

# The Agility of Agile Methodology for Teaching and Learning Activities

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**Abstract**— This paper presents the review of literatures that shows the contribution of the agile methodology towards teaching and learning environment at university level. Teaching and learning at university has since migrated from traditional learning to active learning methodology where students are expected to learn by doing rather than listening passively to lectures alone. The agile methodology naturally has promoted the active participation of team members during system development phases. The nature of agile development methodology has been identified as abundantly compatible and supportive towards active academic learning. Some literature have proposed ways of adopting agile into active learning to improve teaching and learning processes and have highlighted this method as a great success. With the review presented in this paper, we would like to highlight how efficient the agile concept is in tackling several situations in academic learning as shown by an interesting mapping of agile principles to the classroom environment. With that, we hope to bring more options to improve active teaching and learning delivery by adopting agile methodology. On the other hand, few papers have used the academic environment to measure the agile principles. By highlighting this, we offer options for the agile evaluation framework to consider academic environment as a tool to obtain the agile performance feedback.

**Keywords**— Agile, agile education, agile e-learning, teaching and learning, active learning

## I. INTRODUCTION

Traditional teaching and learning have most often than not neglected the concept of active teaching and learning in academic environment. For decades, the academic community has been conducting researches and experiments in order to increase students' participation during their learning in the classroom [7]. Recent studies show the usage of technology, team discussion and knowledge sharing session have become favorite options to promote active learning concept. Where the lecturer is the immediate source of the knowledge in the traditional learning, the active learning concept encourages lecturer to become the facilitator between the students and the knowledge itself. Active learning requires students to be independent in getting the basic knowledge by searching the resources online or offline and discussing with classmates [8][9][10][11]. Lecturers provide clarification on what the students have learnt on their own and emphasize more on providing higher level of thinking, as well as facilitate students in overcoming challenges in learning new concepts.

The relationship of lecturer, knowledge and student is reflected in Fig.1 and Fig.2.

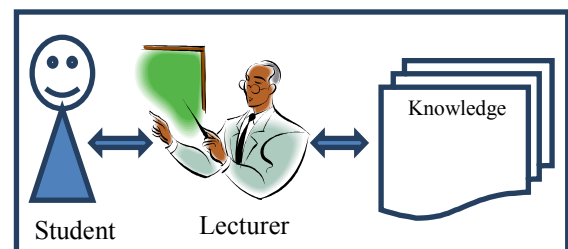


Fig. 1. Traditional Learning

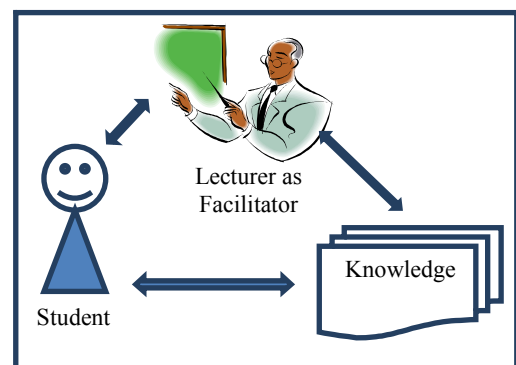


Fig. 2. Active Learning.

The agile methodology has been introduced in the academic environment as a topic or subject for computer science students to learn about developing good software in a timely manner to satisfy client's requirement. The agile methodology underlines direct and frequent communication between client and developer through its incremental processes. The proposed solutions are evolved through communication and collaboration of organizations and teams. Therefore, the key success of agile methodology relies on communication among team members and the ability to adapt to rapid changes [1][2][3].

As teaching agile is part of the curriculum in many computing classes, some educational practitioners have started research on the efficient techniques to teach any subject to students using agile methodology. By embracing a variety of tools and techniques, teaching using agile method has become an interesting topic of discussion among lecturers and instructors. Some lecturers and instructors have begun

conducting experiments in teaching by adopting the agile concept itself.

## II. RESEARCH QUESTIONS

The present research aims to collect previous works that have examined the use of agile methodology to improve the teaching and learning delivery. The following research questions (RQ) are therefore raised:

- RQ1. What are the main goals of previous researches on teaching and learning?
- RQ2. What are the suggested approaches and methods used to improve teaching and learning?
- RQ3. How were the previous researches conducted?
- RQ4. What are the case studies or datasets used?
- RQ5. Would it be possible to carry forward the previous research into a new method for teaching and learning?

