

## *Agile-Model Based Dynamic Curriculum Development and Refinement Approach*

Leon Pan, University of the Fraser Valley, Canada

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### **Abstract**

This paper presents an Agile-Model based dynamic curriculum optimization approach, which contains a number of iterations each of which achieves one of the course learning objectives. The curriculum is dynamically refined and enhanced in each iteration to best suit the students' background and the current iteration learning objective. Each iteration is organized into four phases and the sample activities in each phase are specified in detail. A step-by-step easy-to-follow guidance, which leads to adaptive high quality curriculums, is also presented. It is expected that the teaching and learning outcomes will be promoted significantly by applying this system.

Keywords: Agile-Model, Dynamic Curriculum Development, Iterative Development

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## **Introduction**

Curriculum development is one of the mandatory tasks for every educator. The quality of curriculums plays a key role in the success of teaching and learning. Dysfunctional curriculums not only degrade learning outcomes but also result in students complains. A good curriculum, on the other hand, satisfies the requirements of teachers and students, helps them establish good learning environment, and promote good teaching and learning outcomes.

Realizing the importance of curriculums in the education, many educators and researchers are attracted to this field and significant efforts have been made on developing high quality curriculums (Hall, 2016; Gobbett, 2016; Riel, Lawless, Brown, & Lynn, 2015; Byrum, 2014; Kim, & Habibie, 2014; Pan, 2015; Delaney, Lee, & Bos, 2017). Universities and other educational organizations also provide assistances, including workshops and online guidance, to facilitate the curriculum development. Many institutions established rules and rigorous procedures of curriculum development and improvement. However, a curriculum is by no means static. No single curriculum can meet every student's requirements and suit for all situations. Curriculums should actually be under continuous refinement in order to adapt to the constantly changing environment, including the demographic of students. Thus, the effective method and guidance that assist dynamic curriculum optimization are required.

This paper proposes a dynamic curriculum honing system based on Agile model, which is a widely used software engineering model (Schach, 2010; Sommerville, 2015). The system is composed of a number of iterations each of which is divided into four phases. Different tasks and activities are conducted in each of these phases. It is the author's hope that this research will lead to dynamically adaptive high quality curriculums and the best teaching and learning outcomes. The rest of the paper is organized as the following. Section 2 briefly reviews the agile methodology. In section 3, an Agile-Model based curriculum optimization system is presented. Section 4 points out the future work. And section 5 concludes the paper.

## **Review of Agile Methodology**

Agile method requires that each project is handled in different way and the existing methods are tailored to best fit the project requirements. Agile model adopts iterative development and a project development is divided into iterations (small time frame) each of which goes through a number of phases: plan, analysis, design, implement, and test. Part of current iteration input is from the previous iteration outcomes which are refined in current iteration. A working software build is delivered at the end of each iteration which is composed of accumulative features implemented so far in all of the previous iterations. The final build includes all the features specified in the system requirements. Figure one illustrates how agile model works.

