Learning Impact Evaluation of the serious game "Cultural Awareness – Afghanistan Pre-deployment"

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Abstract

Attention to human factor *in conducting any type of military/security operations is currently an objective of utmost importance in the context of troop training within NATO. To this purpose, a number of serious games were developed, addressing different aspects of cultural awareness and correctness in approaching human beings during a mission. A significant example is "Afghanistan Pre-deployment – Cultural Awareness", a serious game widely adopted in NATO Defense Schools to support pre-deployment training of troops for the International Security Assistance Force (ISAF) missions in Afghanistan. In the context of GALA, the European Network of Excellence on Serious Games, the Romanian National Defense University (MAN) and NATO-STO CMRE conducted a user study particularly focused on the learning impact of this serious game. The study was first run in parallel on different typologies of players (initially soldier trainees at MAN and civilian/military staff at CMRE; then also a group of University students) in order to get different perspectives in the game test and evaluation; results of respective analyses were compared, in order to evaluate the effectiveness of this type of serious game as a learning tool. As a result of this evaluation, the serious game seems to be well received as a new and modern way for quick and effective knowledge transfer; it can be seen a valuable, complementary solution to traditional education and training tools.*

Keywords: *Cultural Awareness, Game effectiveness evaluation, Group studies*

1. Introduction

Developments in information technology and communications generated significant changes in knowledge acquisition and in the modes for approaching education and training. This is especially true in the military field, where wide adoption of innovative education / training technologies is observed, and use of Serious Games [1] in particular builds up on a very long tradition of using games for training. The board game Chaturanga from India and the Chinese Wei Hei were both used about four thousand years ago [2]. In more recent times - 19th century - Helmuth von Moltke the Elder, Chief of the Prussian General Staff, developed a board game called 'Kriegspiel'3, in which model soldiers were used to rehearse possible battle outcomes [3].
Although they cannot 100% replace direct practice, Serious Games are effective self-learning tools [4][5] providing a safe environment where mistakes do not result in casualties or similar catastrophic events, and offering interactive and repetitive scenarios, suitable to favor effective retention of information by users.
Such non-traditional channels provide an attractive, efficient, yet low-cost training method to acquire a wide spectrum of skills, ranging from combat- and operation-related techniques (see games like Army Battlezone, TacOps, Brigade Combat Team, Decisive Action, Harpoon 3) to non-operational, yet crucial skills like logistics, finance, criminal investigation, intelligence etc.
They are also used to address specific issues like managing the very first contacts with the military system (USA SG "America's Army" and Australian Defense Force "Secure the Deck" both have

the purpose of encouraging young people to enroll for military service) or promoting the so-called "cultural awareness", aimed at preparing military personnel to properly react in real-life situation without conflicting with the cultural values and behavioral rules expected in combat/deployment areas.

Awareness of the importance of human factor in conducting military/security operations strongly increased within NATO in the latest years. The revolution in military affairs, dating from the end of the Cold War, and the technology breakthroughs achieved in a number of different fields dramatically changed the way NATO considers the role of the human operator in military activities. This is particularly true when military staff is involved in complex socio-technical systems - with their difficult multi-language, multi-system and multi-cultural contexts - in uncertain and ambiguous environments and conflictual situations. It is considered that new approaches to military situations, with a focus on human factor, mostly benefit multinational operations and - in particular - Operations Other Than War (OOTW) [6].
Part of the effort of NATO Allied Command for Transformation (ACT) and Ministries of Defense (MoDs) of various NATO Nations consists in sponsoring and, in some cases, contributing to develop serious games [7], seen as *learning environments* addressing various aspects of cultural awareness and human behavior correctness during different kinds of security missions (e.g. against terrorism, illegal trade of weapons, etc.). Interesting examples of existing projects in this area are "First Person Cultural Trainer" [8], and, more recently, the CAMO project in Norway [9]. Both make large use of 3D Virtual World technology, and in particular the latter one is based on a rigorous research-based approach, and addresses issues such as high usability and low cost of development.
One of selected best practices of game-based training application on this topic is "Cultural Awareness Training - Afghanistan" [10] a serious game sponsored and distributed by UK MoD and widely adopted in Defense Schools to support pre-deployment training of troops in Afghanistan within International Security Assistance Force (ISAF). ISAF's main objective in Afghanistan is to conduct security and stability operations throughout the country together with the Afghan National Security Forces (ANSF). The "Cultural Awareness Training - Afghanistan" game provides a self-paced training environment that generates and develops the cultural competency of trainees, helping them to perform successfully in civil-military operations based on relevant cultural information. Serious Games, unlike entertainment games, necessitates the implementation of specific educational and technical requirements related to pedagogical constructs, learners' assessment and standardization [11][12]. To this aim MAN carried out the implementation of the "Cultural Awareness Training - Afghanistan" on the ILIAS (Integrated Learning, Information and Work Cooperation System) platform of the "Carol I" National University of Defense in Romania [13]. ILIAS is an open source web-based Learning Management System (LMS) which supports learning content management (including SCORM 2004 compliance) and tools for collaboration, communication, evaluation and assessment.
In the context of GALA, the European Network of Excellence on Serious Games [14], the Romanian National Defense University and NATO CMRE conducted a user study particularly focused on the learning impact of this game.
In the defense and security application domains, learning objectives are often related to operating or making decisions in very dangerous and complicated situations of warfare or disasters, which cannot be (fully) replicated in reality. In these cases effectiveness and learning impact cannot be simply measured by a post-briefing test. Key Performance Indicators (KPI) for measurement are hard to find, as they are generally limited to the cognitive purposes [15], i.e. to objectives related to learning of procedures and techniques like use of a tool / weapon / piece of equipment, vehicle driving etc.
The research literature indicates that training effectiveness in general, and more specifically in the security, safety and crisis management domainsis influenced by three primary determinants [16]:

a) the training program itself (including the game),
b) the trainee (in terms of personal characteristics and attitudes), and
c) the situational context in which the training takes place [17][18][19][20].

Investigation of the impact that situational variables may have on training outcomes is of major importance. Such a multi-pronged approach not only evaluates the overall effectiveness of the training, but is also able to explain "why" the game-based approach may be effective, and therefore provide suggestions for improving future effectiveness of serious games for learning purposes. In the study conducted in this work the authors asked the cooperation of different user groups in order to compare the respective situational context and correlate it with the users' feedback.

The specific evaluation procedure adopted can be seen as a customization of the general-purpose frame of evaluation proposed by Meyer et al. [21].
From a technical point of view, thanks to the interoperability feature implemented by MAN, the user group study could be conducted remotely and in parallel on different kinds of user groups (soldier trainees at MAN, civilian/military staff at CMRE, and finally a group of university students) in order to get different perspectives in the game test and evaluation. Responses were then statistically analyzed and compared, to achieve a more complete and wider view.
This work aims at describing how the user studies were conducted and at presenting and discussing the feedback received by the users through a post-briefing questionnaire.

