriented graduate program that analyzed the curriculum provision or program setting through the perspectives of the University department and the instructors. Indeed, students are one of the most important stakeholders of the program. By verifying assumptions through scientific methods of analysis, the essay aims to establish a adaptive learning model that can be used for application-oriented postgraduate talent training. In addition, the essay proves the effectiveness and efficiency of the learning model from the students' point of view.

2. ASSUMPTION AND METHODOLOGY

The mission of the application-oriented graduate program is to acquire theoretical knowledge and practical technics which enable the students to become like professional practitioners. A clear mission helps us to set up the success criteria for evaluating the effectiveness and efficiency of the learning model. The essay considers

two elements which are learning and application skills as well as learning speed. On one hand, through exams, presentations, and assignments, the results can reveal the level of learning and application ability. On the other hand, the slope of the learning curve illustrates the learning speed of the students.

This essay proposes two assumptions. In the first place, the speed of learning and application skills obtained by the students will change during the different phases of the learning model. Secondly, by adopting a combination of development approaches during different phases of the learning model, it helps to maximize the effectiveness and efficiency of training in which assists the students to become qualified application-oriented talent.

There are several scientific methodologies used in this essay that helps to establish and explain the model. To begin with, the first tool used for developing the model is the Stacey Matrix. It is a method that evaluates the appropriate approach for developing a project based on the degree of technical uncertainty and requirement uncertainty [1]. From project management perspective, each course under the program is a project with the constraints of time, cost, and scope [4]. Instead of using a single learning approach, the essay assumes that it would be more appropriate to adopt different development approaches with the courses based on the students' learning level.

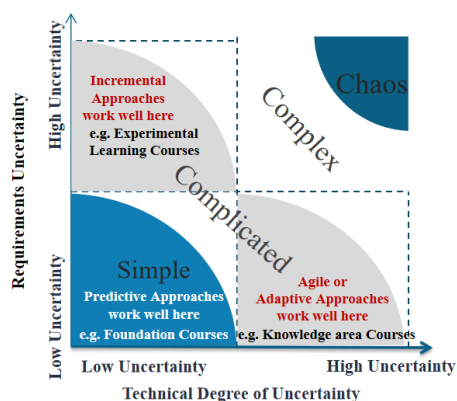


Figure 1 The Stacey Matrix

The methodology of model development is explained as follows. After applying the Stacey Matrix, the courses are located in different areas of the matrix for further analysis. Each area has a suggested development approach according to the Stacey Matrix, for example, the predictive approach and agile approach. The essay utilizes both observation and questionnaire to collect the data. Then a learning curve is created based on the statistics analysis. Next, the essay indicates whether there is a correlation between the learning speed and the suggested development approach. After all, a model is established according to the analysis.

3. DATA COLLECTION AND ANALYSIS

In the first step, after applying the Stacey Matrix, it reveals that all the courses are distributed in three areas as *Fig. 1* shows. PJM5900, the foundation course is located at the bottom left of the graph which suggests using the predictive approach. On the bottom left, courses with 6 weeks of length are suggested to use the agile approach. On the top left, PJM6910, the capstone course is suggested to use the incremental approach. To be clear, the concept of the hybrid development approach is the same as the adaptive learning approach in this essay. Later, the passage will show the evidence of applying the learning approaches with the courses using the observation method.

3.1. Predictive Approach

During the first quarter of the program, it is required to take the course PJM5900 Foundations of Project Management as for project management major. This foundation course aims to provide a comprehensive summary of the 10 knowledge areas and 5 project process groups refer to the PMBOK within 12 weeks. In addition, another course objective is to get familiar with a commonly used project management software which is called Microsoft Project. Although the course learning goal and the requirements are very certain, the students might lack the technical knowledge and skills, in the beginning, to deliver those course outcomes because it is the first course taken in this program. Fortunately, the predictive approach handles this problem by transfer all the planning tasks from students to the instructors. The students have the opportunities to learn step by step through weekly assignments as the instructor planned. It helps to build a solid foundation of professional knowledge at the beginning of the program.

Under the predictive approach, the new course will be proposed by the course director during the initiating phase as *Fig. 2* shows. Next, the course director or the course designer will design the course outline and content using the standard template from the faculty. In brief, the template of the syllabus is a good example of using the project governance methodology. The course syllabus demonstrates the basic content of the course which includes sections such as course description, required textbooks, course prerequisites, course learning outcomes, course methodology, class schedule table with the weekly plan, and evaluation standards, etc. After each section is assigned with an instructor, the instructors can adjust the syllabus partially according to their needs and preference, such as weekly schedule and discussion board rules. The executing phase begins as the course begins. In the first week of the course, the instructors must finalize the course syllabus and send it to the students for course preparation. Then the instructors focus on lecturing as well as monitoring and controlling the students'

performance while the students deliver weekly learning outcomes as the syllabus planned. During the sixth week of the course, there is a midterm that covers the first half content of the course. In the last week of the course, there is a final exam, an inspection of the software lab assignment, and a group presentation. In addition, a performance review will be provided completely transparent between the students and the instructor which enhances the lessons learned of the students. The course ends as planned with a final letter grade on the transcript.



