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APPROACHES TO INCREASING METHOD ACCEPTANCE IN AGILE PRODUCT DEVELOPMENT PROCESSES

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Abstract

This paper presents the results of a 4-year study dealing with concept for increasing the method acceptance in development processes. Therefore, three approaches are presented and discussed. During product creation, product developers can apply various methods to be supported in their work and enhance the quality and efficiency of the respective processes. Even though the additional benefits and added value of the different methods have been verified in many studies, they are not used very widely due to insufficient transparency about relevant methods suitable for the specific situations and requirements, deficiencies in user friendliness, and a lacking sense of achievement during everyday use. This paper points out and discusses different approaches to increasing the acceptance of methods applied during agile product development processes.

Keywords: Design methods, Design education, Research methodologies and methods, Gamification, Method acceptance

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1 INTRODUCTION

This paper presents the results of a 4-year study dealing with concept for increasing the method acceptance in development processes. Therefore, three approaches are presented and discussed.
During product creation, product developers can apply various methods to be supported in their work and enhance the quality and efficiency of the respective processes. Even though the additional benefits and added value of the different methods have been verified in many studies, they are not used very widely due to insufficient transparency about relevant methods suitable for the specific situations and requirements, deficiencies in user friendliness, and a lacking sense of achievement during everyday use. This paper points out and discusses different approaches to increasing the acceptance of methods applied during agile product development processes.

2 STATE OF THE ART

According to VDI 2223 (VDI2223, 2004), the term "method" refers to a regular well-planned procedure for achieving a defined objective. Methods, hence, can be perceived as operational elements describing the procedure for step-by-step solving of a given problem (Lindemann, 2009). To support users in product development projects in fulfilling the respective requirements, one applies methods that lead to the improvement of the product and product creation process in at least one of the three dimensions development time, cost, and quality (Albers et al., 2014). By standardizing action steps according to certain patterns (VDI2222, 1997), methods are able to support the development process in several respects. On the one hand, using suitable methods effects structuring of individual activities in product development and ensures that the respective results are made more comprehensible. On the other hand, suitable methods create transparency in superordinate project structures, thus supporting the predictability and coordination of activities in product development (Graner, 2012). In a nutshell, methods are intended to support users in the effective and efficient pursuit of tasks. Studies e.g., by Franke et al. (2009), Stetter and Lindemann (2005) or Albers et al. (2014) were able to prove a significant added value of the use of methods in the development process. In spite of the high benefit of methods for product development, studies show that they are applied only to a limited degree along the development process (Yeh et al., 2008). This is often explained by a poor experience and the insufficient knowledge of the different methods (Birkhofer, 2005).
Further research projects hence investigated and described the reasons for the lacking acceptance of development methods. In this context, Jänsch (2007) and Bender (2004), conclude that science is often too far away from reality. The individual needs and skills as well as the individual ways of working and thinking are not being considered sufficiently. Besides, the verifiability of improved results or reduced development efforts due to the use of methods mostly can only be pointed out to a certain degree i.e., under specific boundary conditions. Another point of criticism is that it is often difficult to memorize the methods and that method presentation often is too theoretical. Mostly, the selection and preparation of the respective methods does not meet the demands of users. The sum of the points of criticism mentioned results in a lack of acceptance of development methods in practice. Acceptance, however, is the fundamental precondition for successful method implementation and application.
Araujo (2001) identified the following factors that explain the low level of acceptance of methods and tools in practice:

- Lack of a reason and/or interest: Many organizations and practitioners believe that they do not need to use the “new” methods and tools that are available.
- Lack of understanding of the nature of the methods: Many practitioners are not sure of how they can benefit from most of the available methods and tools.
- Lack of resources: Organizations complain that they do not have the necessary resources to learn, implement and use new methods and tools.
- Lack of ‘appeal’: Most methods and tools (especially those from an academic origin) are brought to the public in an unpolished form, presented in an academic language, and are too complicated to be applicable to practical problems and tasks.
- Poor design of methods and tools: The application of many methods involves procedures that are unnecessarily too complicated, does not reflect real practice, and does not fit into the scope of the existing task or problems.

