AMBIENT ASSISTED LIVING JOINT PROGRAM

AAL-2013-6-039

SeniorLudens

Serious Games development platform for older workforce training and intergenerational knowledge transference

D4.3
Recommended actions

Workpackage	WP4 – Pilot evaluation
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1- Introduction

The goal of this document is to highlight the recommendations on case study implementations.

In particular, it aims at identifying problematic areas in the relationship human machine (usability, accessibility, digital divide, etc.). From a methodological point of view, we based our analysis on common/recurrent mistakes along the three evaluation sessions and the identification of barriers to technology use. We focused also on the organizational and procedural aspects related to the usability and accessibility (e.g. language and/or cultural barriers), false expectations, and any other relevant issue that might emerge during the pilot lifetime.

SeniorLudens platform implementation was tested along the whole validation project, specifically in correspondence of the first release at M13 and successively at M22 and M30.

The users' feedbacks collected during the consecutive evaluation sessions constituted some informative guidelines in order to make the system each time more tailored to the user's requirements.

In all the validation sessions, all modules integrated in the platform were tested in terms of functionality, usability and user's requirements. The Use Cases were assessed also in terms of learning objectives.

All these steps of implementation and testing of the system had leaded to the definitive version of SeniorLudens assessed in all its functionality at M30.

SeniorLudens Platform is structured in a platform and four different use-cases. The Platform structures the basis for the overall system, because it centralizes the access for all users, managers and trainees. It is projected for the definition, the creation of a collaborative hub for development, deployment, use and evaluation of Serious Games on which users have the possibility to share their experiences with SeniorLudens Community.

The use cases correspond to different sectors to validate the applicability of the concepts in various scenarios and users:

- **Use case 1**: IT companies. The overall goal of the Grow your Project serious game is to provide training on the process of Project managing in Indra. The training encompasses the steps of organization, planning, and tracking of the project. The game helps to understand the different stages of project managing through the use of a farming metaphor.
- **Use case 2**: Hospital/clinical and home caring. It takes place in the field of patients' motor and cognitive rehabilitation performed by physiotherapists in a hospital environment. It aims for the familiarization of primary-users (Senior Physiotherapists, SPTs) with new technologies and the intergenerational transfer of the SPT's knowledge to young physiotherapists (YPTs, secondary users).
- **Use case 3**: Traditional Food Production. This use case is based on Bagolino's traditional cheese, a village in the province of Brescia (Italy). The use case preserves the valuable knowledge of the elderly cheese manufacturers to permit its transference to new generations.
- **Use Case 4**: Safety at Home. It is based on the job of the elderly advisors Safety at Home from UnieKBO. These advisors are elderly people who visit other (vulnerable) elderly persons who live independently to give them advice about their safety. This use case was included into the use cases' catalogue as a reaction from the recommendations of AAL CMU after the mid-term review to show the capabilities of the system and to validate the usability by elder users, not only from a consumer point of view but also from a creator perspective.

The present document advances the recommended implementation actions for the future of SeniorLudens, firstly, by analyzing the evolution of the usability and functionality features of the

platform and the games along the three evaluation sessions and, secondly, by examining answers to the TAM3 model about the accessibility of the system. These future steps go in parallel with the exploitation planning outlined in D5.6 as they are considered to be evaluated during the exploitation schedule defined after the project execution to fit the SeniorLudens solution to the market necessities.

2- Methodology of recommended actions

In order to identify possible problematic areas of SeniorLudens in the relationship human machine (usability, accessibility, digital divide, etc.) we recorded and analyzed the opinion of users along the three validation sessions by means of ad-hoc questionnaire and standardized scales.

Along the three evaluation the totality of users was 83 primary and 122 secondary recruited by the organizations responsible for each single use-case (INDRA; CBIM; FCG and UnieKBO).

Successively, we compared results obtained along the three sessions at Time 1(T1, M13), Time 2 (T2, M22) and Time 3 (T3, M30) and we obtained relevant information about the common/recurrent mistakes and the identification of barriers to technology use.