## III. AGILE PRINCIPLES AND CLASSROOM ENVIRONMENT

John C. Stewart is the main author of a paper [1] that exposed his study regarding evaluating agile principle in active and cooperative learning environment. This is a big effort that may offer the agile evaluation framework in an actual classroom environment and may reflect the same concept of what is known as agile principle. Starting from extracted values available in the Agile Manifesto, the study proposes the new values of agile pedagogy that constitute modern teaching and learning methodology.

The values of the agile pedagogy extracted from the values of agile manifesto are:

1. Students over traditional processes and tools. (Agile manifesto value: Individuals and interactions over processes and tools).
2. Working project over comprehensive documentation (Agile manifesto value: Working software over comprehensive documentation)
3. Student and instructor collaboration over rigid course syllabi. (Agile manifesto value: customer collaboration over contract negotiation)
4. Responding to feedback rather than following a plan. (Agile manifesto value: Responding to change over following a plan).

There are 12 items of agile principles that is found to be well-suited and adoptable towards classroom environment. The mapping is shown in Table I.

This mapping has given the idea on the compatibility of agile manifesto in a pedagogy environment. From here, the study suggests framework of practices that promote teaching and learning to become more agile since it effectively focuses on student-centric approach. Besides that, the similarities of software development methodology and educational methodology are effortlessly seen in Table I.

TABLE I. MAPPING OF AGILE MANIFESTO TO PEDAGOGICAL ENVIRONMENT ADOPTED FROM [1]

Principles of the Agile Manifesto	Corollary to the Pedagogical Environment
Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.	Our highest priority is to prepare the student to contribute to an organization through continuous delivery of course components that reflects competence.
Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.	The instructor and students welcome and adapt to changes even late in the semester. Agile pedagogical methods use problems and change as an opportunity to facilitate learning and better develop marketable skills in the students.
Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.	Requiring working deliverables from the students over short time periods allowing for frequent feedback and guided problem solving and experimentation.
Business people and developers must work together daily throughout the project.	There is iterative interaction between the instructor and students (or student groups) throughout the course.
Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.	Trust that most students are motivated. Give them the environment and support necessary for them to be successful.
The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.	To the extent possible, allow for direct face-to-face interaction with students or student groups.

<b>Principles of the Agile Manifesto</b>	<b>Corollary to the Pedagogical Environment</b>
Working software is the primary measure of progress.	Working deliverables (i.e. models, software, project deliverables, presentations, etc.) are the primary measure of student progress (not necessarily midterm & final exams that require rote learning and memorization).
Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.	The cooperative learning environment where students actively seek guidance and tools to solve problems is the basis for teaching the skills needed for life-long learning.
Continuous attention to technical excellence and good design enhances agility.	Continuous attention to technical excellence and good design enhances learning.
Simplicity--the art of maximizing the amount of work not done--is essential.	While in education there is some value in exploring subjects in-depth just because there is student interest, however, understanding the problem and solving it simply and clearly is essential
The best architectures, requirements, and designs emerge from self-organizing teams.	Student groups and teams should self-organize, but all should participate equally in the effort of learning.
At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.	At regular intervals, the students and instructor reflect and offer feedback on how to be more effective. All stakeholders then adjust accordingly with the goal of being more effective.

#### IV. AGILE METHODOLOGY TOWARDS TEACHING AND LEARNING TECHNIQUES

Mario Vacca [3] from Italy proposed Extreme Programming instructional design that combines good practices formulated from project based learning and agile instructional design. This research design accommodates the inadequacy of current instructional design to face challenges of 21st century way of teaching and learning. Not only as an instructional design, but this research has also attempted the agile management and learning project. At this point, the agile

and extreme programming principles are adapted to the instructional design context and the problem based learning. The instructional design process is therefore viewed as constituted by roles (students, teachers and headmaster, parents, consultants, etc.) each of them performing some activities (lecturing, checking, solving problems, discussions, exercises, personal study, presentation production, etc.). The result was reported as successful in introducing new concepts such as collective instructional design, active transparency and active role of students and their parents.

Alvaro Soria [5] from Argentina proposed technique to improve the delivery of Software Engineering subject in university by using agile management. This study was intended to address the problem and bridge the gap between academic and professional context. The widespread of agile approaches such as Scrum and Agile Coaching are become teaching models able to cover the other model such as RUP (rational unified process). By using CMMI (Capability Maturity Model Integration) as assessment reference, this evolutionary process accomplished high level of CMMI maturity for students in developing software.

