Design Options and Learning Analytic Pathways in Doing Agile Scrum Team Work in Education

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Abstract
We extend a standard for doing agile scrum teamwork in education that permits individual assessment within teams (IAFOR ECE2020). Since the teacher's bandwidth in education is limited and increasingly under pressure, we focus on course design options that can be used to leverage the bandwidth. One economizing option in courses is to let teams prerecord prototype presentation videos before sprint review takes place. This allocates expensive teacher's time to team interrogation time which enriches interaction and engagement and enables effective sharing between teams to improve communication flow in sparse stakeholder feedback scenarios. We also describe three learning analytic pathways that can be smartly integrated into learning dashboards to monitor student and team progress or into learning recommender systems and chatbots to generate action-directed, just-in-time feedback and advice to students. The first one is for setup that enables control of important team diversity and student inclusion parameters such as demographic, personality and professional traits that are known from the student population in advance and that enables handy attribution of 21st-century skill sets within teams. The second one is the product pathway that builds on a datastream generated from qualitative, quantitative and immersive product features that are known from prototyping. The third one is the process pathway in which information on 21st-century skills is generated that are at play in individual and dynamic team processes. We are convinced that these extensions will further enable effective learning technology that is directed to applying agile scrum in education efficently, both for students as teachers.

Keywords: Scrum, Education, Team Work, Design Options, Learning Analytic Pathways

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Introduction

Imagine a world wherein education can take place outside education institutes in the real professional work field. Artificially created assignments for students by lecturers can be replaced by work that truly matters and that needs to be done and that pays off in the real world. Valuable human resources that are scarce in the labor market such as engineers and data scientists become earlier available to the work field. Scarcity in the labor market due to the foreseen demographic transformation in the Western society will be softened. Lifelong education initiatives will be tailored.

Scrum is an agile framework for developing, delivering, and sustaining complex products (Schwaber & Sutherland, 2017; Schwaber & Sutherland, 2020). It is flexible, fast, low cost and allows for agility for instance. In this paper we use the original scrum framework of Schwaber & Sutherland (2017) as a basis that has recently been updated to Schwaber & Sutherland (2020). This is the most applied framework in the professional work field around us, e.g., in small to medium enterprises, but also in big companies such as KPN, Amazon, and bol.com, etc. In a nutshell, scrum requires a scrum master to foster an environment where: (1) A product owner orders the work for a complex problem into a product backlog; (2) The scrum team turns a selection of the work into an increment of value during a sprint; (3) The scrum team and its stakeholders inspect the results and adjust for the next sprint; and (4) *Repeat*.

Application of scrum in education was hindered for a long time, because, in education, we often want individually allocated grades for group work, and, until recently, this was not possible. This ackward and unpleasant situation has ended reccently because with our newly developed standard that we defined and built on top of the scrum framework of Schwaber & Sutherland (2017) it became possible to effectively assign individual grades to students when needed. Please refer to my earlier paper and presentation for any further details (Loke, 2020).

In this new, additional paper we, firstly, extend on the standard that we currently use for doing scrum in education by giving some relevant design options for teachers. We, secondly, emphasize on three learning analytic pathways that have been found relevant in several courses that we recently have run with the standard. These learning analytic pathways are directed to product, process, and setup in our standard, respectively. To steer expectations for prospective students and teachers that will work with our standard, some illustrative processing results/examples are depicted per pathway. After that, we, thirdly, will discuss and conclude on our work.

Design options

Two of the most important design options that are in particular relevant for teachers are related to: (1) Role topologies of doing scrum team work in education; and (2) Anchoring agile scrum in a course within an overall education program. As (1) has already been described in Loke (2020) and further information can be found there, we will focus below on design option (2).