In the next paragraphs we report the comparison results at T1, T2, and T3 from the following tools:
- **System Usability Scale (SUS)** [1] to test the appropriateness to a purpose of SeniorLudens according to the users.
- The **Intrinsic Motivation Index (IMI)** [2], to test users' intrinsic motivation in carrying on targeted behaviors and in supporting autonomy, competence and satisfaction.
- The **Flow State Scale (FSS)** [3], an index of the user's flow state in using SeniorLudens, considering the flow state as the optimal psychological state to carry out an activity.
- The **PANAS** [4], to have a user's affective state index relative to SeniorLudens experience.

To identify also organizational and procedural aspects related to the accessibility of SeniorLudens (e.g. language and/or cultural barriers) and any other relevant issue that might have been emerged during the pilot lifetime, we also used an adapted version of a complex model assessing the acceptance of technological devices (**Technology Acceptance Model, third version - TAM 3**) [5].

The full description of the evaluations scales is described in deliverable D4.1. The results obtained in each single evaluation session are detailed in the three versions of the deliverable D4.2.

3- User experience results – comparison at T1, T2 and T3

The user's experience is assessed in order to obtain a measure of SeniorLudens usability, user's motivation, affective and psychological state in SeniorLudens usage. A comparison along the three evaluation sessions was performed to obtain useful and reasonable data to recommend future actions for implementation.

3.1- Usability of SeniorLudens System: comparison results and recommended actions

In order to ensure that the platform and the game have a good level of usability, users were asked to answer to a usability scale along the three evaluation sessions of the platform and the use cases.

As for primary users, their judgments on the usability of the platform settled between "ok" and "good" ratings in all the three evaluations. Even though it is a fairly good result, it is possible to hypothesize of working on the margin of improvement of the platform following the suggestions given by the users of the pilot (the functionality results are analyzed in section 6). As for the worsening between the first and the second release of the platform with a successive improvement in the third, it seems strictly connected to the level of implementation of the platform. In the second evaluation some features were visible to the users but not yet functioning. Differently, in the third evaluation, these functionalities were operating and there were also other new working functions.

Secondary users show a positive trend and results settle above the "good" rating. In other words, the games were judged with a good level of usability that was kept unchanged even with the increasing complexity of their structure along the three evaluations.

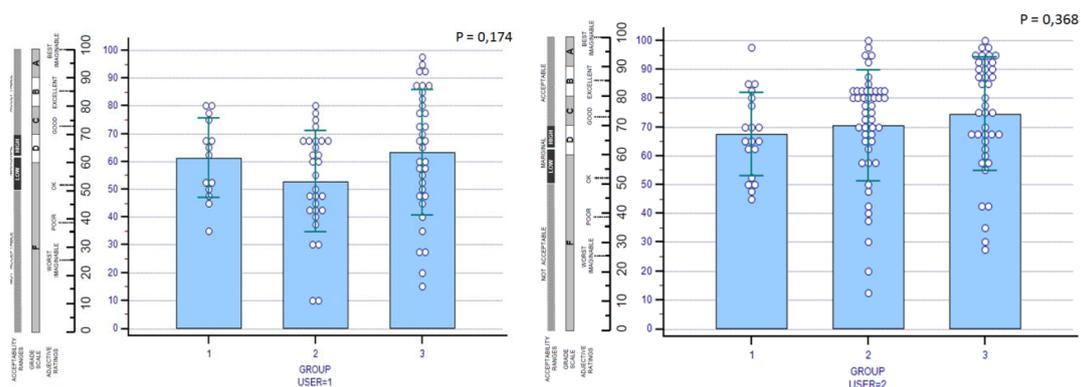The next figure shows a graphic analysis of the results obtained.

Figure 1 – SUS: Usability of SeniorLudens System, comparison at T1, T2 and T3 [Primary users, sx; and Secondary user, dx]

Following Sauro and Lewis [6], we can also consider the SUS model as based not just on a single score indicating overall perceived *usability* of a system as originally intended, but on the two scales it incorporates as suggested by factor analysis. These sub-scales are the *usability* of the system and the *learnability* of the system.