- Poor promotion practices: Not enough professional effort in the dissemination of most of the available methods and tools.
- Fear of change: The impact of the introduction of tools is understandably difficult to assess, and not well reported in the literature. Introduction of new tools is generally perceived as a change, and changing is not always welcomed by most practitioners, no matter the type of industry, and the object of the change.
- Too many options: There is a lack of taxonomy and procedures for supporting the assessment and selection of tools.
- Negative attitude: Most practitioners have a negative attitude towards the introduction of new methods and tools. In many cases, the attitude is the result of some previous bad experiences with introducing methods or tools.

Based on the results of several research works, Badke-Schaub (2011) describe three main categories of deficits in methodology: (1) the questionable performance of methods, (2) the ways that methods are presented and formulated, and (3) process-related problems during the application of methods.

The three aspects (performance, presentation, and process) can be further analysed on both levels, the individual and the organizational level. Individual acceptance especially considers aspects of the personal perception of a method's effort and benefit as well as aspects of its intuitive and flexible application. Organizational acceptance rather includes the measurability of the method's performance and its implementability in existing organizational structures. In addition, the distance from science and practice, which is often criticized, leads to a lacking acceptance of methods and a lacking awareness of developers of appropriate methods (Jänsch, 2007; Pahl and Beitz, 2013). The Group arround Albers argue similarly as, by means of the "extended ZHO model" (ZHO stands for "Ziel Handlung Objekt", which means Objective-, Operation-, Objectsystem), they describe the developer as a thinking and acting person in the center of an iterative product development process which must be supported individually (Albers et al., 2012).

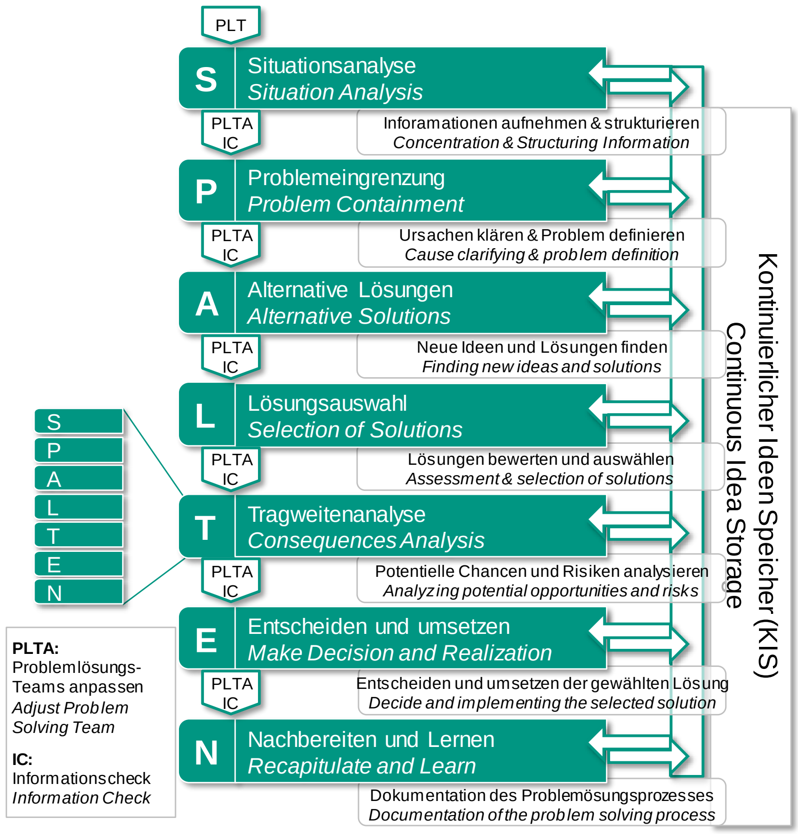

Figure 1. SPALTEN Problem solving process

Problem solving methods are exactly suited for such support. Albers has developed an approach to methodical problem solving which is known as SPALTEN. SPALTEN hence is a problem-solving process which can give support both in emergency and planning situations. It was published for the first time by (Albers et al., 2002) and has been continuously enhanced and consistently applied in the past 15 years (Albert et al., 2016). The SPALTEN problem solving method can be characterized by the steps, shown in Figure 1. In this Process, recapitulate and learning are the final steps of the SPALTEN problem solving method and provide the opportunity of preserving the knowledge obtained for the future, thus making the difference as compared to other problem solving techniques which mostly neglect that step.