Figure 2 Predictive Approach

3.2. Agile Approach

Most of the courses in the program are 6-weeks based and include lots of case studies. Unlike the foundation courses with a predictive approach, courses with 6 weeks' length are more adaptive and focus on specific knowledge area of the major. During the first week of the area course, students group into teams and develop a team charter. Then the instructor assigns a case study or a project scenario to each team. After analyzing the case or the project background, the team holds a group meeting to develop a product backlog. Moreover, user stories listed in the product backlog will be prioritized and formed weekly sprint. The knowledge area course use a week as the sprint length or the time box. Through the quality cycle, Plan-Do-Check-Act [7], the team delivers increments to the instructor and might revise the sprint backlog when receiving feedback from the instructor weekly. In the end, the final outcome will be generated in week 6 for a comprehensive evaluation.

Based on the observation, in the agile approach, the course instructor acts like a scrum master to motivate the team with agile methodology. One member of the team takes the role of a product owner to collect requirements from the stakeholders as well as manage product and sprint backlogs. The other members of the team act as the development team to deliver the increments to the project weekly. In contrast with the predictive approach, in which the instructor is responsible for all the planning, in the agile approach, students execute the PDCA cycle on their own. Rather than the instructor directs the students to finish all the tasks, students have the opportunity of trial and error. So that they can conclude lessons learned more effectively and avoid making the same mistake the next

time. As Fig.5 shows, through several sprints, students can obtain continuous improvement from the course.

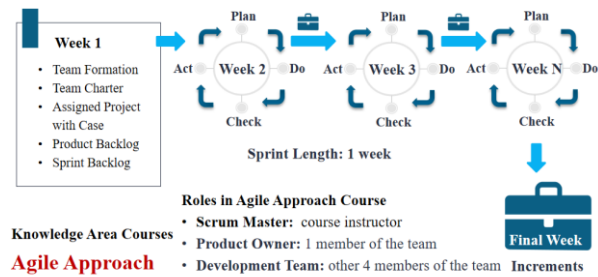


Figure 3 Agile Approach

3.3. Incremental Approach

PJM6910 Capstones is the last required course of the program. It usually links with an XN Project which the students will work with a sponsor from a company to develop a real-world applicable project plan. The outcome of the course is to develop an integrated project plan which includes the management plans of the 10 knowledge areas. After forming the project team, the team develops a team charter and a project charter. Each week after, the project team will deliver increment to the project. The size of the increments might differ among the period. The project team will go through the process of analyzing, designing, building, testing, and delivering the increment as Fig.4 shows.

Among 12 weeks, the instructor will schedule several meetings between the students and the project sponsor to discuss the stakeholders' requirements. The sponsor reviews the increment biweekly. Sometimes the sponsor might reject the increment and cause rework. At the end of the course, the team will present the final solution along with the integrated project plan to the sponsor. In addition, in the final week, the instructor will lead the class to hold a lessons learned meeting. It enables the students to communicate their ideas and feedback for the course.

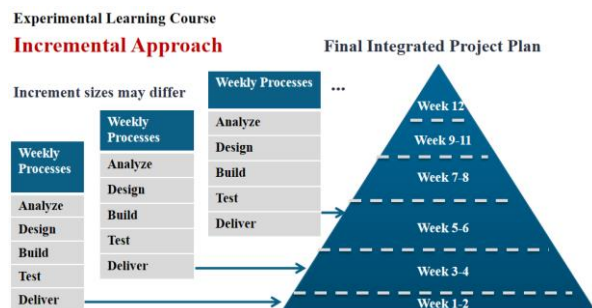


Figure 4 Incremental Approach

In addition to the observation, a questionnaire was conducted on a sample size of 22 graduate students in the program. The questionnaire helps to determine the students' level of knowledge and skills acquired from the

course using rating range from 1 the lowest to 10 the highest. As Fig.5 shows, the program timeline is on the X-axes, and the level of knowledge proficiency is on the Y-axes. The points with data labeled are the mean of the rating over time. The line begins with a mean of 3.05 which indicates a low level of knowledge proficiency in project management and ends with 8.3, a relatively high level of knowledge proficiency.

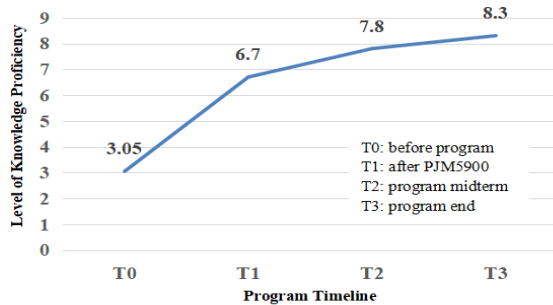


Figure 5 Learning Curve of Students

In the line chart, the slope illustrates that the speed of learning and application skills obtained by the students or the level of knowledge proficiency is changing along the program time. By analyzing the slope of each time section, it is found that section T0 to T1 has the highest slope by adopting the predictive approach followed by T1 to T2 using the agile approach. The trend became more and more flatten during T2 to T3 with the incremental approach. The graph indicates that there is a correlation between the learning speed and the suggested learning approach.

