Exploring the Use of a Kanban Coach for Student Teams

Emergent Research Forum

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Abstract

Recent research has noted the benefit of using Kanban, both within industry and for team-based student projects. Unfortunately, there has been minimal research on how to improve student learning of the Kanban process. This paper starts to address this gap by reporting on the results of an in-class experiment that explores how to implement a Kanban Coach (KC) for student teams that use Kanban. We first outline the key KC responsibilities and interaction mechanisms that enable the KC to efficiently guide student teams, and then report on the results of our experiment. Our results suggest that a KC can be implemented efficiently within an educational context, and that the use of a KC improves student learning and the quality of the team’s project. Hence, our initial results suggest that the use a KC should be considered as part of the project support for student team-based projects and that a KC helps students internalize how to effectively use the Kanban process methodology.

Keywords:

Agile Education, Agile Project Management, Kanban.

Introduction

Kanban, a methodology that focuses on visualizing the flow of work and minimizing work in progress, is becoming increasingly prevalent within the software development community (Ahmad et al, 2018), and has been shown to have a positive impact on software development projects. In fact, a recent study (Lei et al, 2017) statistically compared the effectiveness of Scrum and Kanban for software projects found that both facilitate successful outcomes, but that Kanban was better at project coordination. More generally, it has been noted that Kanban offers improved project visibility, quality, team motivation, communication and collaboration (Ahmad et al, 2013). Perhaps due to this, more and more software teams are transitioning from Scrum to Kanban (Dennehy & Conboy, 2016). Furthermore, Kanban has also been shown to provide an effective mechanism to guide student projects (Saltz & Heckman, 2018).

Hence, it is important to provide students with an appreciation and knowledge of how to use Kanban, so that they not only have the knowledge of how to use Kanban when they graduate and enter industry, but equally important, so that students can effectively use the methodology within the classroom for group projects. However, adopting agile practices often requires a significant effort (Gandomani et al, 2014). For example, it has been observed that a key challenge when teams use Kanban was that the teams lacked the specialized Kanban knowledge and training, and hence, that there was often a misunderstanding of the core Kanban principles (Ahmad et al, 2013; Nikitina & Kajko-Mattsson, 2011). If this is true for industry professionals, it is likely even more of a challenge for students.

One potential way to help students understand and effectively use Kanban is to introduce the concept of a Kanban Coach (KC). Similar to a Scrum Master or Agile Coach, a KC would work to help ensure the team understands and follows the Kanban methodology (e.g., the number of work-in-progress tasks is not too high), and in general, support and guide the students in their use of the Kanban process methodology. However, the scope of what a Kanban Coach should do has not yet been well defined or evaluated.
To help explore the potential value of a KC within an educational context, this research focuses on the following research questions:

**RQ1: How can a KC be efficiently implemented within an educational context?**

**RQ2. Does the use of a KC improve student outcomes?**

The rest of the paper is organized as follows. First, some background context will be presented. Then the potential use of a Kanban coach will be discussed, which will be followed by a discussion of an in-class experiment using Kanban coach. Finally, a synthesis of our observations will be provided within our discussion and conclusion.

**Background**

Unfortunately, it has been observed that agile techniques cannot be acquired solely through reading books or attending lectures (Kropp & Meier, 2013) and therefore, agile needs to be taught through practical exercises and coaching (Taylor, 1999). In addition, it has also been noted that using agile might require faculty to provide additional assistance to students (Rodriguez et al, 2016). This might be due, for example, to the fact that students may not have adequate skills, including non-technical skills such as teamwork or process knowledge issues (Rodriguez et al, 2016).

The adoption of agile methodologies can be significantly facilitated via coaching (Paasivaara & Lassenius, 2014). An Agile coach can play multiple roles including teacher, facilitator, coach-mentor, conflict navigator, and collaboration conductor (Adkins, 2010). In fact, agile coaching can bring many benefits including better understanding of agile practices (Adkins, 2010), and better teamwork (Victor & Jacobson, 2009). Furthermore, the most popular Agile process methodology, Scrum (Denning, 2015), has a similar role, the Scrum Master. The Scrum Master attends all the Scrum meetings, but does not solve technical challenges (Santos et al, 2013). Rather, a Scrum Master discusses the various challenges with the team, and helps the team to reflect on what to do next (Davies & Pullicino, 2009).