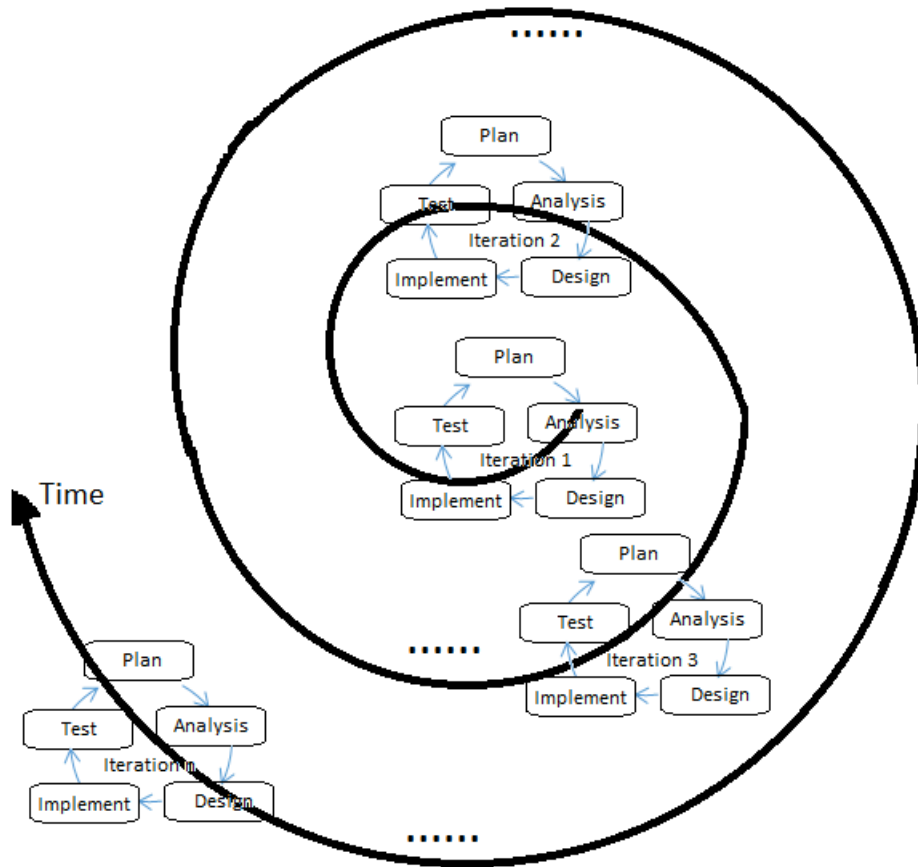


Figure 1: Agile Model: an iterative and incremental method

Agile model advocates adaptive planning, evolutionary development, early delivery, and continuous improvement and self-adaptive; and it encourages rapid and flexible response to change ([https://en.wikipedia.org/wiki/Agile\\_software\\_development](https://en.wikipedia.org/wiki/Agile_software_development), n.d). Because of these characteristics, it can be well applied in other situations, such as dynamic curriculum enhancement.

### **An Agile-Model Based Curriculum optimization System**

The proposed method, which adopts and extends the agile model, provides a way to dynamically optimizing new and existing curriculums in order to exert the teachers and students greatest potentials. A number of study iterations are designed each of which achieves a specific teaching and learning objective. Each iteration is divided into four phases: plan, design, implement, and test. Teachers and students are constantly optimizing the teaching and learning activities in these iterations. Students are now active participants rather than solely passive learner. This method is especially applicable to the passionate and devoted teachers and motivated students.

In the system, the initial course plan developed up-front is no long rigid. Instead, teaching objectives are better achieved by continuously adjusting and refining the teaching materials, including tasks (e.g. practice and assignments), activities (e.g. experiments, tests, and group discussions), and teaching method (e.g. lecture, hand-on demo, academic field trip) according to the teaching objective(s), students'

background, students' progress in the previous study iteration, and resources available. Figure two summarizes the method.

