IDEA – TOWARDS AN INTERACTIVE TOOL THAT SUPPORTS CREATIVITY SESSIONS IN AUTOMOTIVE PRODUCT DEVELOPMENT

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ABSTRACT

The basis for developing future products in the automotive industry is finding creative and innovative solutions. Ideas can be found by means of creativity methods that support product developers throughout the creative process. Product developers are provided with a variety of different and new methods. This leads to a "method jungle" in which it is difficult for product developers to find the most suitable path. The successful use of methods in product development goes hand in hand with the acceptance and implementation of the methods. Despite the added value, only a low use is observed in the development process. The field of Creativity Support Tools also offers a wide variety of different tools that support the creativity process. Although a chasm exists between the many CSTs that are developed and what creative practitioners actually use. Therefore, previous studies iteratively developed a user-centered tool called "IDEA" that tries to provide a tool that responds to users' needs. The question arises how the developed tool IDEA performs in "real life setting" regarding its UX and usability as well as the creativity method acceptance and level of mental workload.

Keywords: Creativity, User centred design, Workspaces for design, IDEA, interactive surface

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1 INTRODUCTION

The basis for developing future products in the automotive industry is finding new creative and innovative solutions and ideas. Ideas can be found by means of creativity methods. Creativity methods support product developers throughout the creative process. Product developers are provided with a variety of different methods and new methods are continuously being developed (Becerril et al., 2019). This leads to a "method jungle" in which it is difficult for product developers to find the most suitable path. The successful use of methods in product development goes hand in hand with the acceptance and implementation of the methods. Despite the added value, studies show that only a low use is observed in the development process (Reiß, 2018). The field of Creativity Support Tools also offers a wide variety of different tools that support the creativity process. Although Frich et al. (2019) points out the "existence of a chasm between, on one side, the many (and diverse) CSTs that are developed in research labs and, on the other, what professional creative practitioners actually use." Furthermore, Gabriel et al. (2016) indicates that CSTs do not focus on the "real needs" of users with tools being abstract or only supporting a small part of the creativity process. Therefore, previous studies iteratively developed a user-centered tool called "IDEA" that tries to provide a supportive tool that responds to users' real needs (Kaschub et al., 2022, 2021a,b). The question arises how the developed tool IDEA performs in "real life setting" regarding its UX and usability as well as the creativity method acceptance and level of mental workload. In the following section the according study design and results are presented.

2 METHOD

2.1 Study design and participants

To evaluate and analyze the concept, a 3x4 explorative mixed-method study design was chosen. The study design consisted of four stages: a pre-test (demographic questionnaire and acceptance of creativity methods), a workshop part (introduction to the tool IDEA and active usage of the tool to experience the tool in action), a post-test (questionnaire consisting of standardized questionnaires and specific questions about IDEA) and the final stage - a semi-structured group interview. In total the workshop and additional post-test and interview took 2,5-3 hours. 12 participants (three female and nine male) took part in the workshop. The area of expertise and work experience was within the domain of mechanical/electrical engineering mostly focused on product development in the automotive sector. The participants worked in industrial settings (58%) as well as in research settings (42%) with 11 participants having a master's degree and one participant with a bachelor as highest degree. When asked about their usage of creativity methods, 58% indicated a usage of one time per month and 42% never applied creativity methods in their daily work life.

2.2 Material

2.2.1 Demographic questionnaire, pre-test and other material

To set up the study, different materials were developed and compiled. The demographic questionnaire and pre-test were the first aspects of the study participants encountered. The questionnaire could only be filled in, if the participants accepted the terms of the data protection form. The questionnaire was divided into four parts. The first part focused on demographic aspects such as gender, work experience, degree etc. This part was followed by questions directed towards participants' specific usage of creativity methods and experience/knowledge on methods and processes (e.g., design thinking, systems engineering, VDI2221). The pre-test of the acceptance of creativity methods took over the next part of the questionnaire. Here, the TAM2 was used to study the acceptance of creativity methods by users before the usage of IDEA. In total the questionnaire took about 12 minutes to complete. To get users comfortable at the beginning of the actual workshop and furthermore introduce the researchers, a short presentation was shown depicting the LEGO personas of the researchers. These personas were used as a representation of the researchers depicting different features accounting for the different persons.