Considering the *usability* sub-scale, results are similar to those of the general SUS scale. Whereas, considering the *learnability* sub-scale along the three validation sessions, results show a significant difference ($p < .05$) between the first and the other two evaluation sessions for secondary users (Figure 2) with ratings increasing in the second and in the third sessions. This result highlights the important learning effect the games produced in secondary users along the three evaluations.
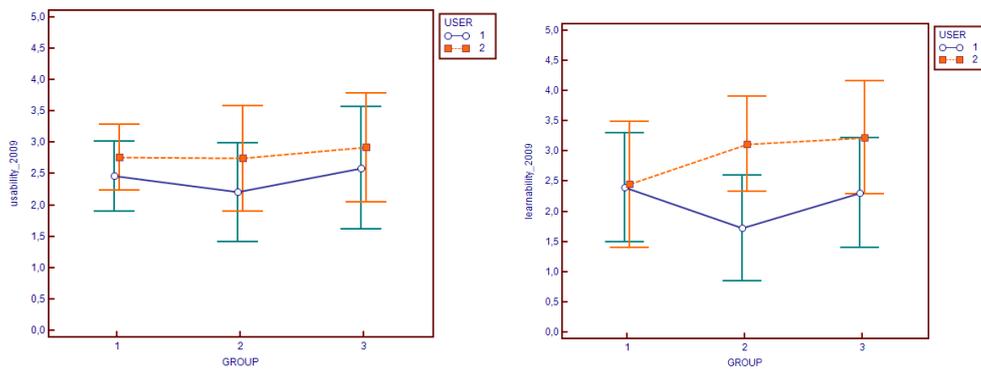

Figure 2 – SUS: Usability AND Learnability of SeniorLudens System, comparison at T1, T2 and T3 [ALL users]

Even though usability level results are good, it is possible to hypothesize some actions to improve it in terms of becoming more engaging and attractive. In this sense, very useful can be the qualitative suggestion from primary and secondary users for the implementation of the relation of the users with the system which are reported in the functionality session (it is covered in section 6).

3.2- Intrinsic motivation in the use of SeniorLudens System: comparison results and recommended actions

The intrinsic motivation of primary and secondary users in the use of the platform and of the use cases of SeniorLudens was analyzed along the three sessions and no differences between the two groups of users (primary and secondary) and the three evaluation sessions were identified. All scores ranked in a good position, higher than the mean value of the scale. The graphical representation of the results is included in the next figure (it shows the scores of the two groups in each evaluation).
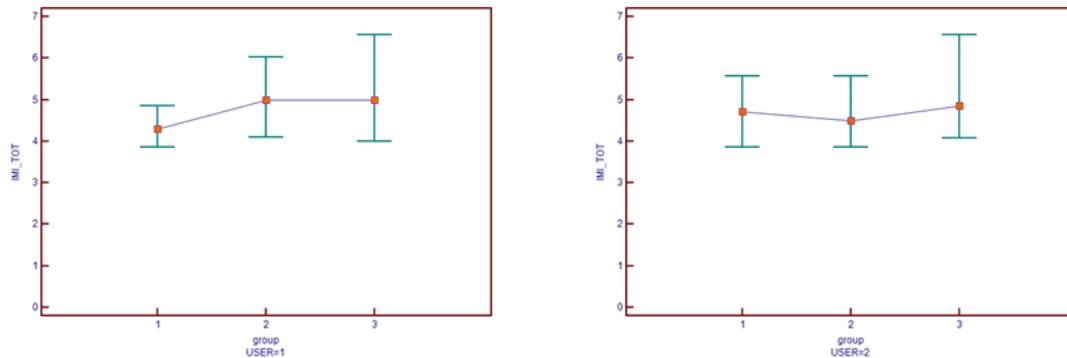
Figure 3 – IMI: Intrinsic Motivation Assessment, comparison at T1, T2 and T3 [Primary users, sx; and Secondary user, dx]

The use of the games and of the platform is attention catching and motivating. Nevertheless actions to reach a higher judgment on the perception of amusement while using the system should be taken into account. Then, it could be interesting to work more on the adherence of the games and the platform to the interests and the work of the users and on the playfulness of the system in order to increase users' motivation in using SeniorLudens.

