Applying Agile Across the IT Curriculum

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Abstract

Agile is emerging as a new paradigm for organizations across a variety of industry sectors because Agile helps teams manage and adapt quickly to change. In order to provide our students with workforce ready skills and better performance in group projects, a regional campus Computer and Information Technology (CIT) department began implementing Agile across its curriculum. After a visit to a local business who underwent an Agile transformation and is now using Agile for all their teams, they said that understanding the culture of Agile is more important than the practices themselves. Revising our curriculum allows us to give our students the advantage of learning how to be Agile and what it means to thrive in an Agile culture.

Keywords: Agile, Curriculum Development

1. INTRODUCTION

An IS/IT education program at a public university is incorporating the Agile way of working into its curriculum to meet industry demand and to improve teaching and learning outcomes. Agile continues to be the leader in organizational transformations due to its ability to rapidly respond to change, no matter the industry sector. According to ICAgile, "agile is not a process, methodology, or framework; it is a mindset that welcomes uncertainty, embraces challenges, empowers individuals, and views failure as a learning opportunity. Adopting an agile mindset unleashes the brilliance of people and teams, which enables rapid discovery and faster innovation" (ICAgile, Mission, n.d.). In order to prepare our students for the IS/IT workforce, we have evaluated every course in our curriculum and incorporated Agile values and practices into them. We have also developed an Agile concentration in our department that offers three different ICAgile certifications. The IS/IT faculty are even using Agile to advance strategic planning initiatives, manage department meetings, and help other campus departments with their goals. If we are going to teach Agile, our department and our faculty must become Agile.

2. MOTIVATION

An Agile organization is starting to emerge as the new leading organizational paradigm (Ahgina, De Smet, Lackey, Lurie, & Muraka, 2018). Based on industry reports, the shift to organizational Agility is a direct result of the rapid changes in "competition, demand, technology, and regulations" (McKinsey, 2017, p. 1). According to a 2017 McKinsey Global Survey on organizational agility, two-thirds of respondents indicated their business sector is characterized by rapid change. This new "normal" of rapid change means that organizations need to respond and adapt quickly in order to remain competitive. The need for

"organizational agility," which McKinsey (2017, p.1) defines as "the ability to quickly reconfigure strategy, structure, processes, people, and technology toward value-creating and value-protecting opportunities," is becoming a need in industry. Even though the business environment is changing, organizations are lagging in implementing Agile practices to help them respond to change (McKinsey, 2017).

While companies are struggling to transform their workforce to an agile organization, being Agile is a top priority (McKinsey, 2017). The success of an organization's Agile transformation depends highly on the culture. A 2018 McKinsey report found that only four percent of organizations have completed an organization-wide Agile transformation. The number one problem cited by the companies who failed is culture (De Smet, 2018). Becoming an Agile organization is a threat to middle management, which is often there to communicate, guide, and control (De Smet, 2018). In an Agile organization, teams are self-organized, and there is no "manager," which is a threat to middle management. This threat can cause the transformation to stall as employees struggle with their new roles. The Agile way of working also challenges the non-management employees as well. They are used to having a manager approve most decisions, but in Agile, teams are empowered to make their own decisions, which requires a change in culture and thinking.

Eighty-one percent of organizations who have successfully completed an Agile transformation report that they have seen a "moderate or significant increase in overall performance" (McKinsey, 2017, p.2). After adopting Agile, organizations reported seeing improvements in many areas (only the top five are reported here): 71% reported improvement in the ability to manage changing priorities; 66% reported an increase in project visibility; 65% reported an increase in business/IT alignment; 62% reported an increase in getting product to market; 61% reported an increase in team productivity (VersionOne, 2017).