**Reviewing the Kanban Process**

Kanban visually represents work on a Kanban board with work items flowing across various columns (or bins) of increasing work status completion. The first column is a list of potential tasks written on Kanban cards (e.g. stickies) that are placed in the initial To Do column (like the backlog concept in Scrum). As work is performed on the task, its card is moved across the columns to visually represent its progression in the workflow. Kanban teams often implement Work-in-Progress (WIP) Limits to restrict the number of tasks that can simultaneously be in each column. This helps the team identify and resolve bottlenecks, reduce cycle times, minimize investments in work-in-progress and smooth the flow of work to make sure tasks are completed (Anderson, 2010).

**A Kanban Coach**

In contrast to Scrum, Kanban does not prescribe any roles, rather, it lets the team decide if there should be roles (Flora & Chande, 2014). Thus, Kanban allows for a KC if the team thinks that role is useful. In fact, Anderson (2010) has suggested that a KC could help the team by discussing Kanban policies, visualizations and metrics. The role could also help the team understand their capabilities and help the team to think about possible process improvements (Anderson, 2010). However, beyond these high-level suggestions, there has been minimal research exploring a Kanban coach. Furthermore, while introducing a KC to a Kanban team seems like a good idea, a KC might actually not be positive. For example, since there are no roles in Kanban, it is possible that introducing a specific role could be perceived as conflicting with the general philosophy of Kanban (i.e., making Kanban feel too process oriented) or that the use of a KC might suggest other roles, such as a project manager that should interact with the KC. Furthermore, the use of a KC might require extra work that needs to be justified, which is especially important when Kanban is used by instructors. Finally, due to Kanban’s focus on the Kanban board and minimizing WIP, the role of a KC might be different from the role of other coaches, such as a Scrum Master.
Methods

Experimental Conditions

The use of a KC was evaluated within a graduate level introductory data science course. To address our research questions, consistent with Eisenhardt (1989), we employed multiple data collection methods. In particular, our methodology was a mixed method research approach that combined qualitative and quantitative methods. We focused on qualitative data (from the instructors and the students) as well as quantitative data (board quality, progress on the board, as well as the final project quality).

Specifically, to leverage the best practice of hands-on experiential work-based learning (Saltz et al., 2013; Saltz & Heckman, 2016), during a semester long student project, student teams analyzed a realistic dataset of customer survey responses, within the context of a global hotel chain. The dataset contained roughly 3M responses and each response contained the responses to the survey, information about the person who responded to the survey, and information about the hotel where the person stayed. This was an exploratory data science type of project (Saltz et al., 2017), in that the goal for each team was to identify actionable insights to their client, who was the hotel’s CEO.

The students were randomly assigned to a class section and the team members for the project were all from the same section. All the teams in a section either had a KC, or did not have a KC (i.e., the “noKC” condition). At the beginning of the semester, all team members, across all sections, were provided instruction on how to use Kanban (e.g., limit work in progress, visualize the flow). In addition, the online Kanban board was demonstrated. It was also explained what kinds of tasks were expected to be placed on the board. As per the typical Kanban process, the students were instructed to work through their project pipeline with no defined schedule (beyond the end-of-semester deadline). The goal was to make sure that there was not a lot of time spent on an effort that was not completed (i.e., it was better to get a fewer number of tasks all the way through the pipeline). It was required, across both conditions, that the teams use the online Kanban tool and that they keep their Kanban board up-to-date and hold at least weekly team meetings. Time for questions with respect to how to use Kanban was provided for all teams throughout the semester.