2.2.2 ProTable, VD1 and VD1 companion

The study took place at the ProTable, which is a custom developed interactive surface. It consists of two projectors mounted at the ceiling and a regular conference table. The projectors are driven by a

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computer which uses the custom developed software Virtual Desktop One (VD1), to render a three-dimensional window manager onto the table's surface (Bues et al., 2018). VD1 enables an interactive surface to display desktop-applications in windows that can be rotated, scaled, and resized freely. This allows for example to scale up an architectural plan to be watched by multiple persons. VD1 also allows users to create sticky notes which can also be rotated and scaled freely. Likewise, VD1 builds a suitable base for creativity sessions. VD1's external interface enables remote control and content sharing.
Although VD1 can handle different input systems like touch, mouse, keyboard, and tracking systems, in this study a setup with external devices (e.g., laptops, tablets) was chosen due to external limitations. Therefore, three Microsoft Surfaces with external mice were placed around the ProTable. This setup tries to depict a real-world setting of creativity sessions within product development. Every user can bring his/her custom device including his/her custom data and applications. The Surfaces and the personal menus on the ProTable form the personal space that is differentiated to the common space. This menu is color-coded for each user and enables them to add sticky notes and points for actively working with the methods and be able to complete templates given during the sessions.
To enable sharing of custom data and applications from a personal space to the common space, every device was equipped with a VD1 companion application. This application uses the external interface of VD1 and enables the user to use the input of the device (e.g., mouse and keyboard) as input of the VD1 software and therefore the ProTable. Furthermore, it allows sharing of local data by sending screenshots, images, PDF files, and website-URLs to the ProTable. By sending such content a new window appears on the ProTable which can be moved and scaled freely and closed when no longer needed. To mimic the setting that participants of a workshop would bring their own data already developed during a project, the Microsoft Surfaces were prepared with data related to the task they had to accomplish in this study: a CAD-model of an autonomous vehicle that could be viewed on the Surfaces, a project sketch with a description of the goal put up by the client as well as a PDF of the documentation of the previous/first phase 'problem'. To be able to capture analog input during the workshops a camera was also mounted at the ceiling to take photos.

2.2.3 IDEA

IDEA (Integrated Development Environment Assistant) describes the building blocks that set up this specific creativity support tool. A variety of different building blocks was implemented, each having their own specific function within the tool. A full depiction of all IDEA building blocks can be found in Kaschub et al. (2021a). Due to external limitations not every specification of all building blocks was implemented. The study only used a minimal viable product version to evaluate the tool.
The main building block are the **process bubbles** which serve as the main menu on the ProTable. The three bubbles are Problem, Idea and Prototype and do have a submenu to receive info about the phase and its goal, an overview on creativity methods or show retrospectives. Besides the three bubbles a settings menu is located to set some presets of the IDEA-tool (e.g., how much support is wished from IDEA, 'we are stuck and need help button', as well as adjusting the frequency of screen captures taken by IDEA).
The **creativity methods** and the **retrospective** make up their own building blocks. The **creativity methods** user interface (UI) provides an overview of methods applicable to the according phase (the prototype-phase was only equipped with ten methods per phase with the option to add additional methods later). In addition to the overview, it provides a method quiz to find the most suitable method for the current setting. Here, an adaption of the method selection of Reiß (2018) was applied. Due to the design of the study (comparability of results) this quiz led to the same method regardless of what answers were provided by the users. After finishing the quiz, the three top methods were shown with the previously selected method (e.g., most suitable method) visually highlighted to nudge the users to choose the predetermined method. After selecting a method, the UI shows a step-by-step description, a short explanation video and a fact sheet as well as ratings of other users. By starting a method, the according template opens on the ProTable including a description and duration of the current step in the execution of the method. This content always adapts to the current step (e.g., additional arrows).
The **retrospective** forms another building block essential to IDEA. Users were shown the final state of the workspace e.g., the filled template and IDEA asked users to add 'blops' (half transparent circles with text) above the according space (e.g., 'important for project meeting next week'). This workspace with the corresponding blobs is saved and could later be found in the menu option 'retrospective'. This

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submenu enables the users to view the evolution of their ideas and data by scrolling through a timeline of different workspace captures. By selecting them, the UI zooms into the capture to show its details. This was especially important for users to view information beneath a 'blop'. Furthermore, a search function allows filtering different retrospectives according to their date and method/phase. Additionally, an automated PDF documentation was integrated, providing a summarized view of working sessions in an acquainted format.