3 METHODOLOGY

This paper deals with the question how method acceptance can be increased in agile product development processes. Based on the taxonomy of learning objectives in the cognitive domain according to (Bloom et al., 1976), the main objective described above can be subdivided as follows:

- Knowledge of methods.
- Understanding of methods.
- Application of methods.

Whereas the "knowledge of methods "aspect examines the question as to how product developers can be provided with a transparent overview of relevant methods suitable for specific situations and requirements, the "understanding of methods" item investigates how methods can be treated with regard to contents and to media to create plausible understanding and, hence, increase the acceptance by the users. To increase the actual "application of methods", motivated method learning and experiencing in controlled practical environments are finally investigated.

4 APPROACHES TO IMPROVING THE ACCEPTANCE OF METHODS

This section presents and discusses three selected approaches to increasing the acceptance of methods by example of the InnoFox method recommendation app (knowledge of methods) (Figure 2, left), method explanation videos (understanding of methods) (Figure 2, center), and the method learning game "Die SPALTEN-Expedition" (the SPALTEN expedition) (application of methods) (Figure 2, right).

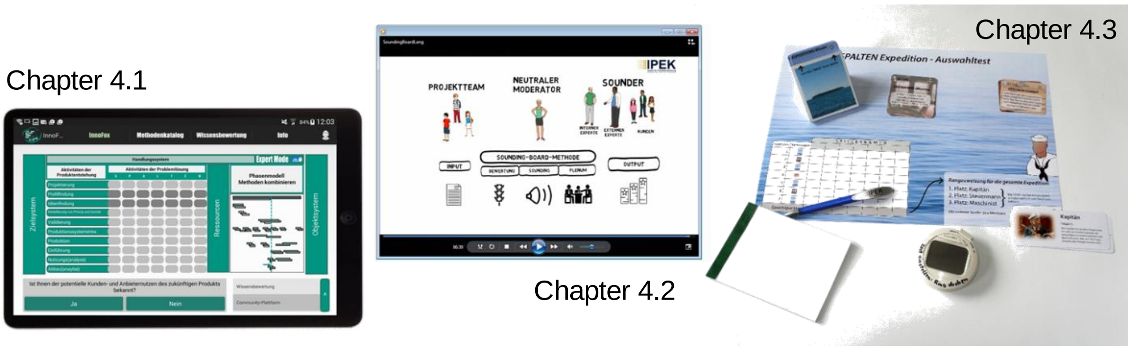

Figure 2. Innofox – method videos - SPALTEN game

4.1 Knowledge of Methods

Each activity that is part of product developement pursues certain goals. Methods are means that support the achievement of this goals (Lindemann, 2009). Along these lines, the use of methods must be tuned to the respective tasks (Braun, 2005). The various methods applicable to product development can be subdivided according to the objectives whose achievement they support. These objective criteria of method application are found in the area of construction methodology (Albers et al., 2011), method-independent objectives of product development (Ehrlenspiel and Meerkamm, 2013), and business process optimization. Objective criteria are e.g., the reduction of maintenance or reject costs considering that each method of product development may be suited differently for achievement of these objectives. Beside the descriptions in the literature e.g., by (Pahl and Beitz, 2013), there are special books or collections containing several design methods e.g., the Delft Design Guide. Another way to describe methods and to provide the necessary knowledge about how to apply them are online platforms or, more recently, applications. The first method application designed for mobile devices called "InnoFox" was presented in 2014 (Reiß et al., 2016). It provides a huge catalogue of design methods and various possibilities to access methods which are suitable for the situation given by the company's surroundings.