3.3 - Flow state in the use of SeniorLudens System: comparison results and recommended actions

Results of the factors of the flow state scale (challenge and skill balance, action-awareness merging, clear goals, unambiguous feedback, concentration on task at hand, sense of control) ranked on values higher than the mean value of the scale, both for primary and secondary users. Although results ranked at a good level for both, secondary users tended to judge more positively the games than primary users the platform.

In figures 4 and 5, it is possible to observe an increasing of some of the FSS ranks both for primary and for secondary users in the third evaluation. More specifically, primary users judged the feedback of the platform as increased in clarity along the implementation of the pilot. Secondary users, gave significantly better judgments in the last evaluation to the relevance of the game with the skills of the users, to the level of specification of the goals, to the reduction of disturbing noise while accomplishing the task, and to the sense of control in using it.

These results show that the platform increased in complexity and, at the same time, in giving a clear feedback on how the user was performing. Furthermore, the use cases, although each time more difficult, improved in matching with the abilities of the user and in letting the user feel to have a sense of control on them. Results clearly show a higher level of engagement of users with the games than with the platform, because of their playful relevance.
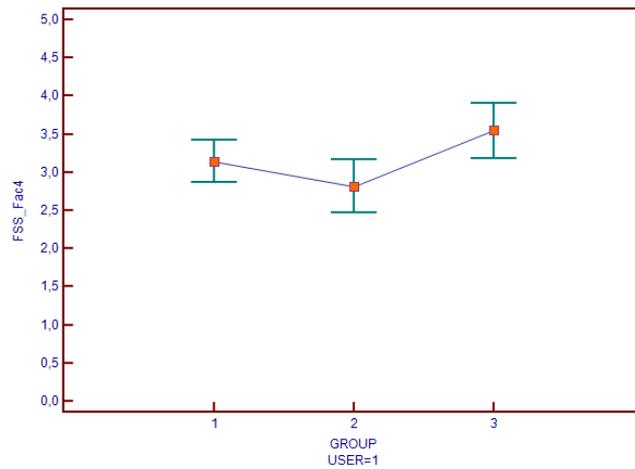
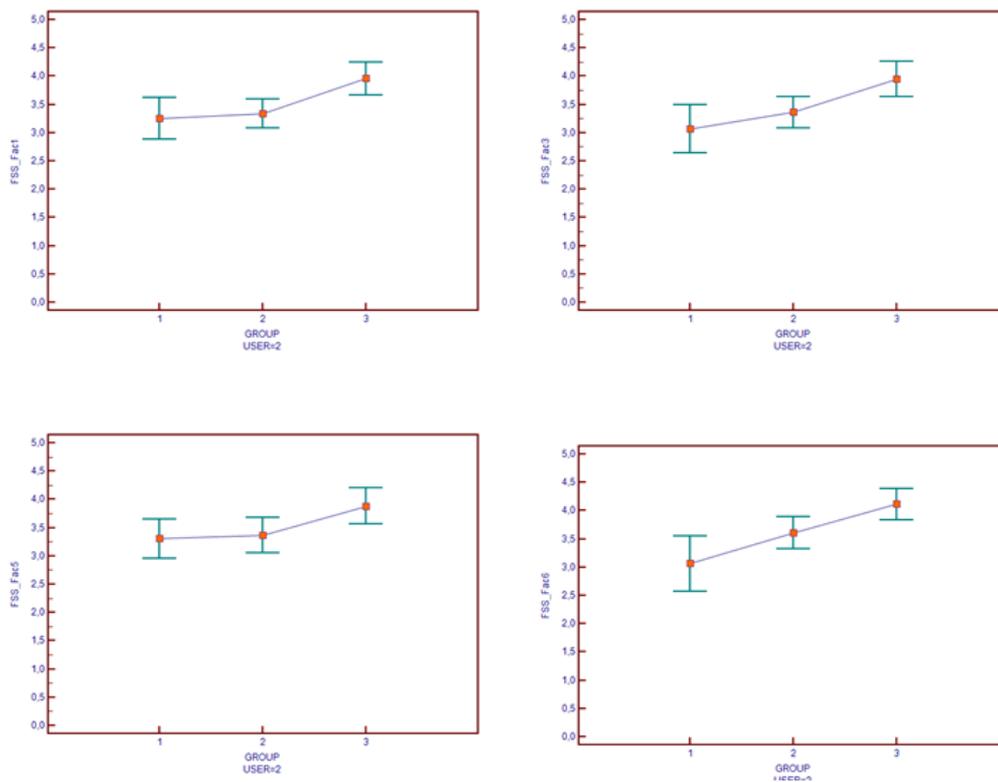**Figure 4 – FSS: Flow State Scale, comparison at T1, T2 and T3 [Primary users]**