2. CIMIC doctrine and the importance of Cultural Awareness

The importance of a robust cultural awareness programme for individuals deployed in theatre operations becomes evident in the framework of the NATO CIMIC (Civilian-Military Cooperation), which is defined [22] as "*The co-ordination and co-operation, in support of the mission, between the NATO Commander and civil actors, including national population and local authorities, as well as international, national and non-governmental organizations and agencies*".
Establishment and maintenance of full co-operation between military commands and civilian authorities, organizations, agencies and population within specific areas of operation is one of the CIMIC primary purposes.
Although the context and profile of CIMIC varies depending on the nature of the operation (narrower focus in combat operation, broader and more complex focus in Crisis Response Operations – CROs), taking into account social, political, cultural and environmental aspects becomes a key success factor in planning operations and in creating favorable conditions to support achievement of objectives.
General principles are set to govern the conduct of CIMIC, falling into two main categories:
– Principles governing the Military Direction of CIMIC
– Principles governing the Civil-Military relationship
Cultural Awareness is the first of six principles governing this second category, based on the assumption that [22] "*in a politically sensitive environment a thoughtless violation of local laws or custom can create a highly unfavorable news event and seriously undermine the mission's chances of success. The military must acquire a sound understanding of local culture, customs and laws*".
The role of education in developing cultural awareness of the forces is explicitly mentioned in the CIMIC doctrine.)

3. "Cultural Awareness – Afghanistan Pre-deployment" serious game

3.1. Short description of the game

"Cultural Awareness Training - Afghanistan" is part of a pre-deployment course, the main objectives of which are to train troops to (a) familiarize with the specificities of a mission (in terms of techniques, tactics and risks); (b) familiarize with the geography of the area; and, above all, (c) learn the best approach to keep with local people.
It was developed in 2007 by LINE Communication, the UK corporate which works very close with the UK MoD for training and education programme. LINE worked with the MoD in identifying authentic scenarios the troops could face, possible cultural factors that could influence them and ways in which service personnel could react. Culture is a subjective issue and the opportunity for the trainers was to raise awareness and facilitate a behavioural shift rather than teach individual elements of Afghan culture. The course needed to be adaptable, as it needed to be available both as a pre-deployment desktop resource for classroom-based training and for commanders to use with their troops in any environment once deployment had taken place.
The game consists in a first introduction (aimed at providing with background information on Afghanistan geography, population and culture), followed by a set of game scenarios where the players can verify and improve the cultural awareness achieved in the first part.
A parallel between two cultures (Western culture – Culture A – and Afghan culture – Culture B) is then run, by describing peculiarities of these cultures with specific emphasis on what is considered

as a normal, common state. This is based on the consideration that a significant number of cultural conflicts are due to different cultures considering different things as "normal practice"
A general introduction to the game is aimed at making such elements clear, highlighting what is common to the two cultures, what is different, with specific emphasis on "hidden" aspects and on what is critical for each of them. This is followed by a briefing session providing a general overview of Afghanistan (main cities, climate, recent history, ethnic groups and social model, religion, etc.).
A separate "Resources" table – a fundamental component of the game - is then provided in the main menu (Fig. 1).

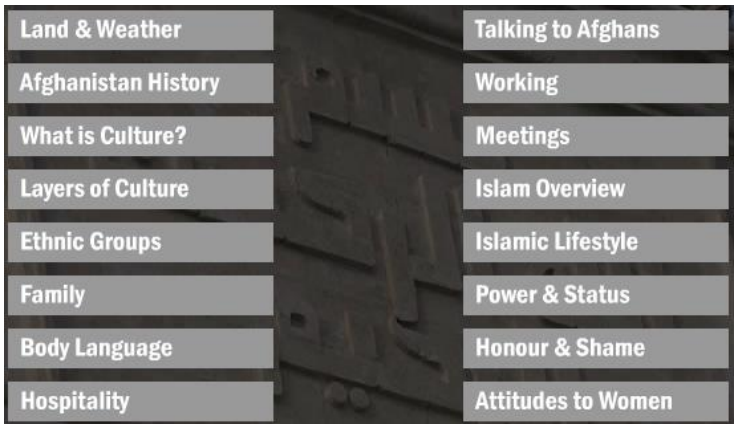

Figure 1. "Cultural Awareness Training - Afghanistan" resources, as listed on a screenshot of the game.

Each of the "Resources" provides a detailed explanation of the information that was only summarized in the introductory session. Further aspects not included in the briefing are addressed, with specific emphasis on clarifying what is an appropriate or inappropriate attitude and behavior, and providing supporting motivation.

Users are then required to go through a series of scenarios, based on the most common situations members of armed forces may expect to encounter in Afghanistan:

- *CIMIC project - how to get the best out of workers:*
  The user is supervising a team of local workers within the framework of a CIMIC re-building operation, and faces situations where he has to deal with individuals as well as with groups. He must identify the most appropriate way to deal with issues like directing workers, praising / criticizing the work done or adapting his own behavior to respect constraints due to the workers' religion (opportunity for the supervisor to drink in a position visible to the workers in the period of Ramadan, where drinking or eating is forbidden to Muslims during the day).
- *Meeting the local community - how to keep the situation calm*;
  The user is the leader of military personnel group arriving in a village to build relationships and to arrange for a PsyOps[1] show. He is required to identify the most appropriate behavior to adopt in approaching the local authorities and in dealing with their hospitality ruiles (respect due to older people, gifts to be presented, recognition of roles, do's and don'ts when invited to enter a closed space and offered food and drinks etc.)
- *M3OA on patrol:*

[1] PsyOps is the acronym for Psychological Operations, also known as Military Information Support Operations (MISO). They are defined in the Joint Publication 1-02 of US Department of Defense (Dictionary of Military and Associated Terms) as "*planned operations to convey selected information and indicators to audiences to influence their emotions, motives, objective reasoning, and ultimately the behavior of governments, organizations, groups, and individuals".*

The user is a UK soldier out on patrol together with an ANP (Afghan National Police) officer. Questions to be answered range from how to deal with day-to-day situations (children requesting gifts, appropriate body language to adopt with a known person, behavior towards women or people who pray, respect of privacy, use of dogs in patrolling, reconnaissance of different ethnic groups) to how to manage cultural differences between the UK and the Afghan soldiers in patrolling actions.

- *Vehicle Check Point - how to get people to cooperate*;
  The user is a soldier assigned to a vehicle check point and a car with a young driver, an old passenger in the front seat and women/children in the back seat approaches. The soldier is expected to adopt the appropriate behavior to ensure an effective check is performed on the vehicle and/or people, while respecting the different roles of persons (e.g. by recognizing the role of the oldest person in the car as the individual-of-choice to deal with for requests/permissions/communication with other passengers), and making sure no inadvertently offending behavior is put in place during searches, with specific attention to women.
- *Training and Mentoring Afghans – how to get the best out of trainees*.
  The user is a soldier mentoring a number of Afghan instructors. Instructors need to be trained on how to use specific equipment and on specific procedures. He must identify the most effective modes to get respect from the trainees and to deal with questions. He is also requested to find the most appropriate ways to check that trainees have actually understood and are able to apply correctly the procedures they were trained on.

The scenarios are presented through a combination of photos and videos with interview to military experts. The user interface is extremely basic and static, with reduced man-machine interaction. The choice to use audio-visual materials to communicate the real-life experience of experts aims at transferring high level of realism to the player.
For each scenario a number of questions are put (through text and reading voice), and multiple alternative answers are listed for selection by the user (see a significant example in Fig. 2). Immediate feedback is then provided through a simple visual indicator of "cultural risk increase": the right answer is the one reducing the cultural risk, but each answer has a corresponding impact.