We distinguish between implicitly and explicitly embedding agile scrum into learning objectives and learning outcomes. The characteristics of implicit embedding are: (A) Focus is on product for stakeholder that is delivered by development team; (B) Boldly assumes that students are already acquainted with the Agile Scrum process; (C) Grading is on product

features. Process features that are related to Agile Scrum will not come back in the grading grid and are not graded; (D) Enables and stimulates, both formative and summative, feedforward and feedback loops between product owners (teachers) and development team (students) on product dynamics; (E) Enables voluntarily, formative, feedforward and feedback loops on process dynamics. An example of implicit embedding can be seen in Table 1 (note that the example is for illustration purposes only).

Learning Objectives Database Management course. **Student is able to..**	**(Alignment with** overall program**) Learning Objectives Master Digitally Driven Business. Student is able to..**	**Learning Outcomes Database Management** course. **Student does/shows..**	**(Alignment with** overall program**) Learning Outcomes Master Digitally Driven Business. Student does/shows..**
..	..	..	..
Develop data queries on a database to explore data to generate insights for organizations	Act on the belief that digital technologies and theories in digital business are continuously evolving **to stakeholder needs**; therefor it's always crucial to continuously adapt or improve in the effort to seek the most appropriate and sustainable solution for business	*Successfully develop a database by following the Agile Scrum Method*	Critically reflect and demonstrate that the most appropriate and sustainable solution for business issues has been found/ designed *Effectively cooperate and contribute to a multidisciplinary development team, applying the Agile way of working*

Table 1: Example of implicit embedding.

The characteristics of explicit embedding are: (A) Focus is, besides product, also on process in development team; (B) Assumes that students are possibly not yet acquainted with Agile Scrum; (C) Grading can be on both product and process features. Process features that are related to Agile Scrum will be in the grading grid and could play a role in computing grades; (D) Enables and stimulates, both formative and summative, feedforward and feedback loops on holistic product and process dynamics. An example of explicit embedding can be seen in Table 2 (again, note that the example is for illustration purposes only). Explicit embedding presumes logically extended grading grids when compared to implicit embedding; see Table 3 for an example.

Learning Objectives Online Data Mining course. **Student is able to..**	**(Alignment with** overall program**) Learning Objectives Master Digitally Driven Business. Student is able to..**	**Learning Outcomes Online Data Mining** course. **Student does/shows..**	**(Alignment with** overall program**) Learning Outcomes Master Digitally Driven Business. Student does/shows..**
..	..	..	..
Learn to be a modern, esteemed and motivating team worker that systematically uses the dedicated Agile Scrum method (Learning Goal---LG 4)	Proactively and autonomously steer one's **professional effectiveness** in order to be resilient in a continuously changing professional environment	*Successfully work by following the Agile Scrum Method* To be a team worker with whom it is pleasureful to work with who creatively integrates business, technology and data demands	*Effectively cooperate and contribute to a multidisciplinary development team, applying the Agile way of working* Critically reflect on **personal** development of 21st century skills

Table 2: Example of explicit embedding.

GRADED CRITERIA*	1.0 – 3.4	3.5 – 5.4	5.5 – 6.9	7.0 – 8.4	8.5 – 10
Product related features in Team Scrum Log File (90%)---LG 1-3	..	..	..	..	..
Process related features in Team Scrum Log File (10%)---LG 4	Provides no or hardly any reliable evidence to support Agile Scrum	Provides some yet insufficient reliable evidence to support Agile Scrum	Provides enough reliable evidence to support Agile Scrum, but this evidence should have been based more on the dedicated Agile Scrum method	Provides a substantial amount of reliable evidence to support Agile Scrum and this evidence is sufficiently based on the dedicated Agile Scrum method	Provides an exceptional amount of reliable evidence to support Agile Scrum and this evidence is solidly based and possibly extends on the dedicated Agile Scrum method

Table 3: Explicit embedding: grading grid example (for illustration purpose only). Note that LG 4 relates to the learning goal that has been depicted in Table 2.