In addition, for teams in the KC condition, a Kanban Coach was assigned to each team (one KC covered more than one team), and those teams were provided with a clear process of how to work with their KC (the KC was a TA for the class who had knowledge and experience using Kanban). To facilitate the discussion between the team and the KC, teams in the KC condition were required to use a special first column on their Kanban Board, labeled “proposed”. Specifically, the teams put suggested tasks in the “proposed” column, and the KC would then move those tasks to the “to do” column (i.e., the next column on the board). Only the KC moved tasks from “proposed” to the “to do” column. This helped to provide a structure such that the students could easily get feedback from their KC, and the students (and the KC) could ensure that the task was appropriate and well defined. Then, as with teams in both conditions, when a student was ready to work on the task, that task would then be moved from the “to do” column to the next appropriate column. In summary, teams in the KC condition had a structured communication mechanism to communicate with the KC via the “proposed” column, and the KC mainly interacted with the team via the Kanban board. For teams that did not have an assigned KC, the TA was available to answer questions as needed, and also provided feedback during the project updates.

Data Collection

331 students participated in the study. Of these 331 students, 206 were in the KC condition (39 of the 59 teams studied). The average team size was 5.3 in the KC condition and 6.3 in the noKC condition. The variation on team size (across the two conditions) was due to students dropping the class. Across both conditions, the students had a diverse set of undergraduate degrees, ranging from chemical engineering to business. The students also had diverse geographic / cultural backgrounds, with students gaining their undergraduate degree from Asia, Europe and North America. In addition, forty percent of the students were female. Finally, the majority of the students had two to five years of IT work experience.

Qualitative and quantitative data was collected during the study. Consistent with IRB approved guidelines for this research, student participation was voluntary and students were informed that, with their
agreement, the instructor observations could be used, in an anonymous fashion, as part of an ongoing pedagogical research project.

In terms of qualitative data, instructor observations provided insight into how effectively the teams were working together, as well as the group dynamics within the team. In addition, at the end of the semester, a semi-structured student survey was distributed to each student to explore their perceptions with respect to the methodology that they used. The qualitative data was analyzed via an iterative process of item surfacing, refinement and regrouping.

In terms of the quantitative data, a final project evaluation was performed. The final project evaluation criteria were not focused on the use of Kanban, but rather, the quality of the overall analysis. In addition, there were three quantitative evaluations of the boards during the semester. The first was three weeks after the project started, the second was one month later, and the last evaluation was two weeks before the end of semester. The Kanban board evaluation was conducted by two annotators and the final project was evaluated by three independent reviewers. For these evaluations, there was a high degree of agreement between the reviewers and any differences of opinion were identified, discussed and resolved. The boards were evaluated according to the following criteria, with each criterion being scored on a scale of 0 to 5:

- **Board Quality** – this metric included criteria such as if teams were minimizing their work-in-progress, if there enough tasks on the board to keep the team busy, and if the tasks were well defined.
- **Board Progress** – this metric captured the amount of progress, as shown on the board, that the team had made from the previous update (i.e., were there enough tasks “moving through the pipeline”).

## Findings

### Quantitative Results: Board and Project Evaluation

The impact of a KC on the quality of the Kanban board and the progress each team made (via an analysis of the progress of their Kanban board) is shown in Table 1. Specifically, teams that had a KC performed statistically significant better, in terms of board quality, board progress and final project evaluation. This suggests that introducing a KC helped to improve the teams’ performance as well improve the leading indicators of team performance (board quality and progress).

<table>
<thead>
<tr>
<th></th>
<th>With KC</th>
<th>No KC</th>
<th>p-value (t-test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Board quality (5 is best)</td>
<td>4.8</td>
<td>4.2</td>
<td>0.02</td>
</tr>
<tr>
<td>Board progress (5 is best)</td>
<td>4.1</td>
<td>3.5</td>
<td>0.01</td>
</tr>
<tr>
<td>Final project evaluation (20 is best)</td>
<td>17.9</td>
<td>16.1</td>
<td>8*10^-14</td>
</tr>
</tbody>
</table>

**Table 1. Experimental Results (student teams with/without a KC)**

### Qualitative Results: Student and Instructor Feedback

In analyzing student and instructor comments, three key differences emerged. We discuss each of these below, integrating comments from students with the instructor observations.