Dagmar Monet [6] from Germany introduced agile project-based teaching and learning where the experiences were reportedly undertaken for 4 years. The project-based approach allows students to work with realistic project through which they learn agile concepts more efficiently by doing collaborative and self-organizing team.

John C. Stewart et al [1] states that Jigsaw method can be likened to cooperative learning. Using Jigsaw method, students work in small groups that primarily do some acquisition and presentation of new materials, review or participate in informed debate. Stewart et al shows that Jigsaw has major correspondence with XP and Scrum in agile concept. Group members depend on their own collaboration to accomplish tasks. Stewart et al mentioned that the effective group members naturally assemble different strength and expertise, experience and knowledge, perspective and personalities. The role of lecturer has changed dramatically from source of knowledge to facilitator that discusses alternatives when groups are unhappy with their original plan, for example. Leading the class to summarize their discussion, making sure all group members participate and concluding the learning points are other roles of the lecturer.

Astonishingly, the agile concept has been adopted in e-learning environment as well. Michael Tesar is the main author and Stefani Sieber the co-author of [4]. Tesar and Sieber utilized agile e-learning environment to achieve high quality blended learning scenarios. The agile manifesto turns out to be a guideline for the agile e-learning scenario. The comparison of traditional project management, agile manifesto and the inferred principles for agile e-learning development is presented in the Table II below.

TABLE II. THE AGILE E-LEARNING DEVELOPMENT ADOPTED BY [4]

Traditional Project Management (Agile Manifesto, 2010)	Manifesto for Agile Software Development (Agile Manifesto, 2010)	Agile E-Learning Development
Processes and Tools	Individuals and Interactions	Personalised Learning Processes
Comprehensive Documentation	Working Software	Usability of Learning Utilities
Contract Negotiation	Customer Collaboration	Learner Centred Design
Following a Plan	Responding to Change	Flexible Course Concepts

On the other hand, the ATLM (The Agile Teaching and Learning Methodology) has been designed and used in the City University of Hong Kong [2]. This paper explains the process architecture and objectives of the ATLM that emphasizes on agility, communication and learning processes. The e-learning platform and the technologies used provide great support on modern collaboration and knowledge sharing technologies. Some popular applications are introduced on the agile e-learning concept such as blogging, instant messaging, discussion forum, video conferencing, wiki and XML RSS.

Teaching cycle and learning cycle are the main concepts of ATLM that consists of iterative processes as shown below in Fig.2. Teaching cycle is about adjusting and monitoring lecture activities and tutorials, while the learning cycle is about sharing, practicing what has been learnt in assignments and independent studying. Adjusting and monitoring is actually the lecturers' effort to monitor students' progress and provide/obtain feedback as the main input for the next teaching cycle. The sharing, practices and independent study is students' effort to acquire knowledge, skill and enhance the learning experience. The ATLM is definitely student centric with the lecturer as facilitator.

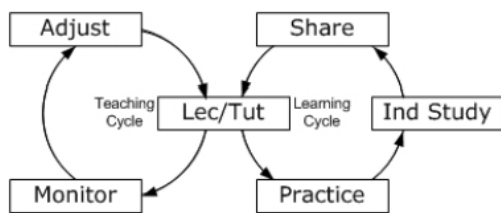


Fig. 3. Iterative Processes for ATLM adopted from [2]

This paper has also stressed the teaching and learning best practices that consist of learning by sharing, teaching how to learn and using feedback to make necessary changes in ATLM when required. Feedback actually makes the ATLM more agile.

Table III depicts information about the overall literatures upon research questions 1,2 and 3. Majority of the previous research aimed to improve teaching while [10] provided insights about the current practice of the agile performance review and proposed solutions to achieve a better review.

Various approaches and methods have been employed for many types of learning and it promises successful results. Most previous works use mapping concept of agile methodology and learning activities to ensure the proposed framework is applicable. Literature [3] even came out with a new systematic instructional design that is essential for teachers/lecturers to carry out their lessons for the day.