InnoFox is an application for mobile devices recommending development methods in accordance with the respective specific situations. These suggested methods are determined as boundary conditions are entered by the user. The application was developed within the IN2 project (from INformation to INnovation) which was initiated for increasing the potential of innovation by means of appropriate processes and methods (Albers et al., 2015). To be able to use the methods in accordance with the situation, it is important to link the PEP (product engineering process) with the supporting methods. In the case of the app described above, this was realized by means of the iPeM (integrated product engineering model) which the interactive access part is based on. The iPeM offers the possibility of describing any PEP (Albers et al., 2016). The iPeM is based on the ZHO model (see Chapter 2) which by means of an action system is to transfer an objective system into an object system. The action system comprises the activities of product creation and problem solving. The latter are represented in the so-called SPALTEN process. As described above, SPALTEN is an acronym that stands for the substeps of this problem solving method. The activities of product creation and problem solving add up to a two-dimensional matrix that consists of 70 activities (Figure 3, left). The action system is being limited by the available resources. InnoFox provides the possibility of summing up and assessing a situation and hence enables to identify the stage of PEP the user is in at the moment. This can either be achieved by selecting the activities to be carried out within the iPeM matrix or by means of an interactive dialog of questions. In addition, the intended objectives of method implementation (objective system), the available resources, and the type of document to be created (object system) can be determined. The objective of method implementation may consist in e.g., a reduction in development time or an increase in the degree of innovation. The available resources may be comprised of temporal limitations e.g., of the maximum time available for method implementation, or of personnel and spatial resources. On the basis of these inputs, a congruent value is calculated for each method stored in the method database by means of a specially developed algorithm. The value obtained is used for calculating a ranking of the available methods. The methods database required for this purpose consists of more than 100 methods. To ensure a high practical relevance of these methods, numerous sources e.g., existing method collections, were tested and documented, and the developed list was extended by an inquiry among project partners from the industry and scientific institutes participating in the project. All methods in the methods catalogue have a method profile which again was developed with the help of partners to ensure a high quality of the theoretical contents and the practical relevance of the method profiles. The method profiles aim to give a rapid overview of the respective method and provide support during method application. Figure 3 (left) depicts the possibility of evaluating situations either directly through activities in the iPeM or through the interactive question dialog. Moreover, the criteria of the targets as well as resources can be specified. In addition, it is possible to define the type of object system to be developed. Based on the selection made, the methods are recommended dynamically. The possibility of specifying search results by defining the available resources is shown on the right.

Figure 3. InnoFox – (left) evaluation of situations, (right) specification of resources

Since the different methods are suited for different activities, combinations may make sense and methods building on one another within the respective action field may be chosen. Whereas, within the action field "idea detection", it is useful, for example, to support the activity for generating "alternative solutions" by the method "brainwriting pool". The activity "solution selection" can be supported by the method "pairwise comparison". The respective features are shown in Figure 4 on the left side. On the right, the "IPEK community platform" method is outlined by presenting a method profile. This is a newly developed method (Albers, 2015) that is added by an online enter function.

Figure 4. InnoFox – (left) combining methods, (right) method profile

4.2 Understanding of Methods

InnoFox helps to counteract many of the above problems occurring with the application of methods in PEP. If, in addition, InnoFox is completed with method videos that describe the respective methods, training periods and the expense of application can be reduced. The videos give brief overviews of the methods. The viewers are approached visually and auditorily. If applied correctly, this approach via various media formats leads to a better understanding and an increased recall performance. The stories told in the videos create an emotional link to the viewers and allow them to better comprehend the relevance of the respective methods to their own PEPs. As the users are being inspired to think along the lines of using methods, their attention and absorption of information grow (Chirumalla et al., 2015), and they reflect the stories shown in the videos, compare them with their own experiences in the respective field, and think about solutions to the given problems. The stories told, moreover, through description of an example allow to introduce the methods into the world of the developer while considering experiences gained so far (Bavendiek et al., 2015). In this way, the methods become less abstract, are being brought closer to the user, and method acceptance is being promoted. Part of the work within the present paper was dedicated to the development of explanation videos for e.g., methods 6-3-5, sounding board, Scrum, and FMEA (Figure5).

