

AAL Project no: AAL-call-2018-150

VIRTUAAL

Virtual and Augmented reality for combating cognitive impairment

DELIVERABLE n° 2.2

Dashboards and KPIs

| | |
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Abstract (for dissemination)

The role of this deliverable is to present the results of the testing phase and the key performance indicators, which are crucial for the understanding of the overall development of the project.

¹ L = Legal agreement, O = Other, P = Plan, PR = Prototype, R = Report, U = User scenario

² PU = Public, PP = Restricted to other programme participants (including the Commission Services), RE = Restricted to a group specified by the consortium (including the Commission Services), CO = Confidential, only for members of the consortium (including the Commission Services)



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1. ABOUT THIS DOCUMENT

1.1. Role of the deliverable

This deliverable provides an exhaustive description of both the key performance indicators and dashboards that include the results of the analysis carried out throughout the project. The first chapter describes the objectives of the project and to what extent they have been achieved. Then, the results of the accomplishment of these objectives are depicted in different dashboards and information tables. The role of this deliverable, in sum, is to collect the data and present it in an understandable way.

1.2. Relationship to other VirtuAAL deliverables

This document is closely related to D1.3, where the tests were designed and the basis of the project was established. Once the objectives of this deliverable have been accomplished, these conclusions can be achieved. D2.1 is also crucial for the achievement of these results.

2. Pilots

ANA.

In Romania we organised 16 rounds of trials - with an average session length of 3,5 hours (the shortest session, with one volunteer was of 1 hour, whilst the longest 3 sessions lasted up to 5 hours).

The sessions took place in 2 Senior's Clubs from Bucharest and at our (ANA's) premises - VR training and testing being performed under the direct supervision of our research team, which always included at least one MD, at some sessions 2 MD's (beside the researchers handling the technological aspects and the supportive actions towards the end-users during testings).

| No. | Date | Location | No of PEU's | Duration (hours) |
|-----|--------------|------------------|--|------------------|
| 1 | 02-Aug-2019 | ANA Premises | 3 PEU's (1st session) | 3 |
| 2 | 08-Aug-2019 | Senior's Club S1 | 5 PEU's (1st session) | 4 |
| 3 | 13-Aug-2019 | Senior's Club S1 | 6 PEU's (3 for 1st session, 3 for 2nd) | 4 |
| 4 | 22-Aug-2019 | Senior's Club S1 | 9 PEU's (4 for 1st session, 3 for 2nd, 2 for 3rd) | 4 |
| 5 | 29-Aug-2019 | Senior's Club S1 | 9 PEU's (3 for 1st session, 3 for 2nd, 2 for 3rd, 1 for final evaluation)* | 4-5 |
| 6 | 05-Sept-2019 | Senior's Club S1 | 5 PEU's (4 for 1st session, 1 for 3rd) | 3 |
| 7 | 06-Sept-2019 | ANA Premises | 6 PEU's (3 for 1st session, 3 for 2nd) | 3 |
| 8 | 09-Sept-2019 | Senior's Club S6 | 5 PEU's (1st session) | 4 |

| | | | | |
|----|--------------|------------------|--|-----|
| 9 | 12-Sept-2019 | Senior's Club S1 | 12 PEU's (3 for 1st session, 5 for 2nd, 3 for 3rd, 1 for final evaluation) | 5 |
| 10 | 16-Sept-2019 | Senior's Club S6 | 5 PEU's (2nd session) | 2 |
| 11 | 19-Sept-2019 | Senior's Club S1 | 14 PEU's (1 for 1st session, 3 for 2nd, 5 for 3rd, 5 for final evaluation) | 5 |
| 12 | 20-Sept-2019 | ANA Premises | 7 PEU's (2 for 2nd session, 5 for 3rd) | 4 |
| 13 | 23-Sept-2019 | Senior's Club S6 | 5 PEU's (3rd session & final evaluation) | 2,5 |
| 14 | 27-Sept-2019 | Senior's Club S1 | 6 PEU's (3 for 2nd session, 3 for 3rd session & final evaluation) | 4 |
| 15 | 03-Oct-2019 | Senior's Club S1 | 4 PEU's (1 for 2nd session, 2 for 3rd session & final evaluation and 1 drop-out) | 2 |
| 16 | 04-Oct-2019 | ANA Premises | 1 PEU (3rd session & final evaluation) | 1 |

CAT

In Denmark we organised 26 days for testing with room for either 2 or 4 users per. day. An hour was allocated for each session, but most session took 40-50 minutes including completion of interviews and questionnaires. This allowed for the team to schedule specific time slots for session 1,2 and 3 for each user.