TABLE III. THE PREVIOUS WORKS TOWARDS THE RESEARCH QUESTIONS 1-2-3

References	RQ1 Improve teaching & learning	RQ2 Approaches/ Methods RQ3 Data Sets or Case Studies
[1]	✓	Cooperative Learning with Jigsaw Methods for the Pace University students populations
[2]	✓	E-learning as platform of implementing ATLM for computer science courses
[3]	✓	New agile instructional design methodology by combining agile methodologies and some features of XP
[4]	✓	Using agile concept for blended learning scenario with the adoption of e-learning scenario
[5]	✓	Teaching students effectively with the Scrum and agile coaching principles
[6]	✓	Agile-based project in courses for the students in Berlin School of Economics and Law
[7]	✓	A new method for teaching agile project management and similar subjects in higher education.
[8]	✓	An innovative method of teaching agile by using agile principles
[9]	✓	Agile approaches as alternative on learning
[10]	Improving current performance review in a company	Reflections and new solution of doing things right for agile performance review.
[11]	✓	Flipped classroom with agile methodologies to promote problem solving in class.

The other research questions are addressed by literatures [1] to [7]. The summary is presented in Table IV below.

Our institution, INTI International University, rolled out student centred learning approach in May 2010. Centre for Instructional and Technology Support (CITS) has conducted trainings to support lecturers in implementing student centred learning teaching strategies. Listed below are some of the strategies introduced to the lecturers.

1. Small Group Discussion
2. Problem-based Learning
3. Blended Learning
4. Cooperative Learning
5. Online Forum Discussion
6. Debate

7. Drama and Project
8. Field Trip
9. Role Playing
10. Peer Collaboration Learning
11. Reciprocal Peer Tutoring
12. Podcast
13. Lecture and Tutorial

The adoption of agile methodology by previous works proves to be in line with the strategies and justifies the flexibility of agile methodology to be adopted in universities.

TABLE IV. THE PREVIOUS WORKS TOWARDS PRESENT RESEARCH QUESTIONS

References	Addressing Research Questions
[1]	RQ-1, RQ-2, RQ-3, RQ-4, RQ-5
[2]	RQ-1, RQ-2, RQ-3, RQ-4, RQ-5
[3]	RQ-1, RQ-2, RQ-3, RQ-4, RQ-5
[4]	RQ-1, RQ-2, RQ-3, RQ-4, RQ-5
[5]	RQ-1, RQ-2, RQ-3, RQ-4, RQ-5
[6]	RQ-1, RQ-2, RQ-3, RQ-4, RQ-5
[7]	RQ-1, RQ-2, RQ-3, RQ-4, RQ-5
[8]	RQ-1, RQ-2, RQ-4, RQ-5
[9]	RQ-1, RQ-2, RQ-4, RQ-5
[10]	RQ-1, RQ-2, RQ-4, RQ-5
[11]	RQ-1, RQ-2, RQ-4, RQ-5

The mapping of literatures towards student centred learning strategies is shown in Table V below.

TABLE V. THE STUDENT CENTRED STRATEGIES TOWARDS AGILE BASED TEACHING AND LEARNING

Student Centred Strategies	References
1. Small Group Discussion	[1][2][3][4][5][6][7][8][9][10][11]
2. Problem-based Learning	[1][2][3][4][5][6][7]
3. Blended Learning	[4]
4. Cooperative Learning	[1]
5. Online Forum Discussion	[2][4]
6. Debate	-
7. Drama and Project	-
8. Field Trip	-
9. Role Playing	-
10. Peer Collaboration Learning	[1][2][3][4][5][6][7][8][9][10][11]
11. Reciprocal Peer Tutoring	-
12. Podcast	-
13. Lecture and Tutorial	[1][2][3][4][5][6][7][8][9][10][11]

## V. CONCLUSION & FUTURE WORKS

From the above discussion, we can see how the agile manifesto and its values have greatly influenced and improved the variety of teaching and learning in university that promotes active learning. Consequently, those experiences have offered some points on how to exploit the opportunity to use learning environment to evaluate agile principles since both of software development and teaching and learning share almost similar values in its operation.

Research in this paper is generally conducted as motivation for our university research to explore the alternative teaching and learning model to support active learning environment by adopting agile concept.

At the moment, our university looks into the concept of flipped classroom and according to our preliminary research flipped classroom is also related with agile processes with regards to daily scrum meeting, sprint planning meeting, sprint and sprint review and lastly sprint retrospective meeting. This future work is similar with an article written by Sarah Dillard [11]. Our future research will look into this direction as part of teaching and learning improvement in the context of flipped classroom.

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