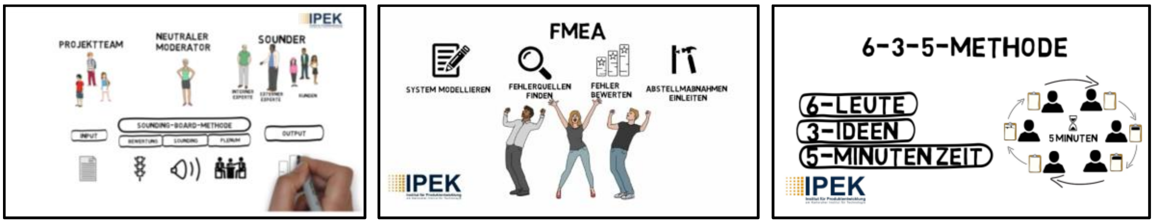

Figure 5. Method Explanatory Videos

The methods for which to produce the explanation videos were selected so as to cover different areas of application and ensure a high relevance in practice. To achieve this, design criteria were developed and implemented in four explanation videos. The explanation videos are aimed at enabling the recipients to generally understand the methods and thus apply them easily. The videos are to arouse the viewers' curiosity and thus motivate them to use the method. Moreover, the videos are to help get users acquainted with the methods and reduce the necessary training periods. The explanation videos are hand-drawn videos created by means of the video software VideoScribe. To produce successful explanation videos, different design rules can be used to make the video attractive and interesting to the viewer and thus optimize video-based knowledge transfer. Below, the production of method explanation videos is explained by the example of FMEA methods.

FMEA is a complex method which due to its description and the FMEA form prescribes and predefines a very clear and structured procedure. In the case of FMEA, the explanation video is to provide a guide for the individual steps and for complete and correct method application. The explanation video is intended to give a practical example that can serve as model. Here too, method-specific terms should be named and explained. The method, in this case, was described by a story whose topic had a technical background and was particularly focused for the target audience: The developed scenario tells the story of a young tinkerer who together with his friends builds cycle trailers from old bicycles and intends to sell these trailers. The group founds a startup but has worries that the market launch could fail through

defects in the product injuring the health of customers and thus decides to subject the product to an FMEA. Exemplary risk assessment is carried out based on the error “release of clutch”. In a first round, this error is assessed as to its significance, occurrence probability, and detection probability using an FMEA assessment form, as shown in the video. To point out what happens if a risk is overestimated applying the risk priority index, the latter is chosen to be still too high after the first assessment and to induce troubleshooting measures followed by a new assessment. The three troubleshooting measures shown in the video are to reduce the significance, occurrence probability, and detection probability and are meant to indicate that in the case of a high-risk error, one should try to troubleshoot all of the three error components and not just one facet. The new risk assessment considering the troubleshooting measures exhibits a sufficiently low risk priority index, which demonstrates the effect of the troubleshooting measures. The video ends with a summary where all phases of the FMEA are briefly outlined again and where the method is finally summed up in a still image.
A still image is displayed which at the end of the video is maintained for a short time and gives an overview of the method. The FMEA explanation video was validated in a validation study during the “Integrated Product Development” project at Institute of Product Engineering. In the course of the project, the students, based on a task defined by an industrial project partner and with the objective of developing innovative solutions, go through the product creation process from product profile to fully operational prototype. The results are shown in Figures 6 and 7. (Groupsample: with video n=24; without video n=18)