During the study the users were only able to complete one predetermined creativity method 'analogies' within the second phase 'Idea' due to time restrictions. The study's setting aims at preventing that users only experience one method within one phase to allow them to achieve a deeper understanding of the feature **retrospective** and experience the tool as a whole that covers the complete creativity process. Therefore, users were told that a part of their project team had already completed the 'Problem' phase and their role was to use these results documented in the retrospective to gain insights in the current project status and apply the results in the consecutive 'Idea' phase. A retrospective and PDF documentation with completed material and data was therefore prepared and inserted into phase one to be found and explored by the users themselves.

Another building block within IDEA are the **sense elements** consisting of a warm-up and mind wandering task (Kaschub et al., 2022). These elements were implemented in a predefined manner to achieve comparability between different workshops. When the method 'analogies' was started, a pop-up appeared with detailed instructions on a warm-up task to build LEGO personas of the users themselves and hereby get comfortable with each other and break the ice. Users were equipped with three LEGO serious play starter kits. The second pop-up appeared before the last step of the creativity method. Here, a task, focused on mind wandering, was implemented. Users were asked to stand up and move to get coffee and snacks (prepared beforehand). Afterwards, a short meditation and breath working session took place. A short video (approximately 2-3 minutes) was started within a pop-up window with the Star Wars character 'Chewbacca' executing the breathing task as well as a description explaining the meditation session. This specific meditation session was chosen to get users comfortable with this new, unusual, and somewhat 'intrusive' task within their common work environment. The pilot study suggested that users are familiar with the character and were more unprejudiced and impartial to follow the task. After the mind wandering and warm-up sessions, users directly got back to their task.

(a) Wireframe of IDEA (b) IDEA in action

Figure 1. Visualization of IDEA

2.2.4 Technical implementation

The IDEA User Interface is developed using web technologies. Therefore, the ProTable just needed to show a web browser with the website of IDEA running on a local server. The NodeJS Server loads the descriptions and metadata of the creativity methods. Likewise, the database of available methods can

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always be edited and expanded. The process bubbles, method descriptions, method canvases, retrospectives etc. are all website, dynamically created using the method descriptions and stored data e.g., history in the form of JSON-files. These websites contain JavaScript code to interact with the ProTable, more precisely the VD1-software. It is using the VD1 interface to spawn new browser windows with specific IDEA Content, create sticky notes, manipulate windows, or capture screenshots.
This interface of the VD1-software is implemented using GRPC. GRPC allows describing remote procedure calls via its own interface description language. It works across a variety of programming languages including python and JavaScript. The companion app is implemented in python and uses the VD1-interface as well. The graphical user interface (GUI) is realized using wxWidgets. The GUI allows capturing input events and creates local screenshots. It uses the remote procedure calls to send this data to the ProTable.

2.2.5 Post-test

The post-test was executed with an online questionnaire tool and linked directly to the Surfaces used in the study to ensure easy access for every participant. The questionnaire consisted of five parts with standardized questionnaires as well as questions directed towards specific elements of IDEA. The first part consisted of the RSME - Rating Scale for Mental Effort (Paas et al., 2016) and the NASA-TLX (Hart and Staveland, 1988) to be able to evaluate mental workload directly after the tool was used. These questionnaires were followed by the CSI - Creativity Support Tool Index (Cherry and Latulipe, 2014), the SUS - System Usability Scale (Brooke, 1996), the UAS - User Acceptance Scale (Laan et al., 1997) to study the general usability and UX of IDEA and support generated by IDEA. Then, the TAM2-Technology Acceptance Model Questionnaire (Part 2) was applied to provide a comparison of creativity methods after the usage of IDEA. The last section of the questionnaire consisted of questions directing towards future relevance of the different building blocks of IDEA (retrospective, pop-ups etc.). A Likert scale determined the level of future integration of users. The questionnaire took about 20 minutes to complete.