The Final Trial testing ran from the 7th of august to the 20th of September and included a total of 22 users. All tests were done at Vikærgården in Aarhus, which both have short term rooms in which elderly users are offered different rehabilitation opportunities during their stay, as well as rehabilitation opportunities for people living at home. The users were recruited by one of Vikærgårdens occupational therapists.

Each session was supervised by one observer from the project team who oversaw observations, interview with user and therapist and questionnaire. The observer was also able to assist with any minor technical difficulties that the therapist might experience.

| No. | Date | Location | No of PEU's | Duration (hours) |
|-----|-------------|-------------|--|------------------|
| 1 | 07-Aug-2019 | Vikærgården | 2 PEU's (4 for 1 st session, 2 cancelled) | 4 |
| 2 | 09-Aug-2019 | Vikærgården | 2 PEU's (2 for 1 st session, 2 cancelled) | 4 |
| 3 | 12-Aug-2019 | Vikærgården | 1 PEU (1 for 2 nd session, 1 cancelled) | 2 |
| 4 | 13-Aug-2019 | Vikærgården | 2 PEUs (2 for 2 nd session) | 2 |
| 5 | 14-Aug-2019 | Vikærgården | 3 PEU's (1 for 1 st session, 1 for 2 nd session, 1 for 3 rd & Final, 1 cancelled) | 4 |
| 6 | 16-Aug-2019 | Vikærgården | 2 PEU's (2 for 3 rd & Final session, 2 cancelled) | 4 |
| 7 | 19-Aug-2019 | Vikærgården | 2 PEU's (1 for 1 st session, 1 for 2 nd) | 2 |
| 8 | 20-Aug-2019 | Vikærgården | 2 PEU's (2 for 1 st session) | 2 |

| | | | | |
|----|--------------|-------------|--|---|
| 9 | 21-Aug-2019 | Vikærgården | 4 PEU's (1 for 1 st session, 2 for 2 nd , 1 for 3 rd & Final) | 4 |
| 10 | 23-Aug-2019 | Vikærgården | 4 PEU's (1 for 2 nd session, 2 for 3 rd & Final) | 4 |
| 11 | 26-Aug-2019 | Vikærgården | 2 PEU's (1 for 1 st session, 1 for 2 nd) | 2 |
| 12 | 27-Aug-2019 | Vikærgården | 1 PEU's (1 for 1 st session, 1 cancelled) | 2 |
| 13 | 28-Aug-2019 | Vikærgården | 2 PEU's (1 for 2 nd session, 1 for 3 rd session & Final, 2 cancelled) | 4 |
| 14 | 30-Aug-2019 | Vikærgården | 4 PEU's (3 for 1 st session, 1 for 3 rd & Final) | 4 |
| 15 | 02-Sept-2019 | Vikærgården | 2 PEU's (2 for 2 nd session) | 2 |
| 16 | 03-Sept-2019 | Vikærgården | 1 PEU (1 for 1 st session, 1 cancelled) | 2 |

| | | | | |
|----|--------------|-------------|--|---|
| 17 | 04-Sept-2019 | Vikærgården | 3 PEU's (1 for 2 ^a session, 2 for 3 ^a & Final, 1 cancelled) | 4 |
| 18 | 06-Sept-2019 | Vikærgården | 4 PEU's (2 for 1 ^a , 1 for 2 ^a , 1 for 3 ^a & Final) | 4 |
| 19 | 09-Sept-2019 | Vikærgården | 2 PEU's (1 for 2 ^a session, 1 for 3 ^a session & Final session) | 2 |
| 20 | 10-Sept-2019 | Vikærgården | 2 PEU's (2 for 1 ^a session) | 2 |
| 21 | 11-Sept-2019 | Vikærgården | 4 PEU's (2 for 1 ^a session, 2 for 3 ^a & Final) | 4 |

| | | | | |
|----|--------------|-------------|---|---|
| 22 | 13-Sept-2019 | Vikærgården | 4 PEU's (2 for 1 ^a session, 1 for 2 ^a session 1 for 3 ^a & Final) | 4 |
| 23 | 16-Sept-2019 | Vikærgården | 1 PEU (1 for 2 ^a session, 1 cancelled) | 2 |
| 24 | 17-Sept-2019 | Vikærgården | 1 PEU (1 for 3 ^a & Final session, 1 cancelled) | 2 |
| 25 | 18-Sept-2019 | Vikærgården | 1 PEU (1 for 2 ^a session, 1 cancelled) | 2 |
| 26 | 20-Sept-2019 | Vikærgården | 2 PEU's (2 for 3 ^a & Final session) | 4 |

3. Tests

In this analysis several tests have been used: EQ-5D-5L, PTQ-ANA, GDS, Socio-demographic test, MoCA and SUS. Now, they are explained and some templates are attached in order to achieve clarity.