Figure 5 – FSS: Flow State Scale, comparison at T1, T2 and T3 [Secondary users]

The results show an increasing of the perception of control over the system. Nevertheless there is still a margin of improvement in the clarity of the platform and of the games to be fulfilled. For example, platform and games should work in a more

automatic way and the games should extend the feedback to the users on how they are performing.

3.4 - Affect in the use of SeniorLudens System: comparison results and recommended actions

Results on the questionnaire about the affect before and after having used the SeniorLudens Platform and the use cases show a significant diminishing of the negative affect component in the secondary users. A trend to diminish in the last evaluations in the primary users is also visible, even though not significant. Then, the playful effect of the games emerges clearly whereas the use of the platform is less related to active participation and enjoyment.

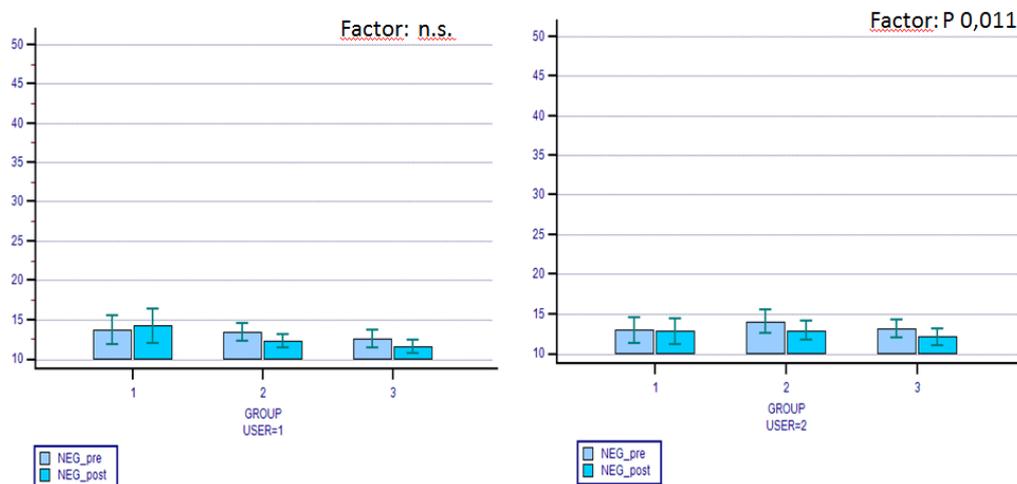The graphical representation of the results is shown in the following figure.

Figure 6 –PANAS: NEGATIVE AFFECT, comparison at T1, T2 and T3 [Primary vs. Secondary Users]

An improvement of positive affect and a reduction of negative affect after using SeniorLudens needs, under our premises, an implementation of the level of engagement of the users with the system. Intervening on aspects related to usability can indirectly have an effect also on affect.