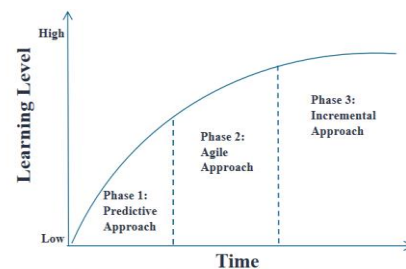
4. ADAPTIVE LEARNING MODEL

According to the statistic analysis and the assumption verification, the essay proposes a adaptive learning model called PAI that can be used for application-oriented talent training and common systematic learning. This model adapts a combination of learning approaches during different phases of the learning curve to help maximizing the effectiveness and efficiency of training. The order of the approaches is predictive, agile, and incremental. Next, the essay will summary the condition of applying different approach with the phases as the table in Fig.6 shows.

To begin with, the predictive approach works well when both the technical degree of uncertainty and requirement uncertainty are low. In the teaching system, this situation usually takes place in the foundation course in which the students are not familiar with the knowledge and skills of the major. So that the course director and the instructors are responsible for the course planning and monitoring the students' progress along with the course. Furthermore, the agile development approach works well when the uncertainty of the requirements is low and the technical uncertainty is high as the Stacey Matrix shows. This situation usually happens when the students are new to the technical methodology but are clear about the

project goal and requirements. After accumulating knowledge and enhancing skills in the previous courses, students can lead a project through a full project life-cycle. In the last course, the technical degree of uncertainty is low. However, the uncertainty of agreement is high because it takes time to elicit the expectations and then, to form the expectation into clear requirements from the project stakeholders. The Stacey Matrix reveals that the incremental approach suits this situation the best.

The essay demonstrates the progress of learning using the PAI adaptive learning model as Fig.6 shows. At the beginning of the program, the predictive approach helps the students to grow their learning curve rapidly. The first course builds a solid foundation that enables the students to obtain the necessary professional knowledge and software skills related to the major. Then through agile approach with the knowledge area courses, students practice working in a group repetitively and quickly iterate learning outcomes. The students gather good practices from success and lessons learned from failure. By applying the PDCA cycle, the students can improve their self-learning ability [7]. At the end of the program, the course integrates with an XN Project that offers the opportunity to work on a project with a corporation. After participating in the program, the students are well-equipped with both application knowledge and skills to walk into the career field.



Factors/Phases	Phase 1	Phase 2	Phase 3
Focus	Foundation	Knowledge Areas	Experimental Learning
Technical Uncertainty	Low	High	Low
Agreement Uncertainty	Low	Low	High

Figure 6 Learning Curve of Students

5. MODEL CONSTRAINTS

Some enterprise environmental factors could affect the effectiveness of the adaptive learning model, for examples, curriculum provision and evaluation system. The essay provides some best practices of using the factors to create a positive effect to the talent training.

5.1. Diversified Curriculum System

In the program curriculum system, each course category has its utility. The three main course categories are the required courses, elective courses, and concentration courses. Firstly, the required courses help to build a solid foundation of the project management

body of knowledge. Secondly, concentration courses assist the students to be well equipped with tools and techniques in the career domain they are interested in. Lastly, the elective courses support the students with experimental learning and motivate their interests. The program considers the level of difficulty when designing the hierarchy of the course [5].

5.2. Interactive Evaluation System

Another good example of using the environmental factor is to operate an interactive evaluation system. The evaluation system of the master program contains two areas which are course evaluation measures and course monitoring. The instructor provides a full description of the course evaluation standard in the syllabus for students' reference. The college has offered a standardized grading matrix in the syllabus template to eliminate the difference between class sections. Furthermore, for both writing assignments and oral presentations, there will be a specific rubric for evaluation. The rubric helps to quantify the assignment standard with different elements such as requirements, clarity, formatting, personal competencies, and grammar. By receiving feedback from the instructor frequently, the students can get continuous improvement.

The program also designs some policies to monitor and control student's performance. Firstly, the students must follow the academic honesty and integrity rules during the program, for example, no cheating and plagiarism. In the first week, the students either sign the academic integrity contract or complete an academic integrity quiz online. Moreover, the program emphasizes professional ethic and promote Code of Ethics and Professional Conduct. The important values of the Code are responsibility, honesty, fairness, and respect [2]. Lastly, the program also utilizes exam monitoring software to monitor student's behavior during the exam. The comprehensive evaluation system helps to create a learning environment with fairness and high transparency of the information.

6. CONCLUSION

In conclusion, the essay uses the Master Program of Northeastern University as an example to explore the innovative talent training methodology. The essay proposes a new adaptive learning model that can be used for maximizing the effectiveness and efficiency of the application-oriented talent training after using the observation method and statistical analysis. Further study can be conducted on the simulation of the phase interchange to help the students to adjust their course planning with learning level. In addition, it is worth exploring more ways of utilizing the positive effect of inputting enterprise environmental factors.

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