

IAC-19-B3.5.50193

Enhancing Crew Training for Exploration Missions: the WEKIT experience

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Abstract

Training is an essential component of astronauts' mission preparation. Every astronaut receives specific trainings for the tasks to be performed in orbit, both routine and emergency, during the two years preceding the launch. Moreover, astronauts are assigned to perform On Board Training (OBT), in order to practice and maintain a high level of proficiency, in particular for complex and emergency procedures. The astronaut training process needs to further evolve and adapt to the different conditions and requirements that come with long-duration exploration missions. Currently, the training period for an astronaut takes between 18 and 24 months. Projecting this estimate onto a Mars/Moon mission with two-year duration (i.e., including the long-distance journey to Mars and back), a training period of about six years would be required, but is not feasible. In addition, today, the Ground Team continuously supports crewmembers while they are performing activities on board the International Space Station (ISS). This will not be possible during a mission to Mars, since the communication between Ground and Mars is affected by a delay that can range from 8 to 20 minutes, depending on how Mars and Earth are aligned in that specific moment.

The WEKIT tool introduced in this paper is expected to fill these gaps by reducing the training duration necessary and by providing support to the crew when communication with Ground is not available, increasing their autonomy. WEKIT is a research and innovation project supported by the Horizon 2020 program dedicated to developing and testing novel ways of industrial training enabled by Smart Wearable Technology (WT). The twelve partners representing academia and industry from six countries in Europe have built a new learning technology platform and unique methodology to capture expert experience and share it with trainees making industrial training more efficient, affordable and engaging. This paper describes the methodology utilized by the consortium to design the WEKIT software and hardware, its features, and the feedback obtained from the almost 200 participants who tested the prototype in ALTEC to demonstrate and assess how the learning processes can be improved in terms of effectiveness, time reduction and user perception by using the proposed methodology.

Keywords: Augmented Reality, Training, Work Support, Knowledge Capture

Acronyms/Abbreviations

AR - Augmented Reality
ODF – On Board Data Files
ISS - International Space Station
SPU - Sensor Processing Unit
WEKIT - Wearable Experience for Knowledge Intensive Training
WT - Wearable Technology

1. Introduction

Many industries in Europe are finding it difficult to update the skills of their workers sufficiently fast and in an affordable way, to keep pace with their global competitors. At the same time, established training methods, including some forms of e-learning and on-the-job training, currently have a content bottleneck (one symptom is delivery of obsolescent trainings), posing a challenge in particular to abruptly emerging and quickly changing training needs.

To overcome the prevalent content bottleneck, the European collaborative WEKIT project has developed novel methodology for training skilled workers with the help of an Augmented Reality (AR) platform. This includes a novel pedagogical approach where skilled experts demonstrate what needs to be taught, with the demonstration being captured in rich media and using, where needed, additional wearable sensors to record the experts' body movement, voice, or point of view. When using the system, trainees replay the rich media as augmented learning content in the AR environment, in order to receive the expert guidance when the experts are no longer physically present. Wearable sensors on the trainee provide data that allow monitoring of trainees' actions and benchmarking against expert performance, so that assessments can be provided and detailed feedback can be given to the trainee. The technique is novel and is expected to shorten training processes, reduce training costs and improve quality [1]. The prototype was subjected to rigorous testing, utilizing a space exploration procedure tested in the physical Mars terrain simulator of ALTEC (recharging of a rover's batteries) to validate its applicability to training astronaut activities for exploration missions. The application, the tests conducted, and findings are reported in this paper.

2. WEKIT Project

WEKIT is a European research and innovation project supported by the Horizon 2020 program dedicated to develop and test a novel way of industrial training enabled by Smart Wearable Technology (WT). Twelve WEKIT partners, representing academia and industry from six countries in Europe, have built an industrial-strength learning technology platform and unique methodology to capture expert experience and share it with trainees in the process of enabling immersive, in-situ, and intuitive learning. This way, WEKIT brings learning content and technical documentation to life via task-sensitive AR, making industrial training more efficient, affordable and engaging.

1.1 WEKIT hardware prototype

The WEKIT hardware prototype consists of three main components [2]: a head-mounted display, a sensor processing unit on a stick PC, and a e-textile garment holding body-worn sensors.