2.2.6 Observation form and semi-structured interview guideline

To be able to not only derive a quantitative vision of IDEA, a qualitative aspect was added. This ensured that the derived quantitative data could be filled with 'life' as the qualitative data provided impressions, feelings and opinions that supported the bigger picture of the study as well as the illustration of details that would not have been captured.
During the workshop, the participants were observed by three researchers throughout the entire period. For this purpose, an **observation form** was prepared with criteria that served as a basis for evaluation of the observations as well as to create and ensure comparability. The observation form was completed by the researchers independently when an activity/statement fit one of the categories of the form. It included the following aspects: IDEA building blocks and their usage, problems that occurred during the workshop, statement made by users regarding criticism or praise, other important incidents as well as the general group dynamic and atmosphere in the team. The observation form provided tick boxes and free text fields to annotate the different findings accordingly. The group dynamic and team atmosphere were documented with the support of predefined adjectives to be ticked off for a better basis for discussion. Following terms were applied: exuberant, quiet, tense, relaxed, many discussions, conflict-averse, dynamic, undynamic, funny. This question served as an additional basis for interpreting the results due to the potential of high impact of group dynamics on other measurements.
The workshop was concluded with a **semi-structured group interview**. The aim of this final interview was to gather opinions, statements, and impressions on IDEA and to gain additional insights into the different building blocks of IDEA. For this purpose, a guideline was drawn up for the interview. The group interview opens with a question on the influence of the IDEA on the acceptance of creativity methods. First, the participants were asked about the criteria that prevent the use of creativity methods in their daily work and to what extent they are addressed by IDEA. This part was followed by the question of whether IDEA could contribute to increase the use of methods in everyday work. Afterwards, questions directed to future usage of the different building blocks (warm-up, mind wandering retrospective) were asked. Subsequently, general opinions of the participants on IDEA were collected, in which positive and negative aspects of the prototype are queried. Finally, suggestions for improvement, other comments and ideas were collected.

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2.3 Data collection - Procedure

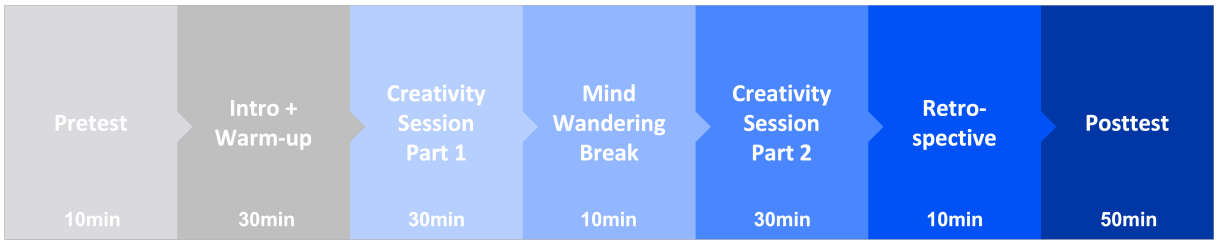

Figure 2. IDEA Workshop Procedure

2.3.1 Pilot study

A pilot test was used to test the study design before the study was conducted. During the workshop, some difficulties arose in the form of problems with the ProTable System VD1. These led to repeated crashes of the entire system and could not be resolved. Therefore, the test was adapted by using analogue instead of digital sticky notes for the execution. This was also adopted for the further studies, whereby the test subjects should first be given the opportunity to try out the use of the system with digital sticky notes. To be able to view a history, pictures of the table were taken with a camera and the prototype was adapted, so that the researchers were able to manually enter these pictures during the process. Furthermore, changes were made with the phase that users should work (switch from problem to idea phase) on and the time management (additional manual time timer).