Agile improves the productivity of groups across the enterprise (Comella-Dorda, Kaur, & Zaidi, 2019). Agile teams are more successful because the Agile way of working helps them focus on a small set of strategic priorities, helps teams to have clear goals, accelerates planning cycles and reallocate resources, and enables self-organized teams. This same success has been reported in group work in higher education settings (Woods & Hulshult, 2018; Hulshult & Krehbiel, 2019). These recent research studies have found that students who are taught by instructors who use Agile practices and techniques in the postsecondary classroom have enhanced learning experience and outcomes. Hulshult and Krehbiel's (2019) research found that Agile helped to improve the quality of student group projects and enhanced their learning. A 2017 study reported that students credited the use of Agile in the classroom with a more effective learning experience and more efficient use of their time. This same study also reported that students credited Agile with enhancing teamwork on group projects and the quality of class project deliverables (Krehbiel, Salzarulo, Cosmah, Forren, Gannod, Havelka, Hulshult, & Merhout, 2017). Agile scholarship is also increasing in higher education. Agile methods are being used in courses in computer science, software engineering, information systems management, supply chain management, technical writing, early childhood education, civic studies, and political science (Krehbiel et al., 2017). Pope-Ruark (2012) has successfully used Agile practices in her English classes in complex group projects to encourage trust, engagement, and accountability among students.

We have begun to implement Agile across our Computer and Information Technology (CIT) curriculum to better prepare our students for an Agile workforce and help their performance in group projects. After speaking with several employees who work for an Agile company, they said that understanding the culture of Agile is more important than the practices themselves. Evaluating our curriculum allowed us to give our students the advantage of learning how to be Agile and what it means to thrive in an Agile culture.

3. CURRICULUM PLANS

Adding Agile practices to our curriculum has two main parts. One part involves revision of existing courses to include the use of Agile practices, teaching of Agile concepts, and activities designed to develop an Agile mindset in students. The other part involved designing an Agile concentration to allow interested students to explore Agile in depth. The department is also engaged in a number of activities to support these efforts.

Current Curriculum

The Computer and Information Technology (CIT) department offerings include a Bachelor of Science in information technology with majors in either Information Technology or Health Information Technology (HIT). We also offer an associate in applied science degree with majors in Computer and Information Technology and Computer Technology.

The overall structure of the degree requirements for the two bachelor's degrees are similar. The bachelor's in Information Technology degree requirements completion of 124 credit hours, as shown in Table 1. The curriculum includes a set of required core CIT courses, a three-course CIT concentration, technical electives, university general education requires (15 credits of which are met by required CIT courses), and additional free electives.

Currently, two CIT concentrations are offered – networking and software development and support. The BS in IT program includes a three-semester self-directed capstone experience.

Component	**Credits**
Required CIT core (including capstone)	44 – 45
CIT Concentration	9
Technical Electives	6
General Education	50
Free Electives	14 – 15
Total	**124**

Table 1. BS in IT curriculum components. The majority of courses in the curriculum are three-credit courses.

The HIT program requirements are similar, with the addition of several courses to develop knowledge specific to healthcare and HIT with a matching reduction in free electives. The HIT degree requires a two-semester capstone experience.

The CIT associate degree requirements cover the first half of the bachelor's degree requirements, including the three-course concentration. The Computer Technology associate degree prepares students to complete a bachelor's degree in computer science.

Changes to Current Courses

The introduction of Agile practices and content is broken into two phases divided by a required project management course that students typically take in their second year.

Courses in the first phase use an approach we call stealth Agile, with students using select Agile practices without formally learning the Agile methodology. Courses in this phase cover basic technical skills, including programming, networking, and human computer interaction. We are introducing a variety of Agile practices for the courses in this area. For example, at the end of a content module, students can showcase what they have learned during the module. This can be followed up with a retrospective activity asking students to reflect on their work during the module and consider how they might improve.

Another opportunity for the use of Agile without teaching Agile is in team projects. A consistent set of weekly activities can be used to provide teams with an iterative, learning process similar to an Agile sprint. The instructor can set a goal for each week of the project. At the end of the week, teams showcase their accomplishments, reflect on the team's progress towards the final project goal, and plan improvements. Use of this approach has improved team collaboration and transparency and gives the instructor better insight into each team's progress (Woods & Hulshult, 2018).