As *head-mounted display*, WEKIT uses a Microsoft HoloLens with a standard Microsoft Holographic Processing Unit HPU 1.0 with 2 GB of RAM. The HPU is an untethered stand-alone computing device running on a specialized version of Microsoft Windows 10. The HoloLens is capable of projecting virtual content into the physical world space in an unobtrusive manner. It also hosts other sensors such as microphone, audio, infrared

camera, which allow different types of user interaction. Wi-Fi and Bluetooth connection allow wireless communication with the other components.



Figure 1: Microsoft HoloLens

The *Sensor Processing Unit (SPU)* is hosted on a stick PC, providing an independent CPU which does not rely on another computer. The SPU is connected to the wearable sensors used by the WEKIT prototype.



Figure 2: Stick PC (Intel®)

The *e-textile garment* collects wearable sensors for measuring posture, hand and arm movements to measure attention and the level of fatigue. Integrated into the harness are sensors to detect heart activity, Galvanic Skin Response, electro-myographic activity for the forearm and hand, positional tracking, 9-axis inertial movement, as well as temperature and humidity. They are connected to the SPU for data collection and storage in the Cloud [3].

The initial design consisted of a tight-fitting interior layer of thin Lycra to house the skin-contact sensors and a vest on the outside to house the bulkier components. The user tests, however, demonstrated that the use of full garments presented numerous challenges, specifically providing inadequate means of securing sensors to a wide range of body shapes over wide-ranging environmental conditions. Thus, a final garment design was produced in form of an adjustable harness (as seen in figure 3), which was found to be cheaper, more easily manufactured and more robust to variations in body shape and environmental temperature [4].



Figure 3: Garment designs (left: full garment, right: reduced harness)

1.2 WEKIT.one software prototype

From the software point of view, the WEKIT.one integrated application was developed for authoring ('capturing') and executing learning experiences ('re-enacting'). Authoring thereby includes a hands-free editor for annotating the real-world with the learning content required to represent a specific learning activity, as well as a sensor-based observation mode for live recording of expert performance. The resulting work product, an authored learning activity with all its content augmentations, is called a 'learning experience' and is stored as IEEE ARLEM [5], following the proposal by working group p1589 for how to represent Augmented Reality Learning Experience Models. The authored learning content is stored locally in the Hololens as well as syndicated to a cloud repository. The learning experiences can be shared across devices and locations, and executed via re-enactment between the client application and the learner.

Thereby, the **recorder** functionality is used to capture real-life experience. It records the expert providing guidance prepared by the instructor for a specific procedure to be performed, defining the various steps and providing additional explanatory material such as images, videos, position markers, verbal instructions, etc.



Figure 4: WEKIT.one main menu

The **cloud repository** receives the ARLEM files from the recorder via a control panel. Each ARLEM unit contains the workplace model, the activity model, media files (mp4 videos, wav audios, jpg images), as well as the sensor data files. They are wrapped into a zip archive to become self-contained units that can easily be exchanged across devices and locations.

The **player** functionality is used to re-enact experience in the ARLEM units. The learning activity is started by air-tapping the 'play' button or by using the voice command "start". This automatically launches the action step defined as start action and re-instantiates all augmentations connected to it. The action step can be completed by either clicking the 'next card' in the activity cards view, the checkbox in the task list view, or by using the voice command "next". Upon activation of the next action step, the previous step is marked as

complete with a checkmark on the activity card and task list view. This allows the user to successfully perform the procedure by avoiding mistakes, also in the case where trainees have not received a specific training for the task at hand [6].

3. WEKIT Trial Organization

Within the WEKIT Consortium ALTEC was responsible for managing the industrial pilot trials dedicated to the prototype evaluation tests and the coordination of the three industrial partners participating.