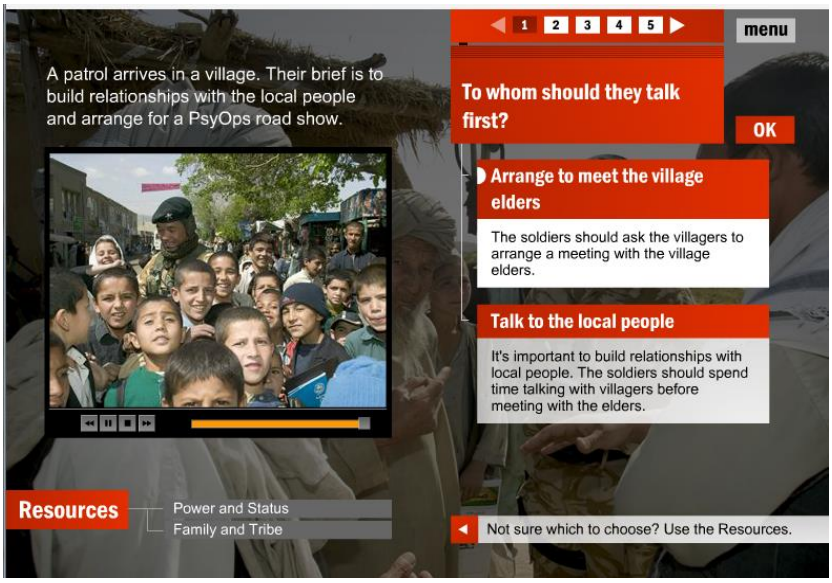

Figure 2. Snapshot of the SG showing an example of quiz submitted to the user on the scenario "Meeting the local community". The question and multiple alternative answers are listed on the right, while at the bottom of the screen the user may access a set of pre-selected "Resources" to have proper guidelines, if needed.

The "Resources" related to the specific scenario are made available to the user during the game for consultation or as a source of explanation in case the cultural risk results to be increased as a consequence of the selected behavior.

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The amount of knowledge which is supposed to be transferred to the player through the game is relatively limited, given that an expert in this topic (i.e. someone who does not need to access resources to have suggestions on the answer to give) can complete the game in about 15 minutes.

In this context the "Cultural Awareness" serious game is intended to help users to develop and reinforce skills in identifying relevant cultural information, generating decision criteria and selecting alternatives. The skills which can be achieved through the game mainly consist in:

- basic knowledge of Afghan culture, and, more importantly,
- capability of making the best decisions in various scenarios and situations by using available resources.

The game integrates audio and visual assistance able to provide the user with useful information and, hence, support feedback and performance assessment. The development concept revolves around adaptable decision-making scenarios and real-time assessment of actions. The user can choose among different scenarios and his/her performance is assessed along the game by showing escalated/decreased state of conflict, depending on his/her personal choices and answers.
It is clear that the main user target for the game is military personnel to be deployed in Afghanistan theatre of operation. However, such training can be extremely useful also for those civilians who have to participate to humanitarian missions with administrative, logistic, or support tasks.

3.2. The major characteristics of the game as a learning environment

- The primary purpose of the game is to help players learn something real about the reality of battlefield. In the military field a successful training can make the difference between being dead or alive.
- Players are autonomous. They need to be free to make decisions. Only a very short pre-briefing on how to access the game through the web and to use the game's man-machine interface is provided at the beginning.
- There are different game scenarios classified according to various types of missions. The scenarios propose possible situations, and solutions to the problems encountered can be found among the theoretical inputs provided in an introduction. The difficulty level increases from scenario to scenario: users need to apply, evaluate or adapt the knowledge/experience background provided in the introduction, depending on the difficulty level of the specific problem [23][24]. This means that in the most complicated cases the user cannot directly find the solution in his background knowledge, but needs to associate various factors and extrapolate/adapt the solution from the whole fund of cultural awareness gradually achieved during the game.
- Users can repeat an action as many times as they want, until awareness is complete.
- Users have the possibility to access available resources (pop-up windows with information in the form of text) while playing for reference purposes
- The scenarios, situations and tests are presented through a combination of photos, text, and videos with interview to military experts.
- Immediate feedback is provided. Feedback motivates and stimulates action, even when it is negative. Players see the consequences of their actions and receive an instant response if they acted well or not. The way this game is designed reduces the stress associated with the learning process and favor an easy and natural knowledge transfer. Mistakes are not perceived as a failure and an impediment to progress, but are instead seen as an essential and unavoidable part of the game.
- Being a self-paced game, timeframe is not set in advance, but it is for the user to set his own deadlines;
- Assessment is given during the game by displaying both the correct answers/solutions, and a conflict indicator (Fig. 3):
    - feedback is provided via virtual human presence embedded in the game (videos with short interviews or statements by military personnel actually involved in operations and with profound, direct experience on the field);
    - if the player fails, the culture risk indicator clearly indicates this, and a video explains the related risk.
- Relation with a learning goal or outcome: by selecting the right answer among those proposed to the user, the conflict status expressed by the "cultural risk" indicator is kept low, thus

showing that the main learning goal (i.e. understanding the local culture and adopt the most appropriate behavior not to create a cultural conflict with locals) has been achieved.

The competition element – which is normally an important aspect in games – is not reflected in this specific one: players are not in competition among themselves, and the challenge is represented by providing the right answer and maintaining the risk indicator low.

3.3. Technology/standards used

The game is based on flash technology and can be used inside a Learning Management System (LMS) or as a stand-alone on a CD. Use inside a LMS, allows tracking of user learning progress but, in consideration of the game not being 100% compatible with SCORM standard, it is not possible to see all separate pieces of the game, but rather only the game as a whole. As a result, not all LMS features regarding learning progress (e.g. monitoring of evolution during each scenario) are available. The game can be accessed on mobile devices with flash technology included.

4. Organization of user studies of "Afghanistan-Cultural awareness" at MAN and at CMRE

The study was first conducted in parallel on different typologies of players (soldier trainees at MAN and volunteer players - civilian and military staff - at CMRE). The results of respective analyses were then fused and compared.
Whilst the vast majority of CIMIC activities are performed and coordinated by military personnel, employment of civilian components as functional specialists is also considered. Criteria used for selection of the two groups of users therefore served the purpose of providing an assessment of the game's learning effectiveness from different standpoints.
Civilian personnel are normally employed for very specific tasks only and [3] they must be under readiness status, enabling them to be deployed as required.
Although no deployment clause is directly applicable to CMRE personnel, it was considered that they represent a meaningful sample of NATO civilian personnel which in different Agencies are subject to such a clause, and provide a diversified sample of expertise (engineering, logistics, communication, CIS) normally required to functional specialists.
Results from the two groups then provide a meaningful assessment from a heterogeneous, yet realistic sample of potential users in real-life scenarios.