Learning analytic pathway directed to product

Figures 1 to 7 illustrate some example results of decomposition, Trello board, Trello board with poker weights, and, comparison of estimated and real poker weights in a sprint review, respectively. Note that the relevance of decomposition, Trello boards and playing poker were already outline before; please see Loke (2020) for any details.

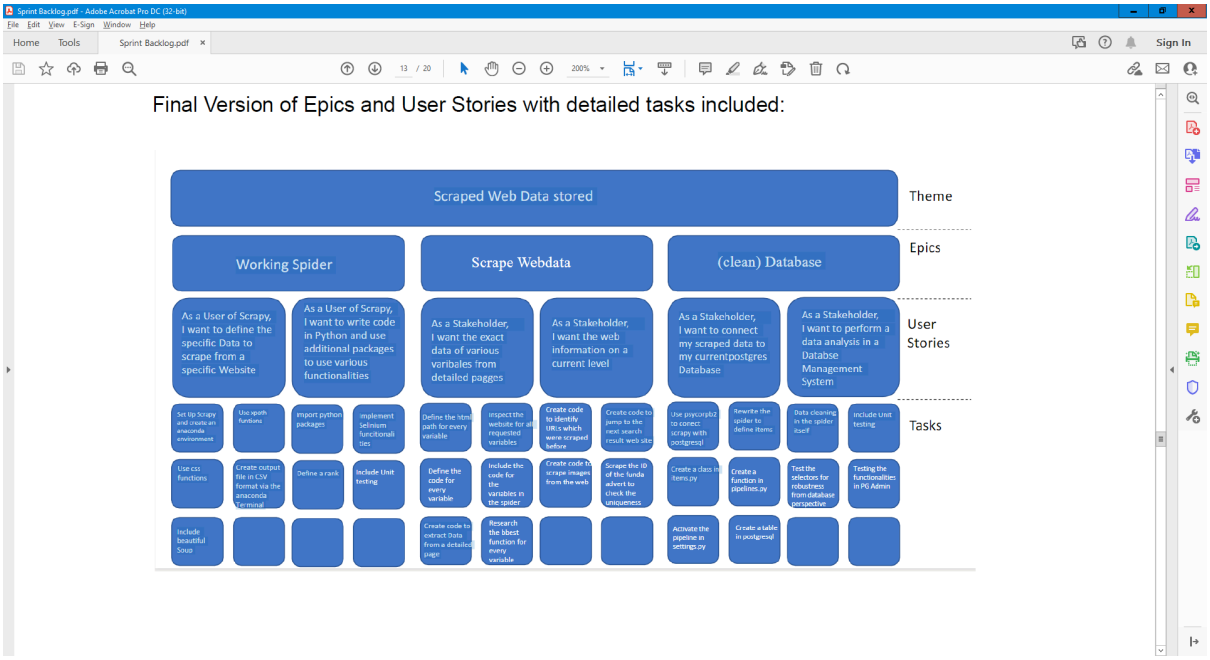


Figure 1: Example processing result for product learning analytic pathway.