The objective of the experiment was to demonstrate how the learning processes can be improved in terms of effectiveness, time reduction and usability by using the WEKIT methodology in three different industrial scenarios identified by the three industrial partners:

- ALTEC (Aerospace Logistics Technology Engineering Company) is a Public-Private company based on the partnership between Thales Alenia Space and ASI (Agenzia Spaziale Italiana). As part of the ESA (European Space Agency) ISS utilization program, ALTEC has responsibility of astronaut training, logistics and operations support services for ESA since 2015. Basing on its crew training background, ALTEC has developed a futuristic training scenario dedicated to the recharge of the batteries of a Mars Rover prior to starting an exploration mission on the planet.
- EBIT s.r.l., an ESAOTE group company, 100% owned by Esaote S.p.A, focused on the design, sales, distribution, installation, start-up and service of software systems, hardware systems and IT- networks for the management of data and images in medical and healthcare environment. Thanks to a deep knowledge of clinical workflows, in WEKIT project EBIT has developed training scenarios related to the Healthcare domain (utilization of an ultrasound equipment to perform specific medical analysis).
- Luftransport (LTT), located in Tromsø, Norway, is an independent aviation company, emerging as a leading Nordic airline within special operations, with continuous emergency services with aircraft and helicopters as a main area for business. Thanks to a deep knowledge in aeronautics, LTT has developed training scenarios related to the aeronautics maintenance domain for the WEKIT project (replacement of an airplane wheel).

4. Astronaut Training for Exploration Mission

Training is an essential component of the mission preparation of an astronaut. For about two and a half years before the launch, astronauts are trained for all the activities (nominal and emergency) that they will have to perform on board.

The responsibilities of each astronaut assigned to a mission on the Station are defined by the various Space Agencies according to the background of the astronaut (specialist in some subsystems or modules, specialist in the use of the robotic arm, specialist for extravehicular activities, expert for certain experiments, etc.). The training activities need to be carefully planned and managed by the different training centers in order to optimize the training and travel time of the astronauts.

In addition to the training carried out before the mission, the astronauts are also assigned to perform On Board Training (training carried out remotely while astronauts are on board with the assistance of ground instructors who communicate with them through voice loops). During these sessions, astronauts' practice to maintain a high level of proficiency, in particular for complex and emergency procedures. Generally, these sessions are scheduled a few days before the execution of activities that involve a high degree of risk such as docking or undocking certain vehicles (e.g. Soyuz, Progress, Cygnus, Dragon) and to always maintain the reaction to emergency procedures at the highest level (reaction in case of fire on board, toxic spill or depressurization).

The aim of the trainings is to ensure that astronauts are always able to react as quickly and effectively as possible, even though they may have received specific training on ground several months before the execution of the activity on board.

The astronaut training process needs to evolve taking into account adaptation to different conditions of exploration missions. Currently, the training period for an astronaut is 18-24 months. A large portion of crew training is aimed at instructing them on procedures about the maintenance of spacecraft items, although the chances that such procedures are going to be implemented on-orbit are low. If this estimation is projected on a Mars/Moon mission of probably 2 years (i.e. including the long-distance journey to/from Mars), a training period of about 6 years seems to be necessary, but at the same time not feasible. This gives us a support of an idea of additional AR training that can compliment and enhance standard training in this timeframe.

Crewmembers are now constantly supported by the Ground Teams while performing the activities on board of ISS. Therefore, Ground is always able to guide and support them. This will not be possible during a mission to Mars since the communication between Ground and Mars is affected by a delay that can range from 8 to 20

minutes, depending on how Mars and Earth are aligned at that specific moment.

The duration of the training period and the communication delays for this type of activities, highlight the necessity to make astronauts more independent and autonomous in executing their tasks and also in reacting to contingency and even emergency events.

The WEKIT prototype is designed to fill these gaps by reducing the hours of training dedicated to maintenance activities and by providing support to the crew when communication with Ground is not available or does not provide the latency required [7].



Figure 5: Mars Human Exploration

5. WEKIT Space training scenario

The objective of this space trial is to test the WEKIT prototype using a space-training scenario. The chosen scenario is considered as a valid example of a potential astronaut training activity to be performed on the Mars surface during an exploration mission [8].

5.1 Space Trials Organization

The activity used is a procedure that foresees the recharge of batteries of a Mars Rover prior to starting an exploration mission on the planet. Before performing the activity, some safety checks are required in order to put the Rover in safe mode. Once the recharge is completed, some additional steps describe how to put the Rover back in operational mode.

All the components and mock-ups were available at ALTEC facility as well as the complete procedure, which was performed on the ALTEC Mars Moon Terrain Demonstrator (MMTD) — an arena designed with the purpose to simulate the Martian soil, used normally to test the locomotion of Mars Rovers and plan their activities.