3.1 EQ-5D-5L

This test consists in five questions about user's mobility, self-care, usual activity, pain or discomfort, anxiety or depression and one more question which consist in the percentage of health the user think he has (it is defined as subjective-health; S-H). The first four questions have to be answered with the following scale:

| | |
|---|------------------------------|
| 0 | no problems/pain/anxious |
| 1 | slight problems/pain/anxious |

| | |
|---|--|
| 2 | moderate problems/pain/anxious |
| 3 | severe problems/pain/anxious |
| 4 | unable to do the activity/ extreme pain/ extremely anxious |

Table 1 - EQ-5D-5L values

The way possible answers are written means that a higher score imply having a worse health. Then, it can be computed 'how much health' users have (it is defined as parametric health). Then, the mean value between parametric-health and subjective-health is what it is consider the health of the user.

Moreover, correlation between the 'quantity' of health and how much score they got in MoCA test can be studied.

3.2. PTQ – ANA

This test consists in questions about the game with given possible answers. To compute them, values from one to five from the first answer in the left to the last one in the right part are given. This showed the global score in every single item taking the mean value from all users in each group. This test was answered two times: one after the first trial and the other one after the last trial. As this was done, differences between first impressions and final ones can be studied. (GSD was carried out in Romania but not in Denmark, so then this measure is only available for that group)

1 Graphics

Brightness of the scene:

too dark dark just right bright too

bright 3D effect:

disturbing boring don't know ok

very cool Models (house, kitchen, bank):

ugly boring ok nice beautiful

Lighting:

unrealistic slightly wrong ok beautiful

realistic Game graphics overall opinion:

ugly not so nice ok nice very appealing

2 Sound Volume

Balance between sound effects (eff.) and music (m.):



- eff. far too loud eff. too loud well balanced m. too loud m.far too loud
Sound effects:
 silly boring ok nice very nice

3 Input Steering:

- too easy easy just right hard too hard
Game targets understandable:
 not at all no partially mostly no problems
Game speed:
 too slow slow just right fast too fast
Frying the egg:
 too easy easy just right hard too hard
Introducing the forms in the boxes
 too easy easy just right hard too hard
Taking the money in the bank:
 too easy easy just right hard too hard
Grabbing objects with HTC:
 too easy easy just right hard too hard
What is the best device?
 Oculus HTC Augmented Reality
What is the best game?
 Forms Kitchen Bank

How satisfied are you with the game experience:

- **Forms:** Very dissatisfied Dissatisfied Satisfied Very satisfied
- **Bank:** Very dissatisfied Dissatisfied Satisfied Very satisfied
- **Kitchen- Vive HTC:** Very dissatisfied Dissatisfied Satisfied Very satisfied
- **Kitchen- Oculus Go:** Very dissatisfied Dissatisfied Satisfied Very satisfied

Very dissatisfied- 1 point

Dissatisfied- 2 points

Satisfied – 3 points

Very satisfied- 4 points

3.3. GDS

Geriatric Depression Scale (GDS) is made up of the following fifteen questions. The user scores one point for each bolded answer. If he/she gets more than five it suggests depression.

1. Are you basically satisfied with your life? yes **no**
2. Have you dropped many of your activities and interests? **yes** no
3. Do you feel that your life is empty? **yes** no
4. Do you often get bored? **yes** no
5. Are you in good spirits most of the time? **yes** **no**
6. Are you afraid that something bad is going to happen to you? **yes** no
7. Do you feel happy most of the time? **yes** **no**
8. Do you often feel helpless? **yes** no
9. Do you prefer to stay at home, rather than going out and doing things? **yes**
no
10. Do you feel that you have more problems with memory than most? **yes** no
11. Do you think it is wonderful to be alive now? **yes** **no**
12. Do you feel worthless the way you are now? **yes** no
13. Do you feel full of energy? **yes** **no**
14. Do you feel that your situation is hopeless? **yes** no
15. Do you think that most people are better off than you are? **yes** no

The possible correlation between depression and (EQ-5L-5L) health users have can also be studied (GSD was carried out in Romania but not in Denmark, so then this measure is only available for that group).