4- TAM3 - comparison results and recommended actions

We included the analysis of the Technology Acceptance Model (third version) [5] only in the last validation session in order to acquire the level of technology acceptance of the final integrated version of SeniorLudens at the end of the validation process.

The TAM model assesses the behavioural intention to use technology as affected by the salient information or beliefs related to the consequences of a determinate action. TAM model describes two main beliefs that affect user's inclination to use technology: *perceived ease of use* (the degree of difficulty that instrument use involves) and *perceived usefulness* (the belief that, by using the instrument, the user will improve his/her productivity).

For the collection of answers some items were modified and deleted according to let the instrument fit with the requirements specified in the user-requirements document.

Furthermore, SeniorLudens was used in the three specific moments of the evaluation sessions but was not trained for a period at home and it was released in a pilot version. As a consequence, it was not possible to analyze all the determinants of the TAM for SeniorLudens. It is intended to extend this analysis in the exploitation period which starts after the project finalization.

For the analysis of the Perceived Usefulness dimension, Perceived ease of use (PEOU scale), Job relevance (REL) and Results demonstrability (RES) scales were took into analysis.

For the analysis of the Perceived ease of use dimension, Perception of External Control (PEC), Computer anxiety (CANX), Computer Playfulness (CPLAY) and Perceived enjoyment (ENJ) scales were used.

Results showed a significant effect of group (Indra > CBIM and FCG) for all factors except for the Computer anxiety and Job relevance scales. Indra workers, then, showed to perceive Senior Ludens as highly useful for their job and extremely easy to use with respect to the users form the other groups. This is aligned with the fact that Indra validation was performed by involving IT experienced workforce.

In the comparison among the three groups of users (Indra, CBIM and FCG), the scales of the Perceived usefulness dimension obtained fairly good results - with answers ranking above the mean value of the scale. In the PEOU scale, the interaction with SeniorLudens platform and games was judged clear and understandable and not requiring a high mental effort both for primary and secondary users. In the RES scale, primary and secondary users considered in their possibilities to tell others the results obtained with the use of SeniorLudens. Considering the Job relevance scale (REL), answers from secondary users of CBIM were significantly lower than those both of FCG's and of Indra's. This result is in line with the fact that secondary users from CBIM are young users interested in the alimentary field but not expressly in cheese making. The Figure 7 shows a graphical representation of results.

PEOU = Perceived Ease Of Use
REL = Job Relevance
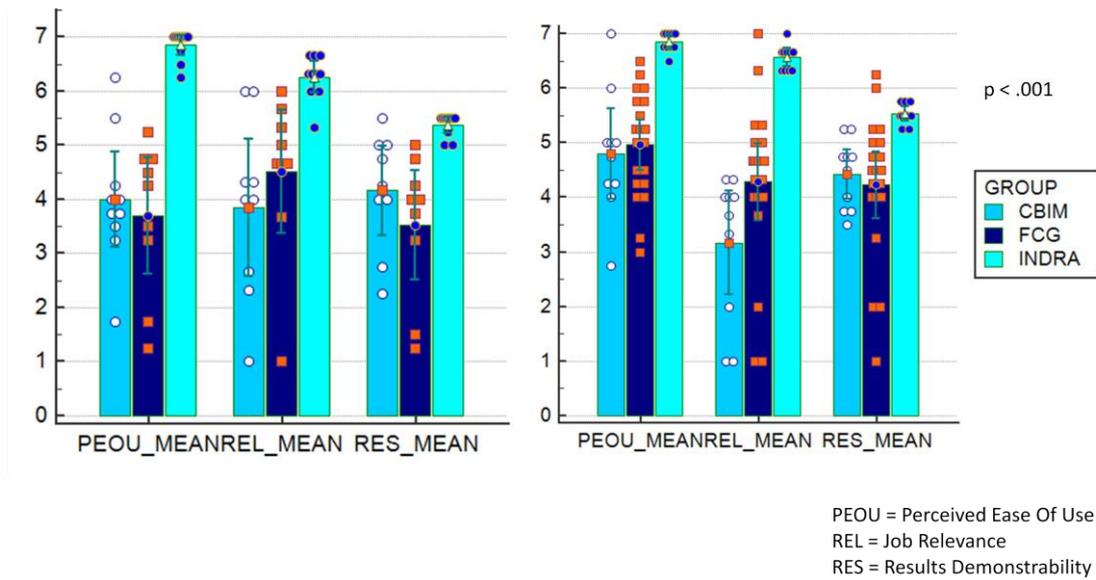RES = Results Demonstrability