Figure 6: ALTEC Mars Moon Terrain Demonstrator (MMTD)

The developed procedure consisted of fifteen steps, including initial status verification, setting the rover in safe conditions, recharging the batteries and restoring nominal conditions at the end. This kind of procedure allows taking into account several aspects of the training methodology and also to test different features of the WEKIT prototype.



Figure 7: ALTEC Rover Mock-up

The data and feedback from the participants were collected using online surveys designed to get a more comprehensive feedback on their experience. The data collected from the participants has been analyzed and the results are described in this paper.

In order to verify the effectiveness of the training performed using the AR tool, another procedure was developed with the objective to be executed in parallel by a control group. Thirty participants, randomly selected, were asked to complete the procedure following instructions from a paper version, prepared according to the On-Board Data File (ODF) Standard [9].

After completing the procedure, they were asked to fill in an online survey mainly dedicated to analyze their knowledge retention after training. Only after that they

had the opportunity to test the WEKIT Player application, thus avoiding contamination of their ratings.

5.2 Participants to Space Trials

The Space Industrial Case trial took place at ALTEC facility in Turin, during an extensive period, starting from July 4th 2018 and ending on February 6th 2019.

A total amount of 199 candidates were involved in the trials. Among them some candidates were experts in the space field (ALTEC and Thales Alenia Space employees), others were students from Turin University or High School programs, while the largest amount was people contacted through social forums and platforms, generically interested in space activities but without any specific background. In fact, the goal of the trial was to demonstrate that the WEKIT tool provides just-in-time effective and efficient training also to people who have no specific background related to the training activity. In fact, following the instructions displayed on the Player application, all non-skilled candidates were able to perform the complex task correctly without problems. In summary:

- 147 candidates tested the Player application.
- 30 candidates were part of the Control Group.
- 22 candidates (all ALTEC internal experts) tested the Recorder application.

The team conducting the trials included skilled astronaut trainers, covering on one side the role of procedure expert and on the other side supporting the candidates who had no experience of this type of training.



Figure 8: Candidate conducting the trial

6. Data Collection

It was decided to execute an online survey with all relevant questionnaires that we asked all candidates to fill in. This method was used to work around the large number of participants and helped to shorten the time of post trial data analysis.

The platform used was the Lime Survey Tool where the following six questionnaires were created:

- Demographics data

- Learning Model Evaluation
- TAMARA – Technology Acceptance Model for AR/WT
- SPINE - Spatial User Interface Evaluation of the Augmented Reality application
- SUS – System Usability Scale
- Training Questionnaires (one for each industrial case scenario) – To evaluate training effectiveness

A dedicated Knowledge Training Questionnaire was developed by each industrial partner with the scope of assessing the training retention after the session. The questionnaire contained several questions related to the procedure to be performed and was filled by all candidates.

The hypothesis was that the results of the training questionnaire would be higher for the candidates who have performed the task with the use of the Player application compared to the paper procedure, used by the Control Group. The assumption is that the additional material (i.e. photo, video, audio information) provided with the AR tool should improve the learning curve related to the procedure activities.

7. Results

In total 199 data entries were considered for analysis for the AR condition group. Quantitative results are depicted below per each questionnaire, additional details are reported in [8].

7.1 Technology Acceptance Model (TAMARA)

The Technology Acceptance Model for AR/WT (TAMARA) is a tool for measuring the generic technology acceptance models (see Wild et al., 2017) [10]. All items except one use a 7-point Likert scale ranging from strongly disagree (1) to strongly agree (7), while one item (usage frequency) is rated on a 6-point scale. The item “usage frequency”, allows expressing in what intervals the participants turn to using AR and WT. The model explains how accepting of AR/WT technologies are questionnaire respondents, and predicts their intention to use them, and likely future usage behavior.