3.4. Socio-demographic

1. Questionnaire with socio-demographic aspects

1. Name:

2. Age:

3. Gender: Female Male

4. Educational level – please select only the highest level achieved

- High-school (1)
- Professional school (2)
- Superior studies (university) (3)
- Post-university studies (4) ● Other (5) – please specify:

5. Living status – choose only one answer

- Alone (1)
- With spouse only (2)
- With spouse and other family members (3)
- With other members of my family (4)
- In a retirement home (5)
- Other (6) – please specify:

In the following questionnaire, we will ask you about your **interaction** with **new technology**. New technology is defined as new technical devices i.e smartphone, Smart TV, computer, mobile phone applications, laptop, tablet, VR system/games

| Please indicate the degree to which you agree/disagree with the following statements. | Totally disagree (1) | Disagree (2) | Agree (3) | Totally agree (4) |
|---|----------------------|--------------|-----------|-------------------|
| | | | | |

| | | | | |
|---|--|--|--|--|
| 01 I like testing the functions of new technologies. | | | | |
| 02 When I have a new technical system in front of me, I try it out intensively. | | | | |
| 03 I enjoy spending time becoming acquainted with a new technology. | | | | |
| 04 I think that new technologies could be useful for my everyday life | | | | |

Table 2 - Socio-demographic questions

3. General Questions on technology usage

- How often do you use the following services/devices/applications?

| | Never (1) | Rarely (2) | Sometimes (3) | Usually (4) | Always (5) |
|-------------------------------------|--------------|---------------|------------------|----------------|---------------|
| Internet | | | | | |
| Desktop personal computer | | | | | |
| Laptop | | | | | |
| Conventional phone - no Smart phone | | | | | |

| | | | | | |
|---|--|--|--|--|--|
| Smart Phone | | | | | |
| Traditional TV | | | | | |
| Smart-TV | | | | | |
| Tablet | | | | | |
| Email | | | | | |
| Social networks, e.g. Facebook, Twitter | | | | | |
| Mobile phone applications | | | | | |

Table 3 - Technology usage questions

This test helps to know the **ratio** between **men and women**, the **mean educational level** and **living status** and **general interaction with technologies**.

In these two tables the mean interaction with technologies and their usage; moreover, their possible correlation is shown.

Furthermore, as these tests were answered by Danish and Romanian users, it is possible to study the relationship between them and if there is any significant statistical difference in there.

In order to do this, **Mann-Whitney U test** is been used because knowing what distribution is under data is not possible. So with this test it is possible to know if the two groups come from two different populations or if they do not and come from the same population. There are two parameters: number of elements of the first sample (n) and number of elements of the second sample (m). Our statistic is

$$U = \min(U_1, U_2)$$

$$U_1 = n \cdot m + \frac{n(n+1)}{2} + R_1$$

$$U_2 = n \cdot m + \frac{m(m+1)}{2} + R_2$$

where R_1 and R_2 are the sum of the positions that are assigned to the ordered values (ordered from the lowest to the highest).

3.5. MoCA

MoCA test is a brief screening tool for mild cognitive impairment. This tool focuses in the following skills: visuospatial/ executive (scored from 0 to 5), naming (from 0 to 3), attention (which is divided into three parts scored from 0 to 2, 1 and 3, respectively), language (which is also divided but into two parts scored from 0 to 2 and 1, each one), abstraction (from 0 to 2), delayed recall (from 0 to 5) and orientation (from 0 to 6). Maximum score is 30 and if the result is 26 or over it is considered as normal. One extra point has to be added if the user which is tested has studied less than twelve years (and if his score is less than 30).

On one hand, it can be studied if there is any correlation between EQ-5L-5D and MoCA in each group. On the other, it can be studied the possible correlation between Interaction with new technologies and MoCA too.

Again, using the U test, the relationship between Danish group and Romanian group can be measured and if there is any significant statistical difference in there.

3.6. SUS

This is the System Usability Scale. It is a tool which measures, as its name implies, the usability of the games in this case. Users have to answer from strongly disagree (1) to strongly agree (5) to the following ten items:

1. I think that I would like to use this system frequently.
2. I found the system unnecessarily complex.
3. I thought the system was easy to use.
4. I think that I would need the support of a technical person to be able to use this system.
5. I found the various functions in this system were well integrated.
6. I thought there was too much inconsistency in this system.