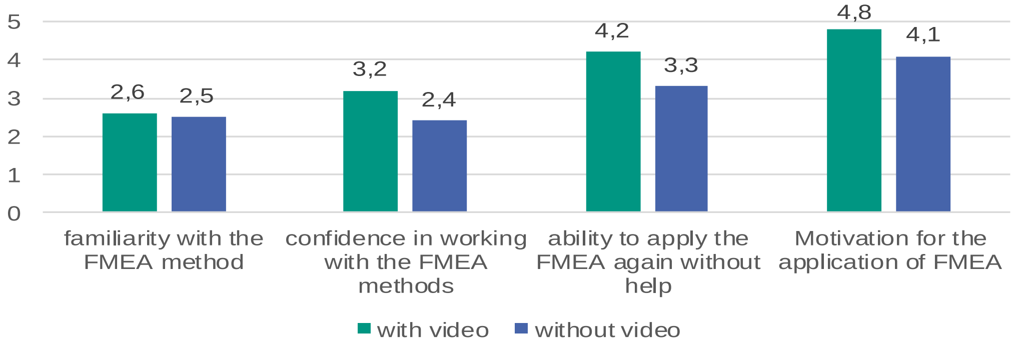

Figure 6. Increasing the safety and motivation of method application

The questionnaire was completed by 40 persons. In the first block, the factors familiarity with methods, safety, learning effect, and motivation were inquired on a scale from (1 - very low) to (5 – very high). Figure 5 reveals that although all participants were almost unanimous in estimating their previous method knowledge, the groups who had seen the video before felt safer in applying the method. By these groups, the information given was considered to be more helpful than by the group that only had the opportunity to prepare itself based on a textual description. Figure 5 (left) points out the problems that occur while the method is being implemented. The non-video participants, for example, often said that they had problems with understanding the general context of the method. It was found, however, that both groups had run the method completely. Even greater differences can be perceived regarding the terms and concepts used. Only 27 percent of the participants in the video-supported project groups but the majority of the non-video participants said they had problems with the terms and concepts. Regarding the question as to how long it approximately took the teams to begin with FMEA (compare Figure 4, right), the non-video participants estimated the time to have been 1.5 minutes longer than was reckoned by the members of the video-supported group. This corresponds to about 12 percent of the training period. To compare the quality of the results, diverse error causes were collected and declared as being 100 percent. Whereas the video-supported groups on the average found 69 percent of the error causes, the non-video teams found only 57 percent.

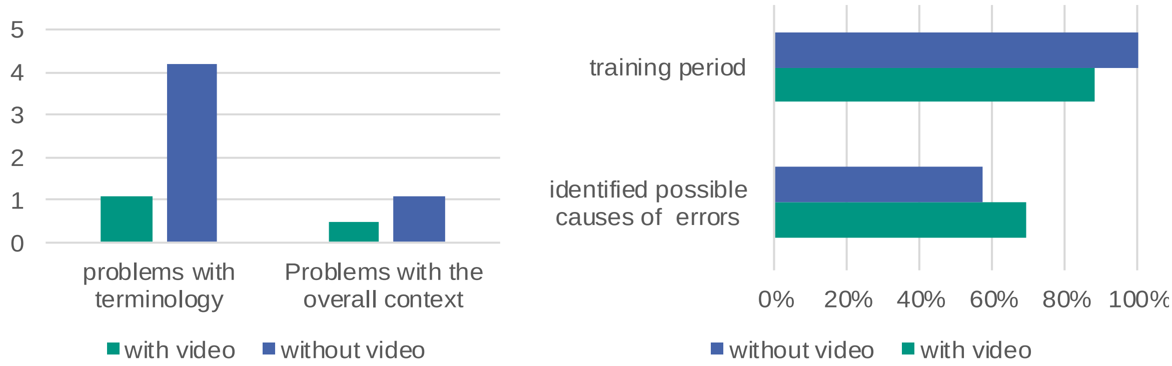

Figure 7. Problems with method application (left), success parameters of method application (right)

The validation study has proved the explanation videos to have positive effects both on the quantity and quality of the results. In line with this, the video-supported teams were able, on the average, to identify more error causes from a larger spectrum of functions. Moreover, it became clear that explanation videos were used as guidelines and were able to help the project teams perform the individual steps of FMEA correctly and completely. In addition, it was found that the videos can contribute to answering some basic questions on the method and its application.

4.3 Application of Methods

Lacking experience as well as a lacking sense of achievement in method application often are observed in practice. Additional benefits are perceived only rarely. The question is, how can methods be learned and experienced in a controlled practical environment and how can actual achievements be attained? A possible approach to increasing the frequency of application and the acceptance of methods is to learn and implement them by playing. This may reduce application obstacles and increase method application. In the literature, this novel approach is referred to as gamification (Entwistle and Ramsden, 2015). In the projects performed at the Institute of Product Engineering, a game format for method learning and experiencing was developed. It was the objective to create a learning game by means of which methods can be learned and experienced using the SPALTEN problem solving method. The objective of the project that provides the basis for this paper is to develop a learning game for learning and experiencing the SPALTEN problem solving method. The development objective is to create a physical learning game by means of which the SPALTEN problem solving method can be learned and experienced in small groups (3 – 7 persons). Primarily, the game is to be applied in a SPALTEN workshop in an industrial environment where participants first learn the theory which they can subsequently apply in the game. It is conceived for small groups with technical/academic background and is intended to take no more than half a day. The physical learning game is applied within the framework of method workshops in industry and education.

The game consists of a main game and eight stations (stations “selection test” and “S”, “P”, “A”, “L”, “T”, “E”, “N”). The main game provides the central theme and makes available the story behind the game. The cooperative game, which consists of different stations and a board game-type main game, uses different development methods. Each station e.g., the station “situation analysis” represents an activity within the SPALTEN method. The players in the game go on an expedition by ship with the objective of discovering SPALTEN Island as they solve different problems by means of supportive development methods made available to them. Whereas the game, as a matter of fact, primarily meets the demand for fun and variety, its eight stations focus on learning, experiencing, and applying the SPALTEN methodology. Since a separate problem scenario was created for each of the stations, the individual steps of SPALTEN are not being dealt with one after the other based on only one problem. Strictly speaking, each station is a game on its own that is connected with the other games (or stations) through the main game. The stations’ modular structure enables individual assessment of the subgames, targeted enhancement of individual stations, and derivation of training concepts in accordance with specific demands.