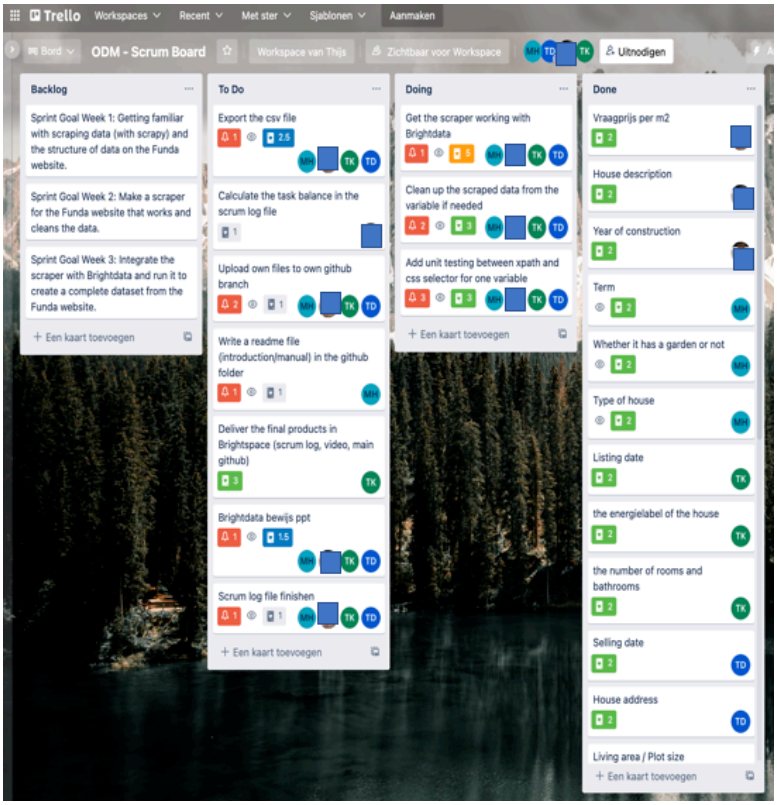


Figure 2: Example processing result for product learning analytic pathway.

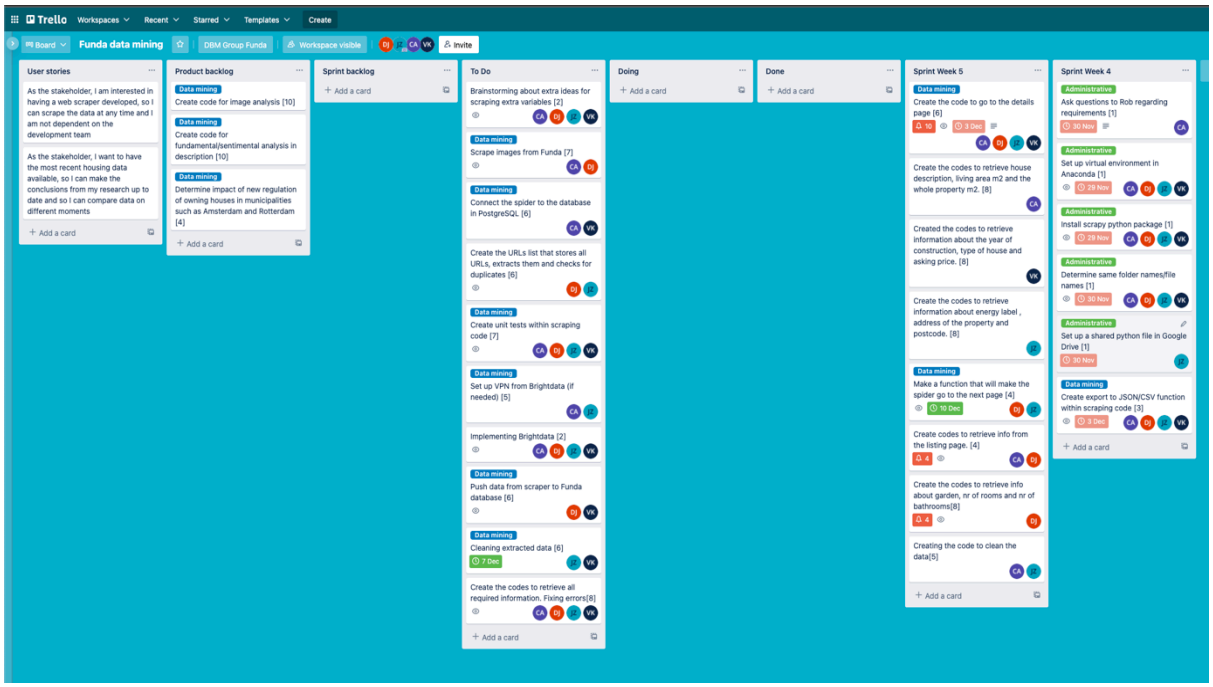


Figure 3: Example processing result for product learning analytic pathway.