Courses in the stealth Agile phase also offer an opportunity to introduce students to technology that is used to support Agile teams. Students are introduced to Trello, which can be used to visually organize and share tasks and Slack, a group communication tool.

An end of the semester activity in the project management course identified additional ideas for using Agile without teaching Agile. Students were asked to offer suggestions on course content that would have helped with earlier CIT courses. Several students suggested that user stories in programming class assignments would have helped them understand why a feature was required, thereby helping them think about how to implement the feature.

Once students have active knowledge of Agile concepts, practices, and methods, the next set of courses will build on this and allow students to gain experience using Agile. Courses in this phase include advanced programming and networking, IT strategy and management, and the capstone courses.

In courses with team projects, beginning of the semester assignments have student teams plan their team's activities and develop a social contract for the team. Teams are expected to develop and prioritize user stories for the work assigned to the teams. They then work in sprints with planning, showcases, and retrospectives. Teams are also expected to use technology to support their work. In addition to the tools they have seen in earlier courses, teams are encouraged to explore and identify tools to address specific team needs.

Students are also encouraged to use Agile practices to manage individual assignments and activities. For example, weekly planning and prioritizing of coursework, tracking tasks using Trello (an Agile storyboard), and periodic reflection.

The CIT capstone courses make use of Agile practices to provide peer support and feedback as students work on individual projects. While capstone projects are individual projects, we see value from showcase activities that provide instructor and peer feedback. These are followed by Agile retrospective and planning activities.

Agile Concentration

All CIT students learn about Agile in the project management course and have the opportunity to practice and develop this knowledge in other courses. For students who wish to explore Agile in more depth, we have added an Agile concentration as an alternative to the existing networking and software development concentrations.

The Agile concentration contains three courses that explore specific aspects of Agile and allow students to earn industry certifications from the International Consortium for Agile (ICAgile). ICAgile is a certification and accreditation body that helps companies build sustainable Agile programs by helping people to think and be Agile. The university is an ICAgile member organization, and this allows us to certify our Agile concentration courses with ICAgile (ICAgile Learning Roadmap, n.d.). This allows our students to earn a different ICAgile certification for each course in the Agile concentration. Students who successfully complete all three Agile concentration courses will graduate with three ICAgile industry certifications.

As part of the university's general education requirements, all students are required to complete a thematic sequence offered outside their major. "A thematic sequence is a series of related courses (usually three) that focus on a theme or subject in a developmental way (Miami University General Bulletin, n.d.)." The CIT Agile concentration has been approved as a thematic sequence. The Agile thematic sequence will offer students from other majors the opportunity to learn about Agile and be prepared to use Agile once they graduate, supporting the growing use of Agile throughout the enterprise (Rigby, Sutherland, & Takeuchi, 2016). Using the same courses for both the concentration and thematic sequence should provide a mix of IT and non-IT majors in the classes. We are seeing significant interest in both the concentration and thematic sequence, and the initial course offering was fully enrolled.

The first course in the concentration is the Agile Launchpad. This course is taught at the 200 level. Students learn and apply Agile values, principles, and practices while working in multi-disciplinary teams to complete a semester long project. Students who successfully complete the course earn the ICAgile Certified Professional designation (ICAgile Learning Roadmap, n.d.). This course is a prerequisite for the other two courses in the concentration.

The second course in the concentration focuses on business value. This course is taught at the 300 (junior) level and stresses value-driven project delivery, the Agile mindset, and key Agile practices designed to emphasize customer value. The course also explores creating successful Agile teams, the environment needed to support Agile teams, and frequent, transparent collaboration between the product development team and the business organization. Students who successfully complete this course earn the ICAgile Agile Product Ownership certification (ICAgile Learning Roadmap, n.d.).