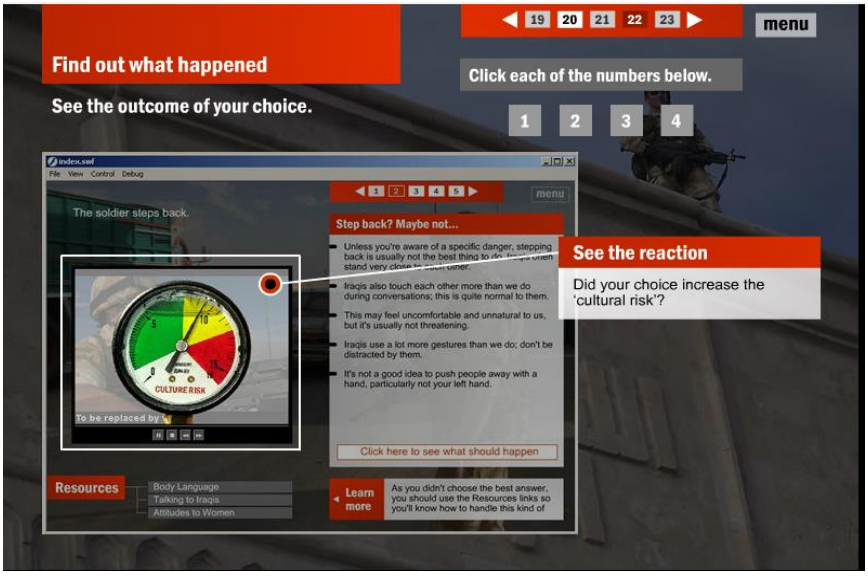

Figure 3. Snapshot of "Cultural Awareness Training - Afghanistan" game. The cultural risk indicator.

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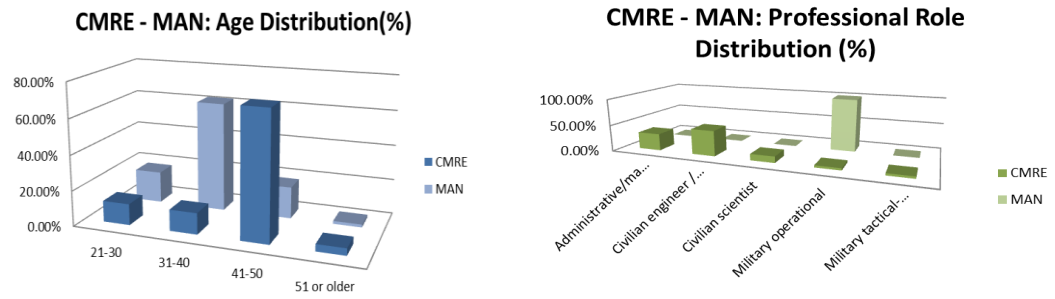
4.1. Characteristics of the user groups

More than 600 MAN users played the game and 60 of them answered the post-briefing questionnaire. Th group was composed of Romanian students at the National Defense University and other military personnel ready to be deployed in Afghanistan.
They were highly goal-oriented, as this SG was part of their pre-deployment training course, and the goal to attain was extremely clear to them. Their motivation was high, as they were fully aware that acquired knowledge would be crucial for their future missions and would be applied on the field in a near future.
They were also aware that learning objectives have to be achieved autonomously to be of real value to them.

At CMRE 40 users were involved. A volunteer recruitment campaign was run among staff. The vast majority of the sample (92%) was composed of civilian staff, although participation from military staff was allowed, in representation of both the operational and of the tactical-strategic component. Most participants were of Italian nationality (reflecting actual shares of CMRE workforce); non-Italian participants were nationals of a diversified sample of NATO nations.
As previously mentioned, no immediate requirements existed for them to apply what was learnt in the training session in real-life situations. They however had a generally high awareness level of the problem and adequate – albeit mainly theoretical - knowledge of the issues related to theatre operations. Only a limited number of users (three people) had acquired first-hand experience on the field.

A significant percentage of CMRE respondents (72%) were aged 41-50, as opposed to a target of much younger people addressed in MAN. Most of them (80%) were administrative/managerial employees (to include logistics and contracting) and technicians/engineers.
64% of respondents had medium to high experience as video-game players: this percentage dramatically dropped to 24% when experience as Serious Games users came to relevance, although more than 50% of respondents declared that they had played Serious Games at least once and 10% had an intensive experience as Serious Games player. Most of them had mid to high technical expertise in modeling & simulation or computing.
Some information can be retrieved from the data shown in Fig. 4 on the profile of the players.



(a) **(b)**

Figure 4. Description of players' profile, in terms of (a) histograms of age and (b) professional role (in percentage, over 100 users).

4.2. Criteria of assessment of game learning impact through user groups

The procedure for the evaluation of the game through user groups was defined as follows:

1) Users were provided with a quick pre-briefing, either in a classroom or via e-mail. This only included instructions on how to access the game and to use its man-machine interface, in that the learning curve was one of the aspects subject to investigation.
2) Users were then requested to play on their own, with the only support of information tools embedded in the game.
3) Users were asked to fill an on-line post-briefing questionnaire. With the exclusion of some initial questions aimed at drawing the players' profile and outline their initial knowledge of the topic, all the questions were focused on assessment of the game impact as a

learning tool. Answers to most of the questions had to be chosen amongst a pre-set range of values: only for a limited number of questions open answers were allowed.

4) Answers were collected separately at MAN and CMRE and local (marginal) statistical analysis were produced.
5) Answers were then shared between MAN and CMRE, and results were subsequently compared and merged.

The following subsection presents a summary of most significant results of the marginal as well as of the combined analysis.

In this evaluation phase it was not possible to include a pre-briefing test to assess the initial level of knowledge of the players on the topic, and eventually compare results with those of a post-briefing test in order to measure the actual knowledge transfer. The learning impact could only be measured through a post-briefing questionnaire, aimed at collecting reactions and subjective perception of participants.

Opportunity of a more objective measurement of the learning impact was however observed: to this purpose, a further evaluation phase was conducted on a third group of players, which included also a pre-briefing questionnaire, as detailed in Section 6.

4.3. Statistical analysis of evaluation results

A statistical analysis of the most interesting and significant results of the game evaluation through user groups is presented in this paragraph.

One of the preliminary issues investigated was related to previous training experience (through briefings, reading, etc.) on this topic. The great majority of CMRE users (around 64%) had not received any type of training on the specific subject before and only 12% of them had received formal training (courses). About 65% of MAN users had received specific training, instead.

All users in both institution believed the information contained in the game correspond to real life situations.

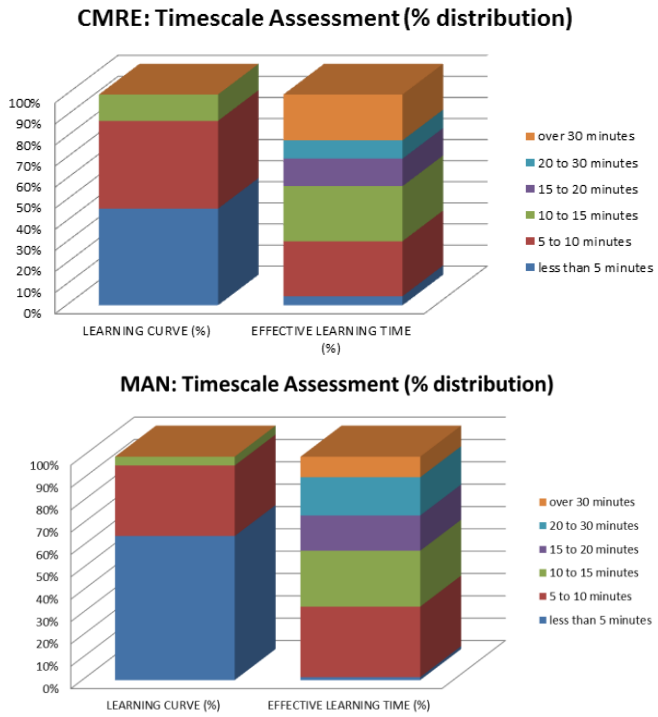


Figure 5. Users' responses on duration of their own learning curve and effective learning time (in percentage).