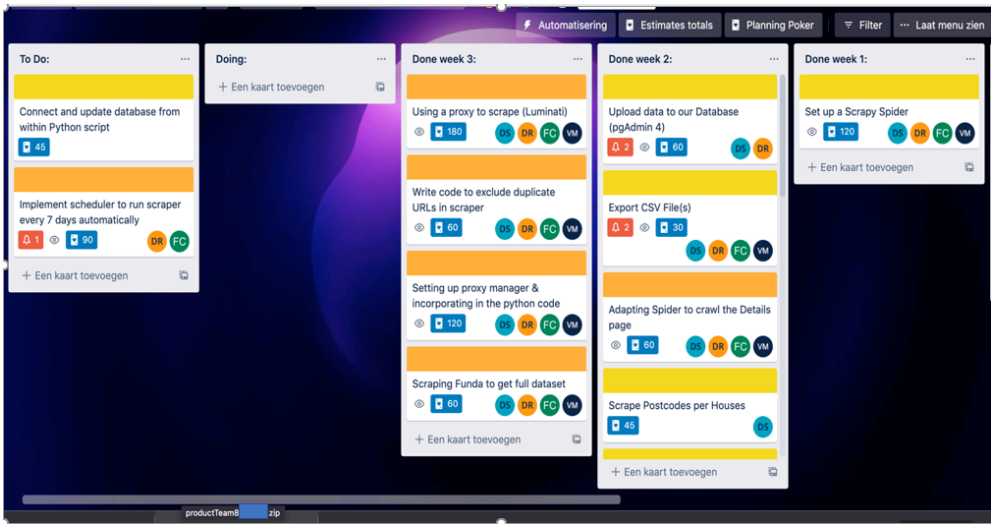


Figure 4: Example processing result for product learning analytic pathway.

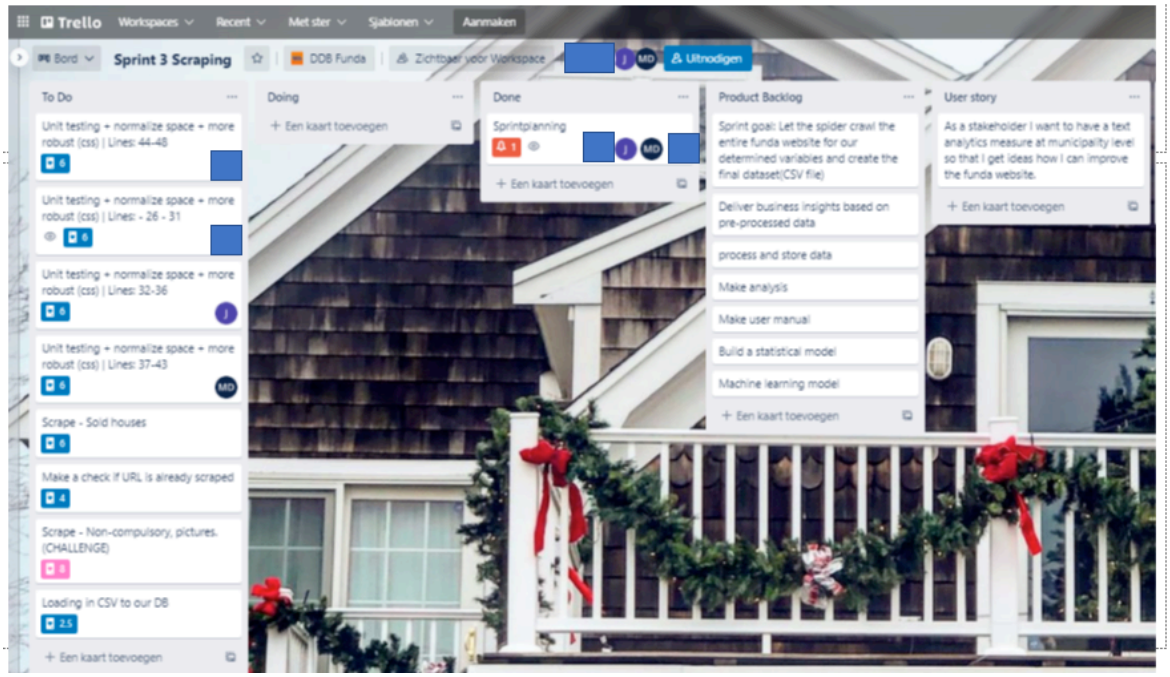


Figure 5: Example processing result for product learning analytic pathway.