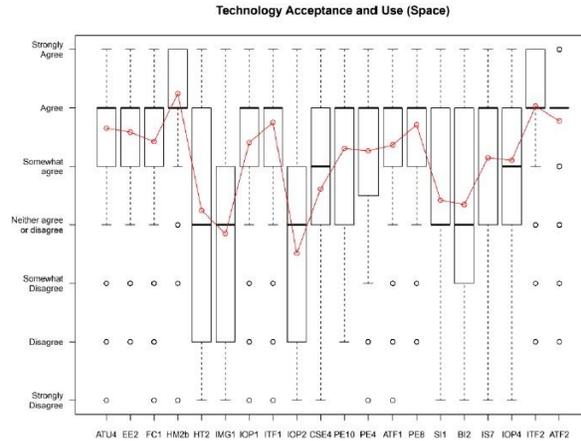


Figure 9: TAMARA results for the Space Trials

Considering the 7-point Likert scale ranging used, it is possible to assess that a mean of 5.13 with a standard deviation of 1.28 indicate a good acceptance of the technology.

7.2 System Usability Scale (SUS)

The System Usability Scale (SUS) is a tool for measuring both usability and learnability. The SUS scores calculated from individual questionnaires represent the system usability. SUS yields a single number representing a composite measure of the overall usability of the system being studied. Scores for individual items are not meaningful on their own. SUS scores have a range of 0 to 100 [11, 13]. According to validation studies, the SUS score starting from 68-70 represents the level of acceptable system usability. The Acceptability ranges are: 0-50 not acceptable; 50-70 marginal; 70- acceptable [12, 13].

Applications	SUS score	Applications	SUS score
Player (P) users only	69	P + P and R users	68.39
Recorder (R) users only	53	R + P and R users	56.68
Overall	59	Overall	67.64

Figure 10: SUS results for Space Trials

The SUS score for Player (69) has reached the range of acceptable system usability. The SUS score for Recorder (57) is in the marginal range for acceptance. The number of test participants using the Player was significantly higher (147) than the number of Recorder users (22). The difference in score lies in the complexity of the functionality, requiring more challenging instructional design activity for the recorder, whereas the player’s users simply follow the instruction provided.

7.3 Spatial Interface Evaluation (SPINE)

The Spatial Interface Evaluation (SPINE) was developed specifically to evaluate usability of the augmented reality user interface. It was designed

specifically to evaluate those usability aspects that SUS is missing. SPINE consists of 29 questions that are grouped into six categories (System Control, Navigation, Manipulation, Selection, Input Modalities and Output Modalities). Each of the categories is looking into a specific aspect of spatial user interaction. For example, ‘navigation’ is exploring usability issues related to location, obstacles, orientation and way finding.

Considering the 7-point Likert scale ranging used, it is possible to assess that a mean of means of 5.04 at a standard deviation of 1.3 indicates a good level of spatial interaction usability.

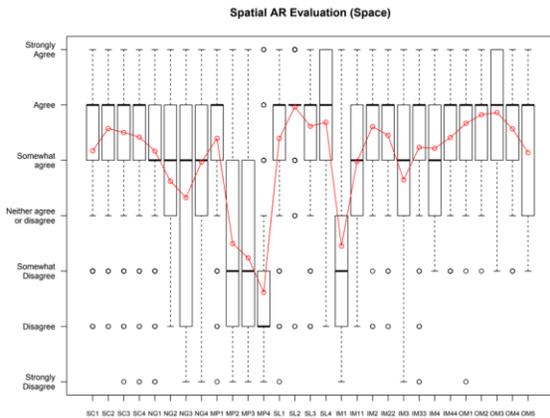


Figure 11: SPINE results for Space Trials

Overall, participants agree that the system helped them to accomplish the training aims and the results suggest that the system has a good usability. They clearly indicated that they understood functionality they have used and it was easy to control the system. The results revealed a high navigational usability of the training system.

7.4 Knowledge Assessment

The aim of the Knowledge Assessment test was to evaluate participants’ performance after the training. Experts at ALTEC designed the knowledge test, and almost all the knowledge test questions are testing knowledge acquired during corresponding procedural steps. In total, there were 15 procedure steps and 15 knowledge test questions.