2.3.2 Demographic questionnaire, pre-test and workshop introduction

One week before the workshops the participants were sent an online questionnaire as well as the data protection form (which was signed at the beginning of the workshops). They were asked to fill in the questionnaire (approx. 10 min) before the workshop (see *Pretest* in Figure 2). The workshops were held at the Visual Interactive Technologies Lab (equipped with a ProTable) of the Fraunhofer IAO. During the workshops three researchers accompanied the three participants and filled in the observation-form during the entire workshop to keep track of problems and issues that occurred as well as annotations made by the participants. Two researchers engaged with the participants directly during the workshop for explanations and questions, the third researcher took responsibility of the technical aspects and the camera to ensure the workshop is running smoothly. Still, issues occurred (sudden crashes of the whole system as well as freezes within the interaction of IDEA). In those cases, the tool was restarted, and the researchers restored IDEA to the step that had previously been running. Furthermore, it was explained to the participants that these crashes were not their responsibility, but were due to the tool being still in a prototype state and that these issues should be disregarded during evaluation.
After the participants had signed the data protection, the researchers introduced themselves by sharing pictures of their LEGO personas on the ProTable and introduced the participants to the study setup of IDEA. The functionalities of IDEA, the ProTable and the VD1 companion were explained to the participants. The participants were able to test out the features afterwards to get comfortable. This ensured that participants also experienced the digital sticky notes, still they were later asked to use analog sticky notes due to technical issues during the pilot study. Next, the participants were introduced to the use case and their task for the workshop. Here, one participant shared the project sketch from their Surface directly to the common space to be able to go through the task description together. Afterwards the process bubbles were introduced with their features. This was executed by using the pre-filled first phase 'Problem'. Here participants were shown how to select a fitting method and then were acquainted with the different captured workspaces as well as the retrospective and the PDF documentation. This PDF documentation was also available on the Surfaces.

2.3.3 Experiencing IDEA

During the next phase the participants experienced IDEA without any disruption from the researchers to be able to grasp an idea of how the tool would perform during their daily work life. The researchers only intervened when difficulties arose, or specific elements were disregarded by participants (such as

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method selection quiz) to ensure that all participants of all groups had a similar experience of IDEA. The participants began getting familiar with the topic and task at hand as well as studying the provided material (retrospective and PDF documentation). This was mostly done individually, and sometimes the PDF documentation was also shared on the common space. As a next step participants began to work on the second phase 'Idea'. Here, the procedure was also mostly the same with all groups. They made themselves familiar with the method submenu, checked some methods in detail and decided to take the method quiz to find a suitable method. Most of the time the participants chose the method that was nudged to them (only once the researchers had to intervene). Then the method 'analogies' were studied in more detail. The explanation video was always viewed, and the steps and general information were studied further.

When the method started and the template appeared, IDEA provided a first pop-up and suggested a warm-up (LEGO Persona) before starting the creativity method (see *Intro + Warm-up* in Figure 2). This warm-up was executed by all groups, although some participants first showed some hesitation. Due to IDEA only being a prototype, an analog timer was started by the researchers (according to the time suggested per step on the explanation). Afterwards participants began with the first creativity session (see *Creativity Session Part 1* in Figure 2). In this phase the participants started using the 'analogies' method, where the problem occurs and then proceeded with the second phase on finding solutions that are applied to solve the problems in these other areas. The explanations provided were understood, and no further questions arose. Then, participants proceeded to dot-vote their favorite solutions and also changed the positions of their top four solutions to the arrows accordingly. Although researchers timed the steps with the timer, sometimes the alarms were disregarded. In other situations, the amount of time however helped the participants to figure out how deep they would/should dive into the step.

Before the fourth and last phase, IDEA provided the participants with another pop-up(see *Mind Wandering Break* in Figure 2). The Mind-Wandering pop-up first showed general information on its usefulness and suggested standing up and get something to eat and drink. This first part led to discussions and disagreement between participants about the adequateness of this suggestion. Some users wanted to proceed and not be taken out of their tasks, others endorsed the perfect timing of the break. After almost all participants had proceeded to take a break (only two decided to keep seated and go on their smartphone or keep researching possible solutions to the task) the second part of the Mind-Wandering pop-up with the meditation video started after 10 minutes. Before the video was started (meditation was executed with every group) similar discussions began as during the first part. But every time the group decided to start the video/meditation and 'just try it out'. Most of the participants seemed to follow the instructions and some even closed their eyes and followed the breathing sounds provided by Chewbacca. Afterwards, the participants dealt with the last step and transferred their top four solutions to the automotive robot-taxi context and discussed their main ideas (see *Creativity Session Part 2* in Figure 2). Then they finished the method, and a photo was taken manually by the camera above (due to analog sticky notes). They proceeded to rate the method (with stars and a short review) and were able to choose if they wanted to receive a PDF documentation of their session and results. Meanwhile, the captured workspace picture was integrated to IDEA manually, and they were able to proceed with the retrospective on this captured workspace. Here, all participants resumed their ideas in different bubbles which also led to further discussions about different interpretations and further ideas (see *Retrospective* in Figure 2).