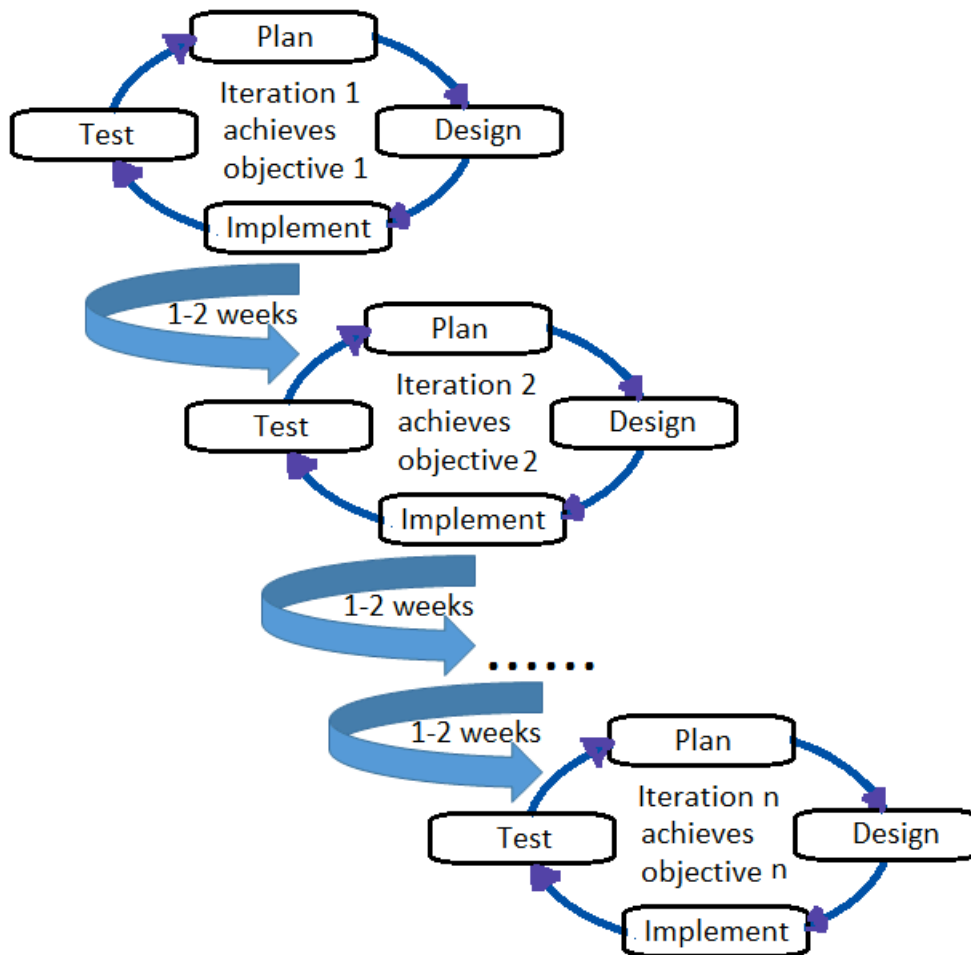


Figure 2: Agile-Model Based Curriculum Optimization System

The proposed method focuses on the teaching objectives which are achieved in a number of iterations. To promote the best teaching and learning outcomes, a curriculum is dynamically adapted in each iteration based on students' background and progress, learning objectives, and resources available. A test or other similar activity is performed at the end of each iteration which is used as the students' progress input of the next iteration. The recommended steps and activities in each of the four phases in every iteration are detailed as the following.

1. The sample activities in plan phase:
  - a. Determine the input for current iteration by
    - i. Performing survey or pretest at the beginning of the semester to get the students' background information (only for the first iteration)
    - ii. Getting the outcomes from the previous iteration(s) (Start from the second iteration)
    - iii. Performing end of iteration test or other similar activities to evaluate students' progress

- iv. Determining the weight of each of the course objectives: the current iteration objective weighs at least 60%; the longer in the future of an objective, the less weight of it.
    - v. Determining the resources availability.
- 2. The sample activities in design phase:
  - a. Refining the following teaching materials based on the input of plan phase
    - i. Lecture notes
    - ii. Suggested readings
    - iii. Practices, hand-on lab, and homework
  - b. Determining the best delivery methods:
    - i. Lecture
    - ii. Group project
    - iii. Educational field trip
    - iv. Self-study
    - v. Guest-speaker
    - vi. Lab demonstration
  - c. Finalizing evaluation measures
    - i. Exams and quizzes
    - ii. Oral test and presentation
    - iii. Homework
    - iv. Term project(s)
- 3. The sample activities in implement phase:
  - a. Delivery the course in an appropriate way
    - i. Online
    - ii. Hybrid
    - iii. Face-to-face
    - iv. Distance learning
    - v. Lab session
- 4. The sample activities in test phase:
  - a. Perform quiz or test
  - b. Perform oral test or presentation
  - c. Evaluate students homework and/project

Note:

- 1. The activities here are not exhaustive.
- 2. The test phase outcomes of the current iteration is partial input of the next iteration.

The guidance presented above is “agile” in the sense that the method itself can be adapted to meet the requirements of different teaching subjects and teaching styles. Additional steps and activities may be added while irrelevant ones can be removed. The system is aimed at dynamic high quality curriculums and the best learning outcomes. Nevertheless, responsible teachers and ambitious students are decisive factors of successfully applying this method.

## **Future Work**

The opportunities of applying software engineering models into new applications are endless. Software engineering itself as a young discipline is still developing rapidly in many directions. In the future, efforts will be made to explore the application of the new models developed in this field to further promote teaching and learning process. Also, experiments will be conducted to validate and refine the proposed method and more details will be added. In addition, computer-aided automatic curriculum development and refinement system will be explored, designed, and developed

## **Conclusion**

The proposed agile-model based system aims at providing teachers guidance to dynamically enhance curriculum. It is the author's hope that this system will result in adaptive high quality curriculums and promote teaching and learning significantly.

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