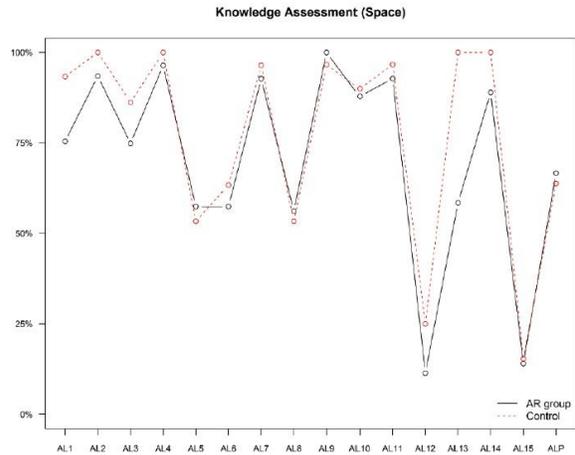


Figure 12: Knowledge Assessment results (AR condition vs Control group)

The black dots and lines represent AR group, and red - control group, the values (in %) indicate the correct answers. AR group completed 66% of the questions correctly. Control group completed 63% of the questions correctly.

7.5 Learning Model/Expert Model

In addition to the previously described questionnaires, the experts participating to the Space Trials were asked to complete also the Learning Model Evaluation questionnaire.

The aim of this expert model evaluation questionnaire, based on Jucks, Schulte-Löbber, & Bromme (2007) [14], was to peer-evaluate the expert model (recording of the expert), by judging its fitness for the purpose via other experts (recording of the expert).

The participants responded by selecting a 7-point Likert scale ranging from strongly disagree (1) to strongly agree (7).

This expert model was facilitated by the affordances of the wekit.one Recorder application and therefore, correlates to the extent to which the application enables effective recording of the expert.

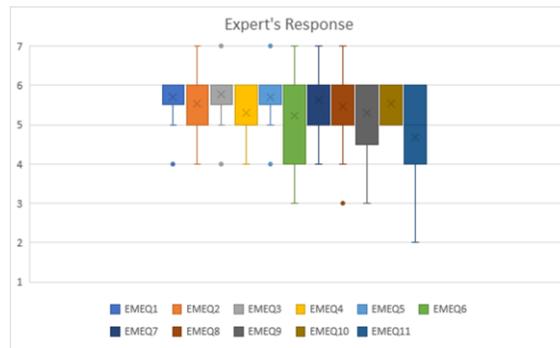


Figure 13: Expert Model Evaluation

The expert participants mostly responded positively to the model with the mean and median of all items above 4. Average results show that the expert participants found the expert model created by the WEKIT recorder and replayed by the WEKIT player to meet the requirements to be used for training.

More detailed data and information have been published on [15].

7.6 Biosensor Data

The WEKIT biosensor harness (BH) was used to measure trial participants' physiological parameters, specifically, blood volume pulse (BVP), galvanic skin response (GSR), bodily and environmental temperature and humidity, and two sets of inertial measurement sensors comprising accelerometer, gyroscope and magnetometer readings. A total of 42 trials involving the BH in conjunction with the HoloLens were conducted across the Space case, with the BH generating time-stamped datasets, which were then manually paired with questionnaire responses.

Both participants and facilitators found the BH is easy to work with in comparison with earlier attempts where they were using the sensor-integrated vests.

Whilst studies exist establishing links between physiological readings and affective state (see [3]), they are usually performed in controlled lab conditions.

Obtaining such consistent data set in the WEKIT trials, particularly for BVP and GSR, proved difficult since participants were required to perform a number of full-body manual tasks. However, manual inspection of the datasets revealed regions of high-quality data for every one of the BH trials, and such regions of interest could be selected for further work using signal-processing methods not employed here.

8. Discussion

The *Technology Acceptance Model for AR/WT (TAMARA)* questionnaire pointed out that, overall, participants are acceptant of the novel technology they tested (mean of means: 5.13 with a standard deviation of 1.28). The majority of participants clearly expressed a positive attitude towards the technology (with a median of 6) and show signs of hedonic motivation to work with the technology, expect low effort in working with the technology, and are positive about the availability of facilitating conditions and resources required.

The *System Usability Scale (SUS)* questionnaire showed that the SUS score of 68 was very close to 70 (scale 0-100), which is considered as the minimum acceptable score for system usability. Thus, the WEKIT applications were considered acceptable in terms of system usability, the participants' feedback indicated that they would be disposed to use the WEKIT applications for performing their activities since the

system is not too complex and the features are well integrated and consistent.