The first aspects investigated in this study were time scale assessment of learning curve (i.e., time needed to understand how to play the game – excluding the time to go through the introductory briefing) and effective learning time (i.e., total amount of time needed to achieve the game learning objectives – again excluding the time taken to go through the introductory briefing) experienced by

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users. As summarized in Fig. 5, answer statistics show that on average the game is intuitive and easy to use. At CMRE about 88% of users assessed their learning curve under 10 minutes, and at MAN this result raised to 96% The effective learning time was also low (70% below 20 minutes at CMRE, 58% at MAN): this means that in a relatively short timeframe a significant percentage of users managed to provide correct answers to the questions based on the information received during the introductory briefing.
This suggests that the game allows an effective use of time and favors quick knowledge transfer.

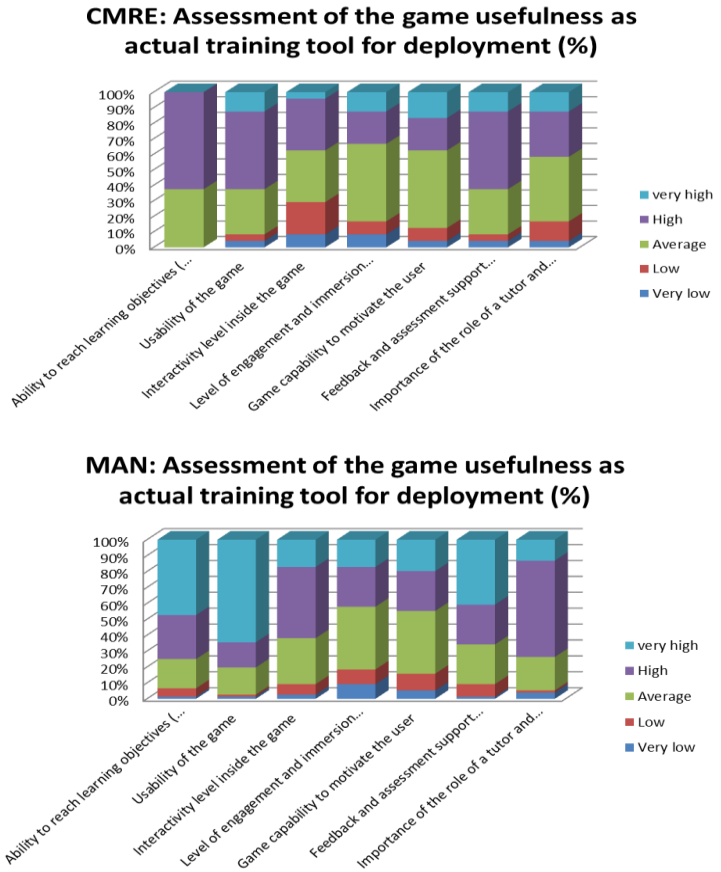

Figure 6. Users' responses on a set of game features related to its usefulness as a training tool (in percentage).

A number of game characteristics determining its usefulness as a learning tool were then addressed in the questionnaire (see Fig. 6). Attention was particularly focused on usability, level of immersion and engagement, motivation capability, interactivity level and assessment tools provided by the game.
Again, the game was considered on average very easy to use (as confirmed by previous results on average duration of learning curve in both institutions), and helpful in achieving learning objectives. Level of interactivity was however rated "very low" to "average" by 63% of respondents at CMRE and by 38% at MAN. Similar results were observed for the level of engagement and immersion (67% "very low" to "average" at CMRE and 58% at MAN): this depends on the game structure, providing for sequential and one-directional communication flows (pre-briefing / question / answer / feedback) rather than for continuous interaction.
Information resources provided on demand were then considered highly valuable by the majority of the sample (42% rating "high/very high" at CMRE and 74% at MAN). Being effective and reliable knowledge transfer among the main objectives of the game, prompt availability of supporting information related to the specific scenario is perceived as an element of utmost importance.
Finally, the assessment tools provided in the game were very much appreciated (63% "high/very high" at CMRE and 66% at MAN): being this Serious Game devoted to education and training, the high rating obtained by this key feature represents a clear measure of success.

It is worth noting that aspects more strongly related to actual knowledge transfer (ability to reach learning objectives, usability, feedback and support resources) – which are generally agreed to achieve a good performance - obtained higher and more enthusiastic ratings among immediate beneficiaries of the training (MAN trainees), whilst more attention was paid (and lower average scores are given) by potential beneficiaries (CMRE users) to more game-specific issues, such as interactivity and immersion/motivation potential, generally agreed to be rather weak.

Two sets of questions referred to the kind of learning goals users believed to have achieved by completing the game (cognitive learning goals, according to the revised Bloom's taxonomy [23][24], as well as soft skills). As presented in Fig. 7, users believed to have improved their knowledge at each of the revised Bloom's taxonomy level, up to the top one (the adapting/creating level). It is particularly interesting that users got this awareness at the end of their game session: an increasing difficulty level, leading the player to pass from mere remembering and understanding to analyzing, is implemented on purpose in the different game scenarios. As expected, evaluation and adaptation/creation learning goals were not considered to be deeply addressed by the game as the lower levels are.
The same positive feedback was expressed at average in the case of soft skills (Fig. 8), where most users stated to have experienced an improvement (from reasonable to high) in each of the considered psychological skills. The game is only based on quizzes and the amount of knowledge transfer is relatively limited. After taking this course users were not supposed to feel ready to conduct their mission on the field: nevertheless, they seemed to get the perception of the immediate applicability of the concepts acquired. The authors believe that the improved psychological skills experienced by the players derive not only from the amount of actual knowledge achieved, but mainly from the successful game design, in particular related to wise use of audio-video material. Comments and feedbacks coming directly from the experts significantly strengthen the players' self-confidence.