7. I would imagine that most people would learn to use this system very quickly.
8. I found the system very cumbersome to use.
9. I felt very confident using the system.
10. I needed to learn a lot of things before I could get going with this system.

These ten items can be divided into two groups: **positive orientated (PO)** items and **negative orientated** items (**NO**). PO is formed by those items which accomplish that if you give a high score to them it is good for the game. On the other hand, giving high score to an item from NO is negative for the game. In this case, PO items are 1, 3, 5, 7 and 9 and NO are the rest (blue-coloured in the table).

Later, relations between item in each group (PO or NO), after the first trial and after the last trial, are studied. In order to get this, a **Wilcoxon test** is used. This test consist in study if two paired samples are independent from the variable which is studied. In this case, this variable is the fact of getting used to the game. Then, there are two sets of data: the one of scores after first trial and the one of scores after last trial, where each value of the first set has a corresponding one in the second set. With all this pairs, taking the one of the first set and subtracting the one on the second set, it results a difference. After this, ordered absolute values of these differences gives a concrete position to each original difference (the one whose absolute value is associated with that position). Finally the **statistic** is the **minimum of two values: the sum of the positions associated to positive differences and the one associated to negative differences**.

4. KPIs

KPIs mark the objectives and accomplishments of the project. They are a series of quantitative indicators whose achievement means success in the testing phase. The following table shows these KPIs:

| Key Performance Indicator | Achieved/not |
|--|--------------|
| Achieving 40 testers | Yes |
| General satisfaction level (as measured by SUS): | Yes |
| Balanced gender distribution in testers | Yes |

| | |
|---|-----|
| Creation of 3 usable and entertaining games for virtual reality with positive feedback in the tests | Yes |
| Completion of the test phase with all the tests passed | Yes |

5. Analysis

5.1. Denmark

In Denmark twenty-two people played the games. Tests which were used were Socio-demographic (answered by fourteen people), EQ-5L-5D (answered by twelve people), MoCA (answered by 19 people) and SUS (answered by 20 people)

5.1.1 Socio-demographic test

| Women | Men | Total |
|-------|-----|-------|
| 11 | 8 | 19 |

Table 4 - Gender distribution

| | U5 | U7 | U8 | U9 | U11 | U12 | U13 | U14 | U15 | U17 | U18 | U20 | U21 | U22 |
|-------------------|----|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Educational level | 3 | 3 | 5 | 0 | 4 | 0 | 2 | 0 | 2 | 5 | 2 | 3 | 5 | 3 |
| Living status | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 4 | 1 |

Table 5 - Socio-demographic data

| | |
|-------------------|---------------|
| Educational level | Living status |
|-------------------|---------------|

| | | |
|------------|------|------|
| Mean value | 2,64 | 1,64 |
| SD | 1,78 | 0,92 |
| Main value | 3 | 1 |