In the following phase, the two researchers took over the session and showed how participants would be able to proceed during their next sessions (open last workspace function) and where they find their workspaces and the retrospective as well as the documentation. The last aspect which was shown to the participants was the three buttons on the left-hand side of the process bubbles (IDEA help button, settings and manual capturing).

2.3.4 Post-test and semi-structured interview

Directly afterwards, the participants were asked to complete the post-questionnaire (that took approx. 20 minutes, see *Posttest* in Figure 2). The questionnaire was conducted on their Surfaces, so they could directly move on at their place. Afterwards the two researchers started the semi-structured interview (approx. 20-30 min). Depending on the answers given by users, researchers directed their questions to gain more details and insight on users' statements. The researchers took notes on the provided answers.

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2.4 Data analysis

The data from the questionnaires was viewed, but no data cleaning was necessary. The standardized questionnaires were analyzed according to their reference (Cherry and Latulipe, 2014; Hart and Staveland, 1988; Paas et al., 2016; Laan et al., 1997). To take a closer look at the effect of IDEA on method acceptance, the significance of the differences of the items and categories (TAM2) before and after was tested under the assumption of a normal distribution with the help of one-sided t-tests for connected samples (df = 11; α = 5 %). After each workshop, the three researchers collected their observation forms and their interview notes and discussed different viewpoints. Furthermore, the dynamic of each group was discussed in more detail to receive a complete picture of the different settings. Then, statements of participants were collected that were relevant to the researchers during the workshops. The data was condensed to the main categories per workshop which are described in section three. These results were used in combination with the different questionnaires to not only provide a general quantitative statement, but to be able to grasp the impressions on a more detailed and specific level.

3 RESULTS

In general, the tool IDEA was evaluated positively. Participants stated that the awareness of creativity methods and general knowledge on the topic is not very pronounced in the engineering field and went on to review the workshop as a 'real aha moment'. They verified and confirmed the usefulness of the tool by being able to develop new ideas. They stated that they were able to increase their quality of ideas and reached new approaches of thinking. Moreover, they stated that 'whiteboard tools are a dime a dozen, but the structure of IDEA does not exist elsewhere'. Although, also negative feedback was given which was mostly directed towards the kind of interaction which was provided by IDEA

3.1 Mental workload

The NASA TLX grants a quantitative view on how the mental load was perceived for participants during the study. With a raw score of 29.58 it indicates a medium workload level [10,29] = medium workload. The second questionnaire RSME (Rating Scale Mental Effort) indicated an effort level between 'almost no effort' and 'a little effort' (M=23.5, SD=27.5). This indication of a low-medium level of mental effort is also supported during the interview and the statements given by participants during the workshop. The low threshold of explanation, videos, step by step etc. seems to lower the mental load 'I don't have to remember anything, but the tool does it for me and I can fully concentrate on the task'. Participants noted that IDEA enables a focus on the essentials and a 'freeing of mental load and thus concentration on the content that is essential'. In other settings participants marked that there is a lack of support, especially for small workshops. There, participants previously needed to take care of organizing, planning, and structuring which led not only to a lot of effort and time for preparation, but also effort required during the workshops to keep the meetings on track. During the workshop users can focus only on the problem at hand. One participant summarized this aspect by saying: 'I don't want to know what and how the tool does its things, I just want to know that I'm doing the right thing and that it is possible (with IDEA)'. Another important aspect of IDEA, linked to mental workload, seem to be the features of the retrospective: 'You can stop in the middle (of a session) and start again, everything is saved, that really is a liberating feeling'. Furthermore, users stated that the photo and screen captures fit into their mental model. Moreover, the feature of restarting a previous session with the affiliated workspace seems to lower mental capacities 'this saves effort and time rebuilding and getting into old sessions'.

3.2 User experience and usability

'There is a lot of potential'. This was a statement given by one participant when asked on their general impression and their vision of the future of the tool. This is also reflected in the results of the post-test questionnaire. Almost every building block of IDEA should be integrated to future versions with score (Warm up: 4,17 SD=0,83; Mind wandering: 4,42 SD=0,67; ProTable: 4,58 SD=0,51; Method Quiz: 4,67 SD=0,65; Method Instructions:4,58 SD=0,67; Retrospective: 4,08 SD=1,00).