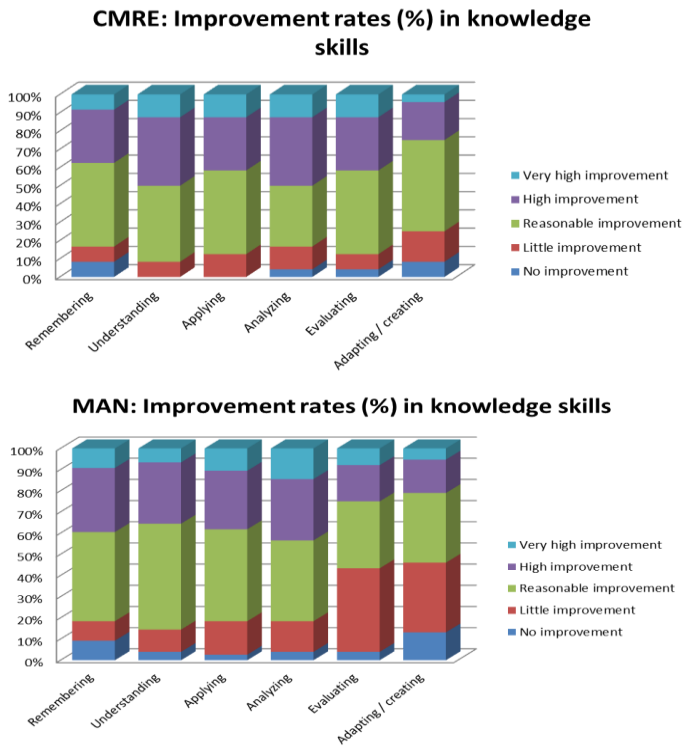

Figure 7. Users' responses on cognitive learning goals (in percentage), according to the revised Bloom's taxonomy [23][24].

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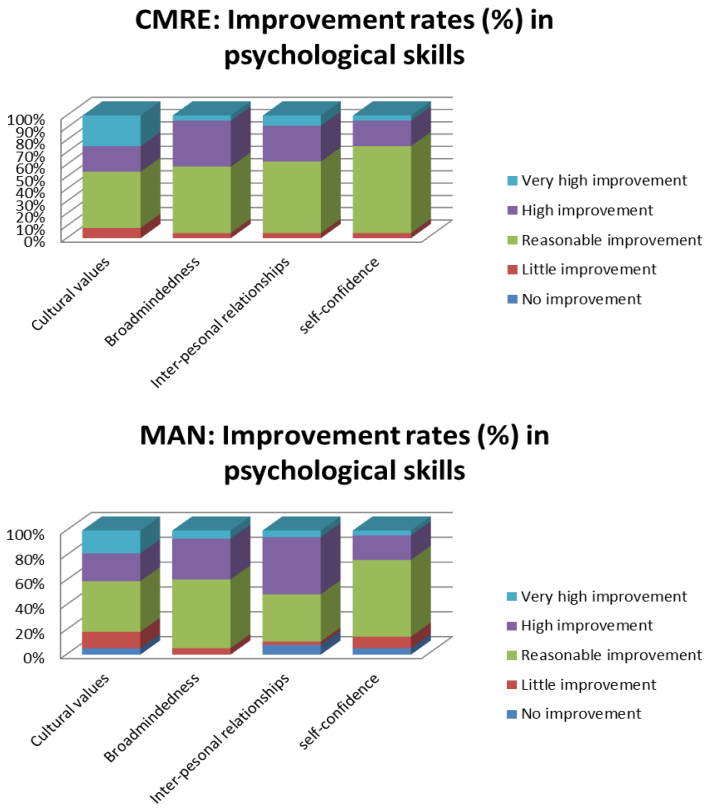

Figure 8. Users' responses on selected soft-skill learning goals (in percentage).

5. Discussion

A summary follows of most significant feedbacks / responses at the two sites.
Some responses are common to the two user groups:

- Great majority of participants at both sites considered this game very useful
- All considered the topic and content very interesting
- Most participants believed that the game enabled a good knowledge transfer, quicker than other traditional means (books or slides)

At MAN, most participants:

- considered that this game is *very well made*.
- believed that the game represents a real support in terms of theoretical training for future deployment
- stated that they would be curious to try/test new learning tools
- Stated that:
  - the interface was very friendly and contained catching audio-visual materials
  - the content was attractive, with detailed features enabling effective knowledge retention

At CMRE, the view was partly different.

- Most participants judged its man-machine/graphical interface too static, basic and obsolete.
- About 50% of them considered the game boring and not immersive at all, and suggested to significantly improve its graphical interface to make it more appealing.
- Feedback and assessment were considered appropriate and successful.
- The vast majority of participants declared they would be interested in being trained on topics of their own professional interest by means of a Serious Game. This appears in general as a significant indicator on the effectiveness of the game as a training tool, and even more significant when this opinion is expressed by 81% of those who never received any training on Cultural Awareness (thus confirming effectiveness of this tool in providing training on the specific topic) and by 100% of those who had experienced the use of a Serious Game before

(suggesting that effectiveness of this specific game is in line with that of similar tools in other fields).

Overall, the evaluation was generally positive: SGs seemed to be well received as new and modern tools for assimilating appropriate knowledge in a pleasant and efficient way.
Major differences in responses might be related to either the level of engagement the game can provide to the two categories of user, and to their different background: different perspectives and different experience are likely to generate different perceptions.
MAN military students were highly motivated, and their target was to get profound knowledge of the content. If the means to achieve this are a serious game instead of pages and pages of a book or a power point presentation, they were happy. They gave less importance to the entertainment/fun aspect of the serious game, usually related to 3D sophisticated and realistic animations and high level of interactivity.
CMRE users seemed to have more expectations in terms of technology and entertainment than a strong will of achieving learning goals. Although they were interested in achieving some knowledge on the topic, they looked at (and much weighted) the fun aspect of the game as well. Many considered the serious game boring and not efficient enough. These users were generally video-game experts, and using arrows and mouse at the same time, as in a typical 3D, technologically advanced game, was not a barrier for them. However, they tended to underestimate that the simplicity of its user interface and the low-mid interactivity level very much decrease the game learning curve, and make the game extremely user-friendly for any kind of user, from neophyte to video-game expert.
Cultural differences between respondents also make some of the answers not intuitive for some of them, although the correct answer after the initial briefings was easily identified..
Reference is made, for example, to the scenario related to a vehicle checkpoint, where an approaching Afghan car is stopped by a soldier and an older man gets out of the car: he appears friendly but moves up very close and speaks in the soldier's face by waving his hands. The most appropriate behavior – according to the pre-training – is to hold the position as stepping back may be offending to the Afghan, who is having a normal friendly behavior as per local cultural standards. The right answer appeared to be the natural choice to Mediterranean people, while options like stepping back or even using a hand to keep distance would have been the instinctive reaction for respondent with an Anglo-Saxon type of culture, although their answers were correct due to the information provided in the initial briefing.

6. Additional case study

Following compared tests carried out by MAN and CMRE, a further test was conducted with a third sample of users.

6.1. Group selection

Selection of users was made to include a complementary set of profiles with respect to the ones selected in the first round.
Whilst the combined analysis made in 2013 included on one hand operative and ready-to-be-deployed soldiers and on the other hand NATO civilians, with the aim of reflecting the two main categories that are typically involved in CIMIC operations, in this case the purpose of the analysis was to test the game's effectiveness on a group of people with no professional link with the above-listed categories.
The group was composed by twenty-two University students of Italian nationality, all in the 21-30 age range and with absolutely no previous training or knowledge in the specific field
91% of respondents had medium to high experience as video-game players with 73% very low / low experience as Serious Games users (much more polarized data with respect to previous samples). Only 30% of respondents declared that they had played Serious Games at least once.