Figure 7 – TAM Perceived Usefulness: [Primary users, sx; Secondary users, dx]

As for the scales of the Perceived ease of use dimension, results were higher than the mean value of the scales in all scales except for Computer anxiety. It means that SeniorLudens was judged requiring the right amount of resources from users and easy to use (PEC); moreover, it was considered a creative and playful tool (CPLAY) and pleasant to use (ENJ). Users judged technology as friendly and not scaring (CANX), even though scores from primary users of FCG were significantly higher than those of CBIM and Indra. The last result showed a higher defensive attitude to technology from physiotherapists whose job is, probably, the one among those considered in the project which in less expressly bound to the use of computers. The graphical representation of the results is included in the Figure 8.
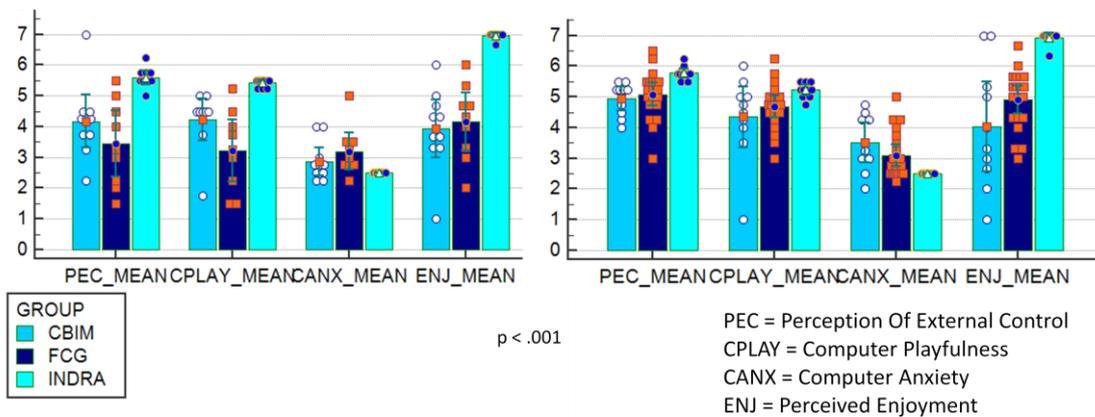

PEC = Perception Of External Control
CPLAY = Computer Playfulness
CANX = Computer Anxiety
ENJ = Perceived Enjoyment

Figure 8 – TAM Perceived Ease of Use: [Primary users, sx; Secondary users, dx]

5- Recommended actions from UnieKBO

The Home Safety use case was specifically developed for elderly advisors: seniors who give other seniors advice regarding safety in their house. This case was developed with the iterative input from advisors in the Netherlands. Their input helped us on the one hand to improve the system according to their needs and preferences. At the other hand it gave us insights in the market opportunities for this specific target group. In this section we describe how the SeniorLudens system would ideally look like in order to fit it perfectly to this target group.

Preferred use and functionalities.

The involved elderly test-users like the idea of using a game to give advice about safety at home; they find this 'topic' very suitable to teach in a visual and interactive way. The advisors would like to use the SeniorLudens system.

Since all individual advisors focus on different topics when they give advice about safety at home, they all would use their own game to teach the elderly people: They like the opportunity to edit the games (tasks) their selves. In order to give them this opportunity, both the task and scenario -editor need to be present in the version for this target group.