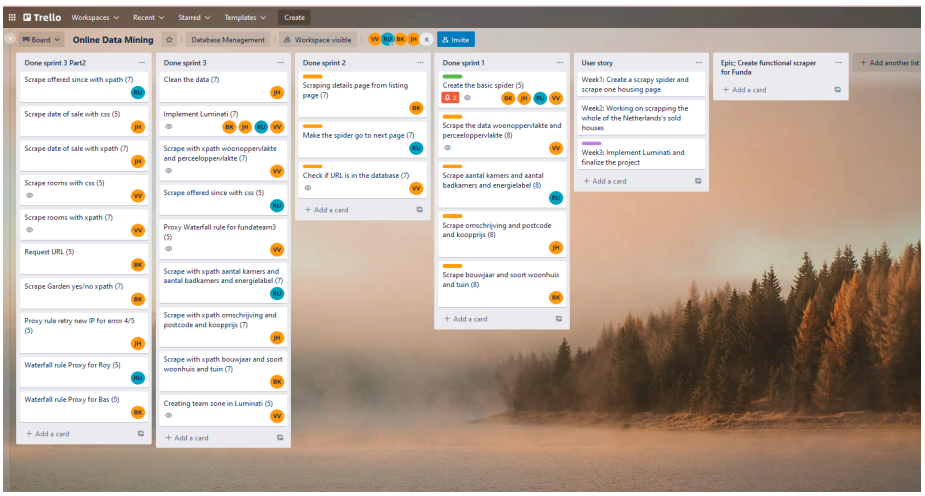


Figure 6: Example processing result for product learning analytic pathway.

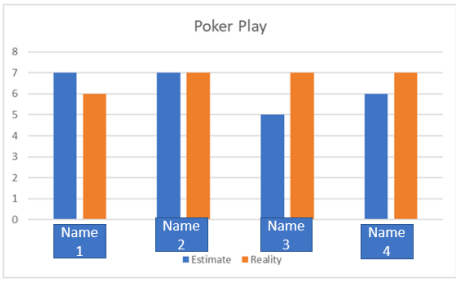
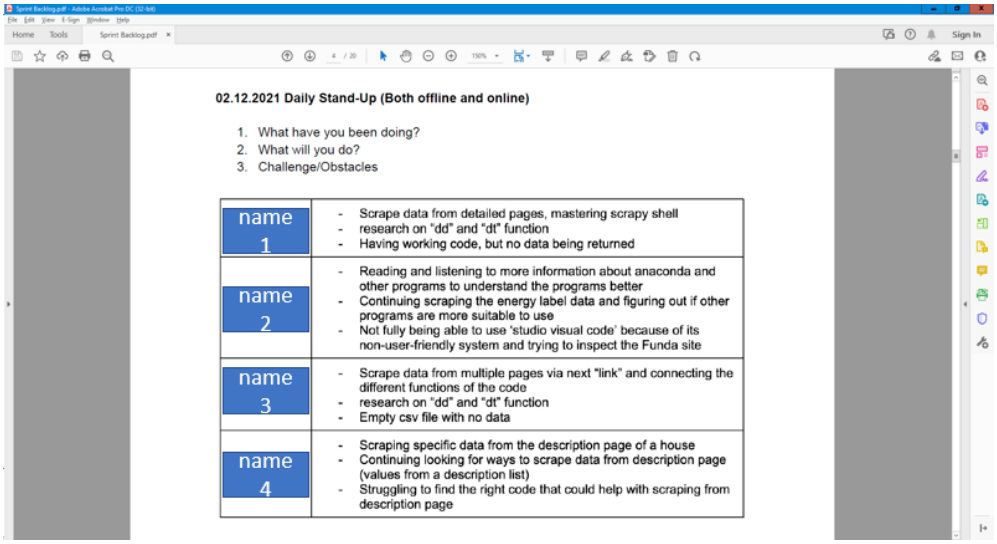