**Improved Ability to Track Progress:** Students in the KC condition much more often reported that the Kanban methodology helped them systemize their work and structure their knowledge. For example, one student noted that “It helped [us] keep a track of progress, and move [us] ahead with the project in a systematic manner” and a different student commented that “It’s easy to organize new tasks as well as add notes when we are doing discussions”. Finally, yet a different student noted that “[it] helped to keep a track of the activities to be performed and so, in a way, helped in planning during the project”. This was reinforced by the instructor observations, such as one instructor that noted “the teams seemed much more organized when they had access to a KC”.

**Clarity of Objectives:** Multiple teams in KC condition noted that the methodology helped to make the project objectives clearer. For example, one student commented that “we have a clear understanding of what were our research objectives and what activities we needed to perform to reach that objectives”, and another stated that “it [the process when using a KC] made us segment our work, have clear objectives and
coordinate team effort”. This clarity of objectives might have been driven by the fact that the instructors perceived that the students in the KC condition both understood and followed the process better, as suggested by one instructor who noted that “the feedback [by the KC] encouraged the students to be more focused on ensuring that they adhered to the process methodology”.

**Improved Efficiency in using Kanban:** It’s interesting to note that only the noKC teams stated that they thought that their methodology was time consuming. This included comments by students in the noNC condition such as “[it was] time consuming to update and maintain [the Kanban Board]”. This suggests that the KC helped the teams be more efficient in the use of the Kanban process and/or also helped the team understand the value of the process (and thus, the students thought that the time discussing the Kanban board was time well spent). This was perhaps due to some noKC teams only using Kanban as a way to communicate to the instructors, as explained by one instructor “some of the teams in the noKC condition sometimes seemed to use the Kanban process as a reporting mechanism to me, rather than using Kanban as a project management process that I could observe”.

**Qualitative Results: KC feedback**

With respect to KCs, they noted that they were able to “clarify possible confusions” such as “putting new tasks to appropriate column”, and also help guide the students in creating “good tasks” (i.e., not too high or low level). They also noted that, in general, the student teams with a KC were not complaining that they needed to use the proposed column. In addition, the KCs noted that the use of the proposed column streamlined the interaction with students, and that the amount of time spent acting as the KC was, on average, 10 minutes per team per week. The KCs spent this time providing feedback via the board (ex. the moving tasks from the “proposed” column), making sure a team used an appropriate level of granularity for the tasks (ex. not too broad or too specific tasks), reviewing progress since last update (via the movement of the tasks on the board) and encouraging the team to make sure the Kanban board is up-to-date.

**Conclusion**

While the Kanban process has been shown to be of value for student team-based computing projects, the use of a Kanban Coach has not previously been studied. This emergent research paper starts to address this gap and provides several contributions. First, a coaching role was introduced within a Kanban context and a structured communication mechanism was defined for how students can efficiently and effectively interact with the KC (i.e., the use of the proposed column), which addresses our first research question (**how can a KC be efficiently implemented within an educational context**). In addition, via a mixed method (qualitative and quantitative) analysis, we explored the impact when students used a KC.

Our results suggest that students did benefit from having a KC, in that the KC helped the students improve their collective ability to track progress, ensure there is a clarity of objectives, and be more efficient in the use of the Kanban process. It was also found that introducing a KC led to an improvement of the team performance (grades) and as well as a leading indicator of project performance (i.e., board quality), which addresses our second research question (**does the use of a KC improve student outcomes**).

Furthermore, we believe that these results show that the use of a KC enabled the students to gain an improved understanding of the Kanban process (which led to the improved student outcomes), which is one approach to improving a student’s understanding of project management. In other words, our results suggest that the use a KC should be considered as part of the project support for student team-based projects since a KC helps students internalize how to effectively use the Kanban process methodology.

Since our study was focused on a data science course, future research will explore if the findings are applicable to other computing domains such as software engineering. In addition, in this study, a proposed column was used to facilitate communication between the KC and the students. Future research will explore other mechanisms to improve the communication between the KC and the students. Furthermore, we also plan to explore, for teams not using a KC, if the proposed column could also improve the teams’ performance and understanding of the Kanban process. Finally, it is possible that the better performance of students in the KC condition was due to the composition of teams (i.e., the “better students” might have all been in the KC condition). Hence additional sections of the class will be incorporated into this study.
REFERENCES

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