6.2. User study organization

Being absence of previous training in the field a pre-requisite for the test, the analysis included a pre-briefing questionnaire: users were required to answer questions before undergoing the pre-briefing session. The same questions would then be found later in the game.
The pre-briefing questionnaire was not submitted to users at MAN and CMRE, and this does not allow complete overlap of user study outcome. This was due to considerations made in the post-study results analysis that a comparison between pre-briefing and post-briefing results would have provided less subjective and more fact-based assessment of learning effectiveness.
The methodology followed by the additional user study was therefore partially different from the one followed for the initial ones, although all the elements of MAN/CMRE user study were kept to allow comparison of results and conclusions drawing.
With respect to the assessment of learning curve and effective learning time (Fig. 9), the intuitiveness of the game appeared to be confirmed, with no rating over 10 minutes as far as learning curve was concerned, and extremely quick effective learning time (no users over 30 minutes and only one user in the range 20 to 30 minutes).

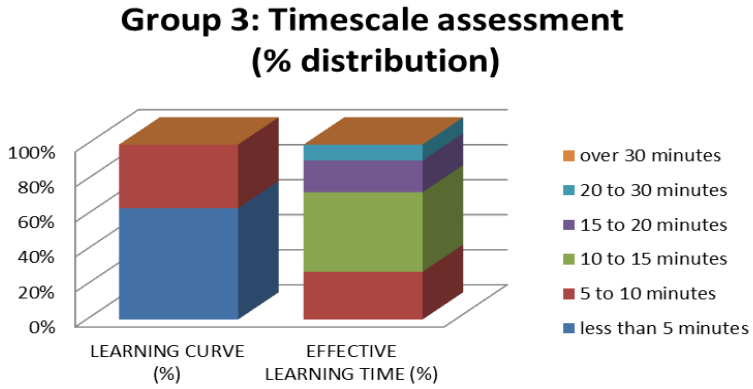

Figure 9. Users' responses on duration of their own learning curve and effective learning time (in percentage).

When assessment of games usefulness as actual training tool came to relevance, polarization in answers became even more evident (Fig. 10).
The game was rated as extremely useful and usable, providing high-value feedback and assessment support; resources available inside the game to support correct resolution were also very much valued by players.
Ratings did not exceed the "Average" value – however when issues like interactivity, engagement and motivation are assessed. Lowest ratings were given to interactivity, with 64% rating between "low" and "very low", while "average" rating prevails (73%) for capability to motivate the user.

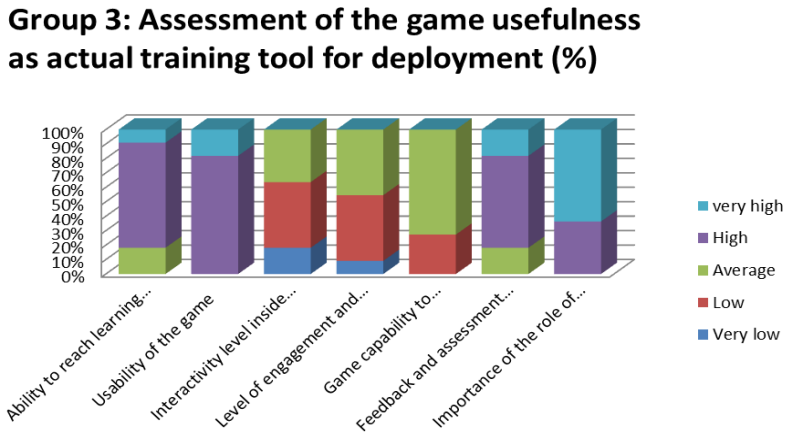

Figure 10. Users' responses on a set of game features related to its usefulness as a training tool (in percentage).

This confirms and somehow enhances the conclusions reached in the first user study: low ratings – definitely lower than those expressed at MAN and CMRE – did not prevent higher ratings on effectiveness-related aspects, which were generally rated at higher level than in the original study

Analysis of answers on self-assessment of improvement rates in both cognitive learning skills and in soft skills (Figs.11 and 12) not only confirms that all users believed they had improved their knowledge at all levels, but also allows to identify a correlation between the level of knowledge and training received before undergoing the Serious-Game based training session and the perceived level of improvement.

In comparing the three sets of values, it is noted that the lower the initial level of training/awareness on the specific topic, the higher the component of "Reasonable" to "High" improvement rates.
This makes it reasonable to conclude that game effectively serves the purpose of bringing users to a level of knowledge / competence which is comparable in absolute value and not only in relative terms.

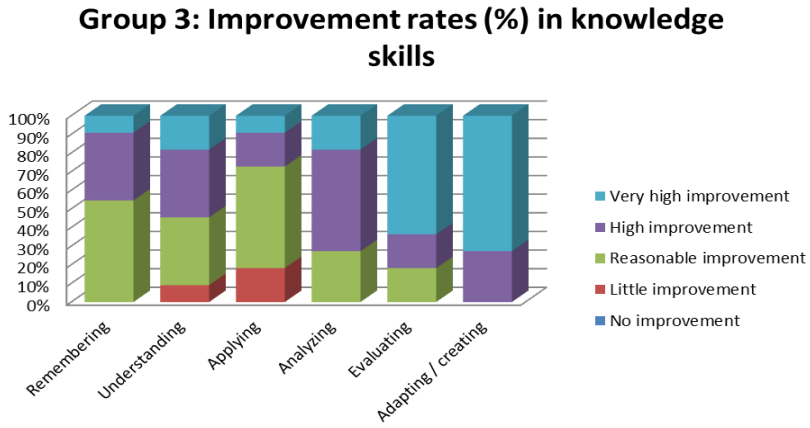

Figure 11. Users' responses on cognitive learning goals (in percentage), according to the revised Bloom's taxonomy [23][24].

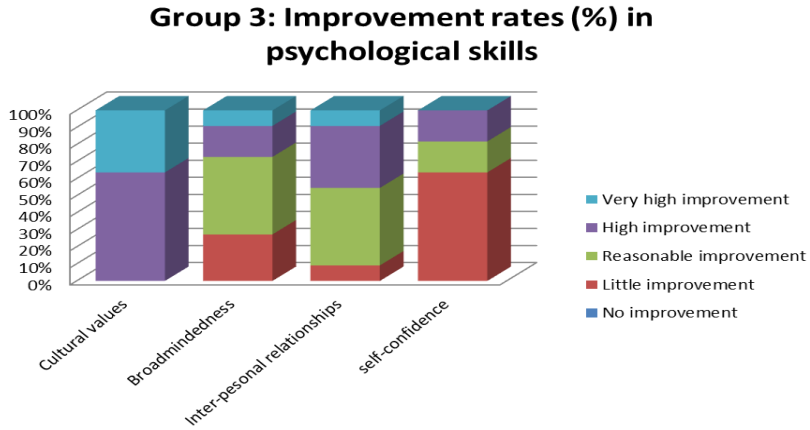

Figure 12. Users' responses on selected soft-skill learning goals (in percentage).

6.3. Comparison of preliminary questions with results after the training

Following a partially different path with respect to the original user study, the self-assessment was then complemented with fact-based assessment of knowledge improvement by comparing the results of the preliminary test with the same questions put after the game. Questions were as follows:

1) **CIMIC Application**: An Afghan team is working under the supervision and responsibility of NATO peace forces for the reconstruction of a hospital.