The *Spatial Interface Evaluation (SPINE)* showed a good usability of the spatial interaction technology. Overall, participants agree that system helped them to accomplish the training aims and the results suggest that the system has a good usability. The feedback clearly indicated that participants understood functionality they have used. The results revealed a high navigational usability of the training system, especially under the category of obstacles avoidance. This can be explained by the use of navigational arrows on the ground that guided people around Mars terrain's stones.

The *Knowledge Assessment Test* showed no statistically significant difference between AR group (completed 66% of the questions correctly) and control group (completed 63% of the questions correctly). Overall, the pattern of the correct answers is similar.

The results of the knowledge test show that with regards to retention, the AR technology used performs on the same level as classical training used for the control group. Given the advantages of the AR solution for capturing emerging knowledge and of authoring in situ, this shows great potential for scaling. The small difference assessed in the score results between the test subjects who used the AR software and the ones who were part of the Control Group is probably also due to the fact that astronauts' procedures are normally very reliable and clear, since they are developed according to specific Operations Data File Standards [9]. Scope of this standardization is to develop procedures as complete and clear as possible, to make them understandable by all crewmembers and avoid mistakes. The "paper procedure" used by the Control Group was developed according to these standards, so the task was well understood and learned by all participants. Furthermore, the procedure created was simplified in terms of activities and terminology in order to allow every participant to perform the task.

9. Conclusions

The objective of this final trial of the WEKIT.one for the space pilot case was to test the hardware and software prototype on a real procedure used for the astronaut training activities.

The number of participants was high (199), the impression collected during the tests, however, was that the reactions were more varied than expected: people with similar age and technical background were showing quite different performance. The feeling was that training could reduce this variability, but proficiency and performance will always be more varied than expected.

All the participants provided positive feedback about the use of the tool. In particular, it was appreciated because it demonstrated how task execution and the

learning process can improve in terms of effectiveness, time reduction, and user perception by using the WEKIT methodology.

Most of the experts involved were from ALTEC and Thales Alenia Space personnel, who understood the potential of applying such technology to this field and they were collaborative in giving advice and feedback on how the prototype could be further enhanced.

The students were enthusiastic to test such a tool on a real procedure. The combination of the HoloLens and the Martian Rover, located in the ALTEC Mars Terrain Demonstrator, where the test was performed, made the experience unique for them.

Overall, participants felt confident in using the system and expressed desire to use this technology in the near future. The general acceptance and usability of the WEKIT tool is good and that point out to a promising perspective of its use in the future.

Finally the utilization of the “WEKIT biosensor harness” allowed collecting data about participants’ physiology, in order to evaluate potential stress indicators that could highlight procedure steps was not completely clear or difficult to perform for the participants, despite the AR information included to clarify the context as much as possible.

ALTEC is particularly interested in continuing the exploitation of the WEKIT tool to enhance the training process for astronauts and to support future Exploration missions on Mars or on the Moon. It is well known that the astronaut training process needs to evolve, taking into account the need to adapt to the different conditions of exploration missions, the duration of the training period and the communication delays, that will be one of the major issues to be faced to prepare the astronauts for long distance and long duration missions.

Astronauts need to become more independent and autonomous in executing their tasks and also in reacting to contingency and even emergency events. The WEKIT hardware and software prototype is one solution to fill these gaps by reducing the hours of training dedicated to maintenance activities and providing support to the crew when communication with Ground is not available.

Further testing could be performed with crewmembers and scientists in the so-called “analogue” environments (like PANGAEA and CONCORDIA).

The Pangaea course is designed by the European Training Astronaut Center (EAC) to provide European astronauts with introductory and practical knowledge of Earth and planetary geology, to prepare them to become effective partners of planetary scientists and engineers in designing the next exploration missions.

The Concordia research station in Antarctica is the remotest base on Earth, far removed from civilization, offering researchers the opportunity to collect data and experiment like no other place on Earth.

Both environments could be ideal to test the WEKIT prototype allowing to gather additional data and feedbacks from astronauts/scientists that could help in improving the prototype before proposing it as an experiment on board of ISS, in preparation for the potential utilization in future human exploration missions.

Acknowledgements

This work was supported by the European Commission under the Horizon 2020 Programme (H2020), as part of WEKIT (grant agreement no. 687669).

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