Evaluation is made in four workshops with experts (n=19) from development practice on the one hand and students (n=12) of integrated product development on the other hand. The group sizes are varied to be able to identify possible problems for different numbers of players. Between the stations, targeted feedback is requested for the purpose of evaluation. After each station and during the entire game, the test players, in addition, answer questions on standardized questionnaires. The results of the study are pointed out in Figure 8.

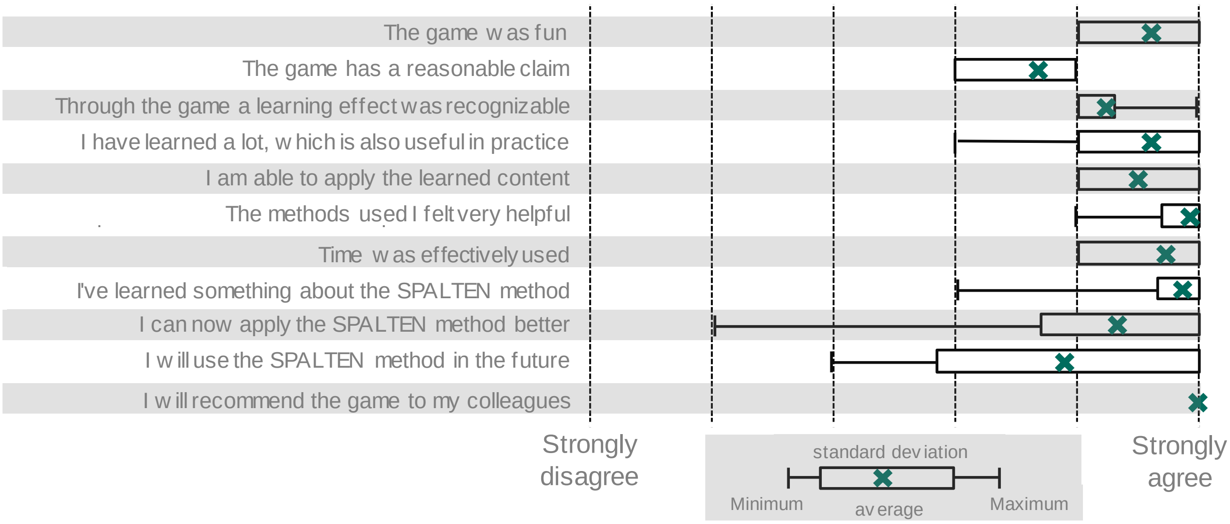

Figure 8. Game evaluation by the test players (N=31)

The positive assessment of the game and evaluation of the learning success are completed by a high teambuilding character owing to the fact that to be successful, the players must cooperate intensively for as long as four hours. Besides, since the players immerse deeply in the game and control their behaviour less actively, monitoring can provide insight into their personalities.

5 CONCLUSION AND OUTLOOK

The three approaches InnoFox, explanation videos, and the Methodgame "SPALTEN-Expedition" reveal that approaches according to Bloom's taxonomy may contribute to method acceptance. InnoFox enables using methods suitable for specific situations and requirements and thus contributes to the "knowledge of methods". Explanation videos considerably reduce the obstacles to getting acquainted with new methods and, in this way, contribute to the "understanding of methods". The SPALTEN expedition generates a sense of achievement in the controlled environment through the "application of methods". Studies that will follow intend to investigate how the expense of method application can be reduced. First studies suggest that the reusability of partial results on working with methods has a positive effect on method acceptance. This can be explained by the fact that the major part of products is developed in generations (Albert Albers et al., 2015). Developers, hence, are used to reusing some aspects while enhancing other aspects of their work. It follows that, if results of the work on methods, as in the case of FMEA, can be adopted for the new product generation, efforts can be considerably reduced in the subsequent generation. It is thus a central task of the developers of methods to consider the approach of product generation engineering in the future.

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