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The Afghan team is working hard on the project assigned. A soldier who is supervising them notices that one of them has been working particularly hard.
Question: How should the soldier praise the Afghan worker?
Options:
1. Take him at one side and tell him he's done a good job
2. Gather all the workers of the team together and praise them all
3. Praise the worker in front of all the others in order to motivate the whole team.

2) **Vehicle check point**. A soldier team controls a car check point. An Afghan car approaches. One soldier stops the car. The soldier approaches the car with an interpreter and asks the older man in the car to make a quick check of the car. The older man gets out of the car. He appears friendly but moves up very close and speaks in the soldier's face by waving his hands.
Question: What should the soldier do?
Options:
1. Step back: This means that the Afghan is up to something. He is speaking loudly. It is best to keep his distance
2. Hold his position: This is normal for the man. If the soldier steps back the Afghan might be offended.
3. Use a hand to keep distance: This might be a threat. He must not step back, but must keep his distance by a firm hand gesture.

The correct answer to both questions was #2.
At the end of the game all respondents were able to provide the correct answer (Fig. 13).

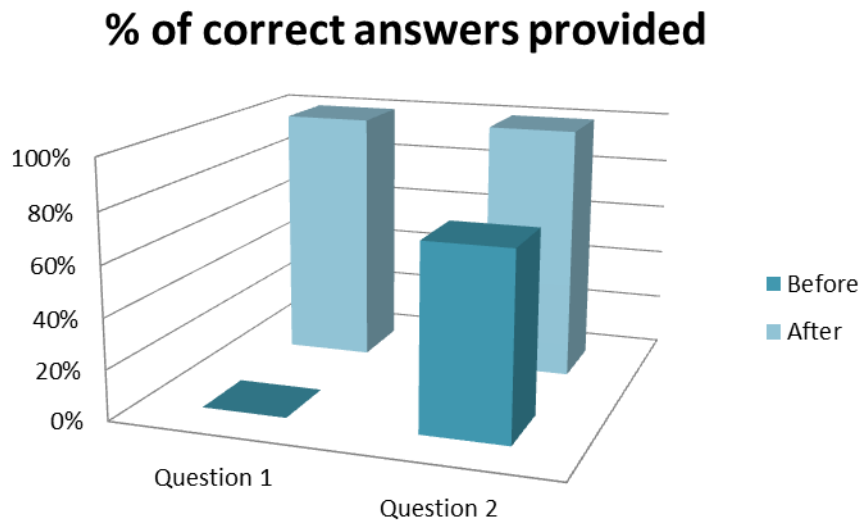

Figure 13. Percentage of correct answers provided by users to set questions in preliminary and post-training test

It is worth noting that the percentage of correct answer to question 2 was high (73%) even in the preliminary round, thus supporting conclusions reached in Section 5 above on influence of differences in cultural background in considering the correct answer to be also the most intuitive.

7. Conclusions and future perspective

In conclusion, the game evaluation was generally positive, both in terms of learning impact measurement and individual assessment from users.
Fact-based measurement of knowledge improvement was only possible for the third group of users (University students). Data based on self-assessment are available for analysis and comparison for the three user groups.
Improvement in cognitive skills at each of the revised Bloom's taxonomy level - to include the adapting/creating level - was observed by all groups. This seemed to be favored by the level-based

game structure, where answers to the questions could initially be found "as-is" in the reference material, but subsequently had to be found by analyzing the specific scenario and adapting the information received to the situation.

A correlation was observed between perceived improvement in cognitive skills and users' initial knowledge level: the highest level of improvement was perceived by those users with the lowest initial level of knowledge, thus suggesting that knowledge level reached by users can be compared in absolute value and not only in relative terms and confirming the game's effectiveness as a knowledge assimilation tool.

Significant improvement in psychological skills was also observed in all three groups. Perceived improvement appears to be generally higher in the first two groups, in consideration of their composition (soon-to-be-deployed military personnel and NATO civilians) leading to more clear perception of immediate usability of the concepts acquired as well as to appreciation of their relevance in real-life situations.

In consideration of these results as well as of the positive assessment in terms of usefulness as actual training tool for deployment, it is reasonable to conclude that this Serious Game appears to be a proper way for assimilating appropriate knowledge with the purpose of determining proper behavioral and attitudinal reactions. It can be seen a valuable, complementary solution to traditional education and training tools.

The simplicity and lack of refinement of its graphical interface annoys the most "technological" users, but allows achieving a very smooth, almost instantaneous learning curve for all users, independently from their background as video game players. The simplicity of the user interface and of the game engine very much increases the game usability.

Evolution of Serious Games in the defense sector is strongly influenced by the existing solutions as well as by simulation tools in use in this area. Whilst games developed few years ago adopted different approaches, the new generation of Serious Games is normally adopting 3D Graphics: it is therefore quite common in the defense sector to expect virtual representations even in Serious Games where the 3D Representation provides limited benefits.

This trend is supported by the evolution of game engines: indeed the diffused use of Virtual Simulation generate expectations from military users to have a graphical interface and to get performances not easily obtained over complex scenarios (i.e. humans, sea surface, complex environments, many players) with small projects (Serious Games budget is often very limited) and with flexible support (i.e. simulation as a service).

The combined effect of defense scenarios and games normally involving strong interaction with virtual humans and challenging external environment, and of rather limited budget for military SG budgets leads to a reduced user audience for military SG players with respect to traditional game audience. This introduces a number of challenges in existing game solutions despite the fast evolution in the sector, although it is reasonably expected that in a relatively short timeframe several issues will be overpassed.

As at today, most of the existing low-cost game engines present evident limitations in addressing concurrently all the issues in defense SG; on the other hand, most high-performance game engines are still too expensive with respect to the Return of Investments (ROI), provided by specific small/medium- size defense SG projects.

Results of the present study on "Cultural Awareness – Afghanistan pre-deployment" confirm this analysis.

Despite its playing-entertainment aspect being quite limited, with rather obsolete user interface and game mechanics, its usability is however high, and users provide a generally high rating, in consideration of both its effectiveness in attaining the main goal – transfer a number of information – and of its capability to ensure real-life kind of experience.

Videos with interviews to real people operating in the specific scenario, and the perception of the immediate applicability of the concepts acquired in real situations also increase the level of motivation of users.

In this specific domain, it is clear that the level of fidelity and refinement of the virtual reality created by a game of the latest generation (refined 3D graphics) is certainly important for the effectiveness of a game, but more important is the content, the learning goals selected, the motivation that is transferred to the user. If the content and the information to transfer are too limited, and are not able to convince to be real, a nice 3D graphics does not help. This is particularly valid when the learning objectives are mainly of cognitive kind.

In order to provide solutions addressing all these aspects, few game companies are currently providing tailored solutions of their game engines for defense; these tools demonstrated

reasonably good performance even though they results quite rigid with respect to user expectations. It is evident that the military users and decision-makers are evolving in term of expectations and requirements for SG, and that new capabilities will be defined as well as new IPR and licensing constraints. Future evolution of military users (Generation X and Y) will change the impact of SG in this sector and will extend the application areas and effectiveness of SG with respect to traditional simulation training.
However, also SGs will be required to be able to self- adapt to the specific defense needs; in future we expect that emotional involvement, crowdsourcing, mobile and immersive solutions will growth in terms of importance with respect to basic virtual representation characterizing the current trend.

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