Figure 7: Example processing result for product learning analytic pathway.

Learning analytic pathway directed to process

Figures 8 to 12 illustrate some example results of playing poker during sprint planning, daily standup, and, sprint retrospective, respectively. Please recall from e.g. Schwaber & Sutherland (2020) that these meetings are default when doing scrum.

Figure 8: Example processing result for process learning analytic pathway.



02.12.2021 Daily Stand-Up (Both offline and online)

1. What have you been doing?
2. What will you do?
3. Challenge/Obstacles

name 1	- Scrape data from detailed pages, mastering scrapy shell - research on "dd" and "dt" function - Having working code, but no data being returned
name 2	- Reading and listening to more information about anaconda and other programs to understand the programs better - Continuing scraping the energy label data and figuring out if other programs are more suitable to use - Not fully being able to use 'studio visual code' because of its non-user-friendly system and trying to inspect the Funda site
name 3	- Scrape data from multiple pages via next "link" and connecting the different functions of the code - research on "dd" and "dt" function - Empty csv file with no data
name 4	- Scraping specific data from the description page of a house - Continuing looking for ways to scrape data from description page (values from a description list) - Struggling to find the right code that could help with scraping from description page

Figure 9: Example processing result for process learning analytic pathway.

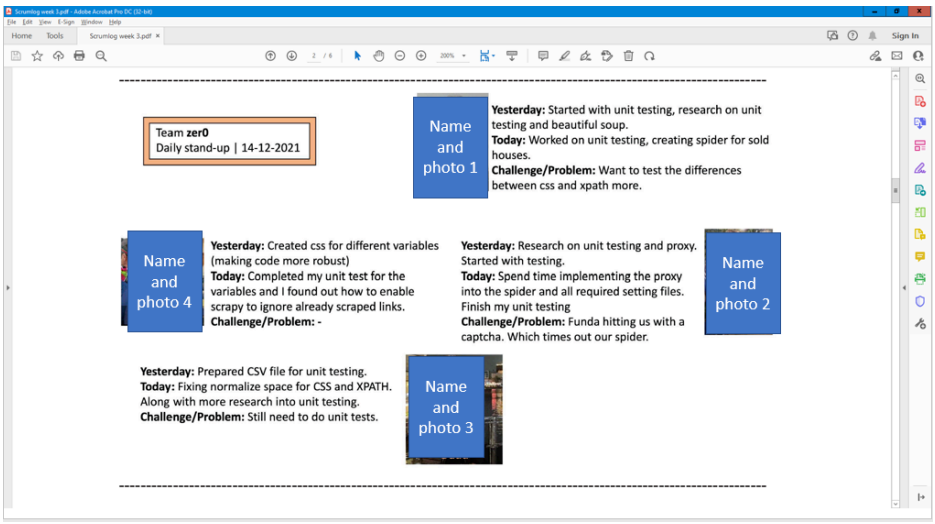


Figure 10: Example processing result for process learning analytic pathway.