This target group prefers to edit existing tasks/scenarios rather than make one from scratch their selves, so preferably example games should be available at baseline.

The elderly advisors would like to prepare a game for an elderly person whom they are about to visit and to play/watch the game together at the elderly's home. Another interesting way to use the system would be, according to this group, to teach new advisors with their game. This application looks most similar to the original idea of SeniorLudens. However, in both cases the advisors are not specifically interested in a Serious Game for the player which they can follow remotely. So this part of the system wouldn't be specifically asked for by this target group. Instead, they prefer the opportunity to save the game they prepared at a USB-stick so they can play it offline. Not all elderly persons have a high-speed Internet connection and in the current version, this is needed to play the games.

In general, this target group liked the provided functions and themes that were included in the system, but more scenarios and tasks would be welcome to keep it challenging for different settings.

Preferred device.

To make the SeniorLudens system attractive to this target group, the system should be made available on different devices. In the current state, the SeniorLudens platform was developed to be used at a desk- or laptop. An improving amount of elderly people (among whom both the advisors and the persons they visit) have a laptop or tablet. It would be helpful if the system would be available on the tablet as well or at least would provide the opportunity to show/play games at home of the elderly person who gets the advice.

Buying the SeniorLudens system.

This target group wouldn't buy (or pay for) the system their selves, but would appreciate it if the organization they work for would provide this opportunity.

6- Platform and Games functionality – Recommended actions

Taking into account the qualitative comments that primary and secondary users had the possibility to express in the third evaluation session, we followed the Nielsen–Shneiderman [7-8] usability heuristics to categorize the actions to improve usability in the way that they suggested:

- **Consistency/Minimalism**: it is important to implement elements that help users to perceive immersion such as the use of buttons instead of folded menu, full screen visualization and the use of sounds and big icons for elderly; an improvement in the access to the activity creation in the platform and an extension of the social network are also appreciated.

- **Visibility/Documentation**: users accept positively the assistance in the use of SeniorLudens with information on the different features of the system and some tooltip to help them in the actions.

- **Memory**: users require to avoid the need to memorize a lot of information during the game but to have the possibility to go back to check some information.

- **Feedback/Closure**: users agree with the need to provide a feedback about users' actions and performance. Primary users also appreciate a challenging and attractive system, for instance with rewards for correct answers and with visible game elements (score obtained using the game, number of wrong and right answers)

- **Flexibility/Control/Undo**: users would appreciate the possibility to go back in the questions. It should also be considered to view both right and wrong answers in red and green.

- **Error/Message**: It could be interesting providing alerts on possible errors and how to recover from these errors.

- **Language**: the implementation of the system in the native language of users could ameliorate usability of SeniorLudens.

Finally, the need for a preliminary training phase, especially for the primary users (the content creators) is considered a necessity to understand the concepts involved in the process.

Working on these aspects in the future will be effective in improving the positive affect of users at the end of the game and their intrinsic motivation to use the system.

7- Conclusion

Considering the results reported in the previous paragraphs, the usability of the SeniorLudens platform and games obtained a good level but could still be liable to be improved in some aspects in the future.

As for the intrinsic motivation of users, the use of the games and of the platform seems to answer in a good manner the expectations of the users of SeniorLudens: it was able to catch attention and to sound enjoyable. Nevertheless, actions to reach a higher judgment on the interest/enjoyment factor should be taken into account, particularly in the following exploitation schedule that starts after the project finalization.

Considering the optimum status to use the system, there is still a margin of improvement in the clarity of the platform and of the use cases to be fulfilled. Most of all, it seems to be important to intervene on the level of automaticity of the system and the implementation of the system in the native language of users. The internationalization of the system has been developed in the final integrated release but it could be interesting to make it more accessible to the users' needs.

Concluding, SeniorLudens resulted to be a comprehensible and effective tool with older generations and a promising tool to be used with new generations, which are day by day more technological. At the same time, particular attention should be addressed to the level of engagement to the system: if this is low, then the system could lose its attraction.

Figures and tables

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