The final course in the concentration explores core components of Agile as a project management approach. Topics covered include leadership, facilitation or coaching, adaptive planning, customer communication, value-driven delivery, working in dynamic and constrained environments, metrics, reporting, and contract management. Students completing the course earn the ICAgile Project Management certification (ICAgile Learning Roadmap, n.d.).

4. SUPPORTING ACTIVITIES

The department is undertaking a number of activities to support the Agile based changes to the CIT curriculum. These include faculty development, developing an Agile mindset in the department, and developing a resource repository. An additional effort is to identify other items needed to support our Agile efforts.

We expect faculty development to be an ongoing challenge. The department currently has three faculty members with significant experience working with and teaching Agile practices. Most of the remaining full-time faculty are in the process of learning about Agile practices and incorporating them into their teaching. However, the department also makes use of part-time and visiting faculty and cannot assume that these instructors will have any Agile knowledge or experience.

To support faculty, we are developing a repository of reference material covering basic Agile practices and methods. We are also collecting simple exercises that can be used to teach and practice Agile methods and plan to develop videos and other training material specific to how Agile is used in the courses in our curriculum.

Our programs consistently attract transfer students, and due to the non-traditional nature of our student population, we have a number of students who are on extended paths to graduation or have even taken a few semesters off. These students may transfer credit for project management or may have taken an older version of our project management course. Either way, they may not have the knowledge and experience with Agile expected in our upper-level courses. To address this, we plan to use material from the resource repository we are developing to build short, self-contained online learning modules that these students can use to fill gaps in their knowledge of Agile.

The Agile mindset is the organizational culture needed for Agile to succeed. It includes attributes like trust, respect, collaboration, commitment to improvement through learning, taking ownership, a willingness to adapt to change, and focusing on delivering value to customers. We believe that for our efforts to teach Agile to succeed, individual faculty members and the whole department must develop an Agile mindset.

To support development of an Agile mindset, we are using Agile practices and methods in the operation of the department. Activities supporting our strategic plan are written as user stories to clearly document the value of each effort. These are prioritized and tracked using a Trello board. In department meetings, we apply the Agile stand up concept for reports from department committees and use the Lean Coffee practice (Lean Coffee, n.d.) to engage everyone in facilitating discussions. We expect this to be an ongoing process.

5. CURRENT STATUS

While faculty members have been working to add Agile to specific courses for several years, work on a coherent, collaborative approach to incorporate Agile in the CIT curriculum only started in the past year with the hiring of a new faculty member with extensive working experience with Agile.

The three faculty members with Agile experience are working to share successful efforts to use Agile in specific courses with the rest of the department while they continue to develop and assess new course activities. As other faculty gain experience with Agile, they update the courses they teach to use Agile methods and practices and assess the results of these efforts to add to the department's growing body of knowledge.

Where there is clear agreement on an activity or practice in a specific course, it is adopted by all faculty teaching the course. This works nicely with the department's current efforts to develop online versions of several courses since the university's approach to online courses involves creating a master course used by all instructors. For example, several courses now use the same Agile based activities to organize course project teams.

Official updates to the curriculum are underway. The Agile concentration for the CIT bachelor's degrees and the associated courses have been approved and added to the curriculum. The Agile thematic sequence was recently approved, and we are now working to make students aware of this opportunity. The Agile Launchpad course is being taught on a regular schedule, and development work on the remaining courses, including the ICAgile accreditation process, is being planned. The first of these

courses will be offered in the Fall 2019 semester.

Another part of our current efforts involves sharing Agile with faculty outside our department and university offices. These efforts have two goals. One is to share our knowledge of Agile and help others explore how it can improve their classes or campus offices. We have worked with colleagues from other departments who are now exploring the use of Agile in teaching English, psychology, marketing, and teacher education. In the corporate world, businesses are seeing the value of using Agile across their organizations (Rigby, Sutherland, & Takeuchi, 2016), so we are involving staff and leaders from campus offices in our Agile efforts. An excellent example of this is the team in the dean's office responsible for external relations and campus event planning. An administrative assistant heard one of the authors speak about Agile at a campus event, and over the past year, the team has worked with the author to adopt a number of Agile practices to improve team communication and collaboration and recently engaged in a year-end retrospective to celebrate their successes and plan improvements in the team's efforts.