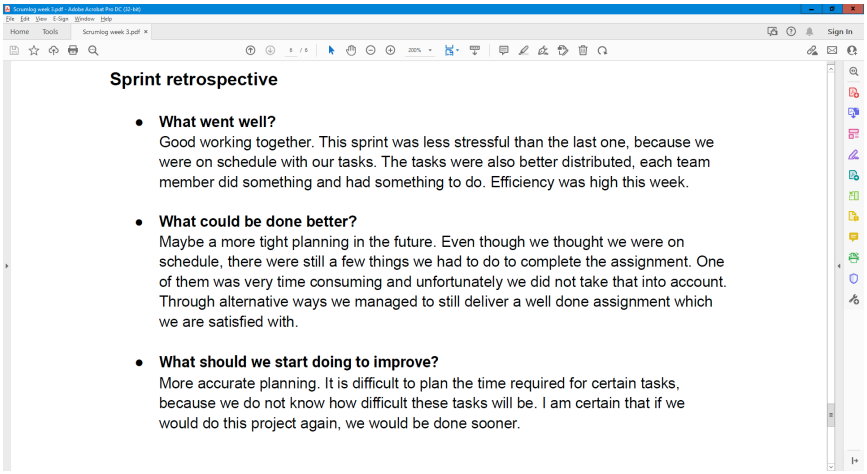


Figure 11: Example processing result for process learning analytic pathway.

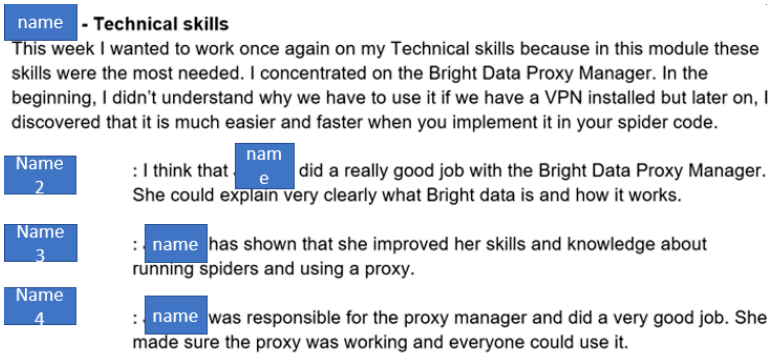


Figure 12: Example processing result for process learning analytic pathway.

Learning analytic pathway directed to setup

Under the assumption that teams are well managed, scrum works best in mixed teams. Therefore, please recall from Loke (2020) that we do automated team formation with computational algorithms to optimise for mixed teams. Obviously, the space that can be formed by all individual student parameters and that can be overlapped/intersected with additional a priori student cluster information as well as allocated group information that has

been computed is a very rich source for computing all kind of learning analytic and class performance measures that should be explored in more depth.

Discussion

The standard as described in Loke (2020) that has been continously applied in the specific expert domain of our master remains in practice highly successfull. The mental map of workload that is a result of the common language of epic, user story and task remains insightful to students during product development. Example processing results per learning analytic pathway are helpful and illustrative for expectation management of rookie agile scrum classes and should form the basis for setting up templates that will be useful for automatic processing purposes (product and process pathway). Setup parameters that are derived from the student population are important to drive automated team formation to maximize overall class diversity in teams that is known to increase agile scrum impact in class (setup pathway).

Recommendations

Introducing scrum into your organization is not trivial. Introducing scrum as a learning paradigm is not trivial either and it takes time for lecturers and students to get familiar with it (as is the case in starting with scrum in the real work field as well).

We have described the most relevant design option when doing agile scrum team work in education that you should address and think of when you develop your course. Explicit specification of agile scrum into learning objectives and outcomes is better for rookie agile scrum classes. Implicit specification could be better for expert agile scrum classes.

It would be interesting to see application of our standard in the education community. The standard can be applied to other expert domains, in other university studies, by other universities and education institutes, in other countries and in other languages. When you apply our new standard in your own work, please refer to this new paper and/or our Loke (2020) paper.

Conclusion

We promote a symbiotic world where education can take place with scrum directly in the professional work field. With this aim in mind, we extended in this paper our standard for doing scrum team work (Loke, 2020) with three learning analytic pathways that should be explored in the near future to boost overall learning efficiency and efficacy and to drive potential learning dashboards, recommender systems or chatbots.

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