To be able for IDEA to function and be applied by users in the future, the UX and usability of the tool builds an essential facet within the evaluation. Therefore, three standardized questionnaires grant a quantitative base to study this aspect in more detail. The System Usability Scale indicated a high usability (M=75.63, SD=12.89) as well as the subscales of the user acceptance scale (usefulness scale:

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M=1.42 SD=0.41; satisfying scale: M=1.46; SD=0.42). Furthermore, the Creativity Support-tool Index also suggested a high support (M=33.86). This is also reflected by the statements provided by participants. IDEA seems to provide a low threshold. This low threshold derives from different features of IDEA. For example, users do not need an external moderator 'this definitely drops my hurdle to use it and try out new methods','I thought it was great, I really arrived in a relaxed mindset afterwards (referring to the meditation)'. It helped with social pressure, that a tool suggested the break and not one of the team members needed to. Users stated that IDEA pop-ups would provide a good base to 'really take the break and not say so and keep on working with a coffee in my hand'. The retrospective functionality provided a key feature for users. They pointed out that the retrospective saves time and effort while also being simple and useful. Furthermore, users indicated that the 'automatic' manner of capturing information helps to remember details of the process and furthermore to being able to structure and annotate their ideas later. The screenshots are automatically stored in the right place which seems to 'fit the mental model'. The additional feature of a PDF documentation seemed to complete the process with a well-known and typical format. One participant disclosed a 'willingness to pay of 100%: I would pay so much money to have that right now in my daily life.'

3.3 Acceptance of creativity methods

As stated previously, the acceptance of creativity methods within product development is low. This seems to be also true for the participants of this study (only 58% used creativity methods one time per month, the rest had never applied creativity methods in their daily work life). In the following section a closer look will be taken on the changes between the pre- and post-test for the TAM2 questionnaire. A significant difference between creativity method acceptance before and after using IDEA could be found for the subscales PEoU $t(11)=2.43$, $p< .05$, OQ $t(11)= 2,14$ $p< .05$, and RD $t(11)=2,36$, $p< .05$. The results could also be supported by a user statement: 'The tool could convince one or the other of creativity methods, since IDEA makes less tangible methods more tangible; You don't have to know all the methods beforehand, but you can still use them all; If you don't know how to use the method, you feel lost - but I didn't feel lost with IDEA.' A user noticed that the main benefit is that the method usage inside IDEA is intuitive and can be executed in an independent manner. It seemed that this building block serves as the main feature for future usage: 'Worth gold in everyday work settings; the method selection with decision support is absolutely necessary; You make someone (consultant) unemployed; As an engineer, you just do a brainstorming session, nobody wants to research methods, but with this tool it's easy - you just try out something new.' However, users also suggested feedback for further improvement. For example, method templates should be adaptable according to the problem at hand (e.g., complex problems might need more than four main points). Users suggested that the tool should somehow learn from their users and their input and provide intelligent suggestions and templates in the future.

4 DISCUSSION AND CONCLUSION

The results of the study could deliver a first step towards a Creativity Support Tool that responds to the 'real' needs of users while not being too abstract and out of users' actual daily work life scope. IDEA seems to have a positive impact within a wide range of aspects that are important for Creativity Support Tools and users within product development. The mental workload could be kept within a low-medium workload level which seems to be most efficient to solve creative tasks (Sun and Yao, 2012). Furthermore, the UX and usability of IDEA was promising for an implementation and actual use within users' daily work life. Still this study only serves as a first explorative view. Future research should focus on specific functionalities and influencing factors to further improve and adapt IDEA. For example, the 'natural interaction' with the tool and what kind of interactions are most suitable for this use case (touch, pen, etc.) should be explored. Furthermore, a closer look should also be taken on how the data collected by IDEA (content data such as retrospective as well as process data such as when which method was chosen etc.) can be fruitful for IDEA to learn from users and provide more intelligent suggestions within the different phases of the process. Globalization and the arising 'New Work' demands ask for remote collaborative settings, which should be addressed in further development of IDEA (Gabriel et al., 2016). The quote of a user during the study 'IDEA provides a first outlook of an ideal future' summarizes the status. According to users, there seems to be a lot of potential, but still many variations are possible, and adjustments are needed to make IDEA fully functional for daily use.

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