As a way to be an Agile department, our faculty are leading initiatives across the campus. Agile faculty in our department are partnering with local businesses to bring projects to our Agile courses. Students work in Agile teams to complete projects. This gives students Agile work experiences and helps local businesses to achieve goals. Two of our faculty led an Agile Faculty Learning Community, which partnered with our Agile Launchpad course to develop a website for the Center for Teaching Excellence. Our department is using Agile to facilitate our department meetings and advance our strategic initiatives. There are about 80 faculty across three campuses who have attended Agile faculty training or who are practicing Agile in their courses. This faculty body is publishing research and scholarship on the results of using Agile in the classroom. One such project is collecting data from an online course that teaches the IT project management lifecycle using Agile and traditional methodologies. After two semesters of collecting data, preliminary results indicate that online students strongly agree that using the Agile practices of using storyboards and user stories improved their online learning experience. Results also indicate that students strongly agree that using Agile to complete online group projects made them work better as a team and helped them produce higher quality work.

Our second goal in sharing Agile with other groups is to develop opportunities for experiential learning in our CIT courses. We feel it is important for students to gain experience using Agile and plan to use client projects in our courses. The use of Agile elsewhere on campus could offer opportunities for course projects and for our students to gain experience in specific Agile roles such as Agile coach and business product owner.

6. NEXT RELEASE

Part of our current efforts involves planning for the next release of our Agile CIT curriculum product. As previously mentioned, this will include development of two newly approved courses in the Agile concentration.

Other efforts include continued faculty development. The faculty involved in the Agile concentration courses are planning to complete several training and certification courses to support these efforts and expand their knowledge of Agile. These efforts will also result in additional material for the department knowledge repository. Other faculty are engaged in efforts to develop and apply their knowledge of Agile.

As part of ongoing efforts to incorporate Agile in existing CIT courses, we plan to review all courses that involve team projects and implement consistent Agile based content and activities for teams including the development of a social contract for the team, initial team planning, tools selection, and regular team retrospectives. A planned update to our introductory technical IT course will allow implementation and assessment of activities for students to showcase what they are learning and reflect on how they can improve the work.

A significant part of the next release will involve assessing our efforts to date. It has been two years since we significantly expanded the Agile content in our project management course, so we are assessing how that prepared students to use Agile in later courses. We also plan to assess the Agile Launchpad course, especially the performance of non-CIT majors, to inform the development efforts for the additional course in the Agile concentration. Students from a number of majors have expressed interest in

these courses, and we want to make sure they will be successful.

7. FUTURE PLANS AND CHALLENGES

Plans over the next year include developing and teaching both of the new courses for the Agile concentration/thematic sequence. We will continue to revise existing courses with the goal of having Agile based activities in all courses. This will also require continued faculty development to ensure that faculty can successfully teach and assess Agile based activities. Faculty development efforts will also support work to develop an Agile mindset in the department.

We will also continue to develop connections with business to learn how they use Agile and help our students find jobs that allow them to use and develop their Agile knowledge.

Our efforts face a number of challenges. The primary one is resources. While efforts to incorporate Agile throughout our curriculum will benefit student learning and job placement, the time available for Agile efforts is limited by current faculty workloads and other important department efforts.

Another challenge is the reality that Agile is not for everyone. Students who insist on taking charge, waiting for someone else to tell them what to do, or want exact specifications may struggle with Agile. While we hope that our teaching will allow students to overcome these constraints, we must ensure that they develop useful skills. Similarly, even though the use of Agile is spreading, organizations will continue to use non-Agile approaches instead of or even alongside Agile, so we must prepare to work in these non-Agile environments.

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