Table 6 - Socio-demographic data

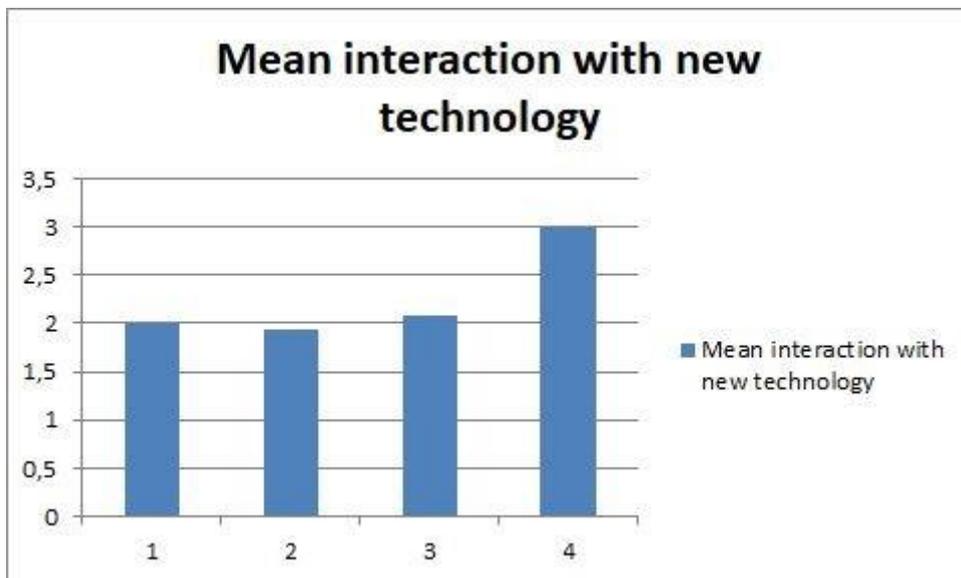


Table 7 - Mean interaction with new technology

Here 1, 2, 3 and 4 are 'I like testing the functions of new technologies.', 'When I have a new technical system in front of me, I try it out intensively.', 'I enjoy spending time becoming acquainted with a new technology.', 'I think that new technologies could be useful for my everyday life.'

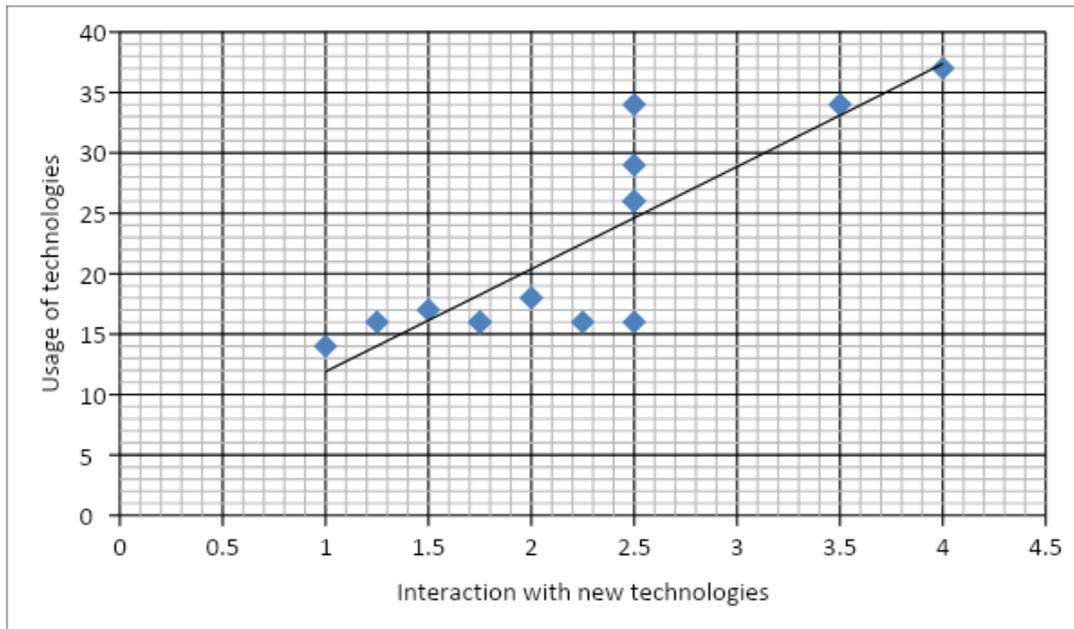


Table 8 - Interaction with new technologies

Only 19 people answered about their gender: 8 were men and 11 were women; this means **57.895%** were **women**. Then, only 14 people answered to educational level and living status question with the following result.

In Denmark, they added the item 'Primary School' (0). As it is seen values go from 0 to 5. The mean education level (2.64 points) is near to superior studies but it cannot be concluded this because standard deviation (SD) is 1.78 points and this means (and it can be proved looking at the data) it moves from 'high-school' to 'other'. This means that it is a multimodal distribution and **there is more than one main educational level**. User number 8, 17 and 21 answered 'tailor (4 years education)', 'similar to nowadays 7th grade but in the old school system in Denmark' and 'have worked on a farm/housework', respectively.

In the part concerning living status, values go from 'living alone' (1) to 'with others members of my family' (4). It is observed that mean level (1.64) is near to the main value (2) and it represent quite good the situation. So then, **the most typical living status is living alone**.

And **for the common use of devices, apps, etc.**, values go from 14 to 37 and it is obtained a mean value of **22.5 points** over 55 points they can get in total.

It is very interesting to notice that there is a **slight-medium correlation between their interaction with new technologies** (the interaction with new technologies

value for a user is defined as the mean of his answers to that question) **and their usage**, as it can be seen in the chart.

5.1.2. EQ-5L-5D

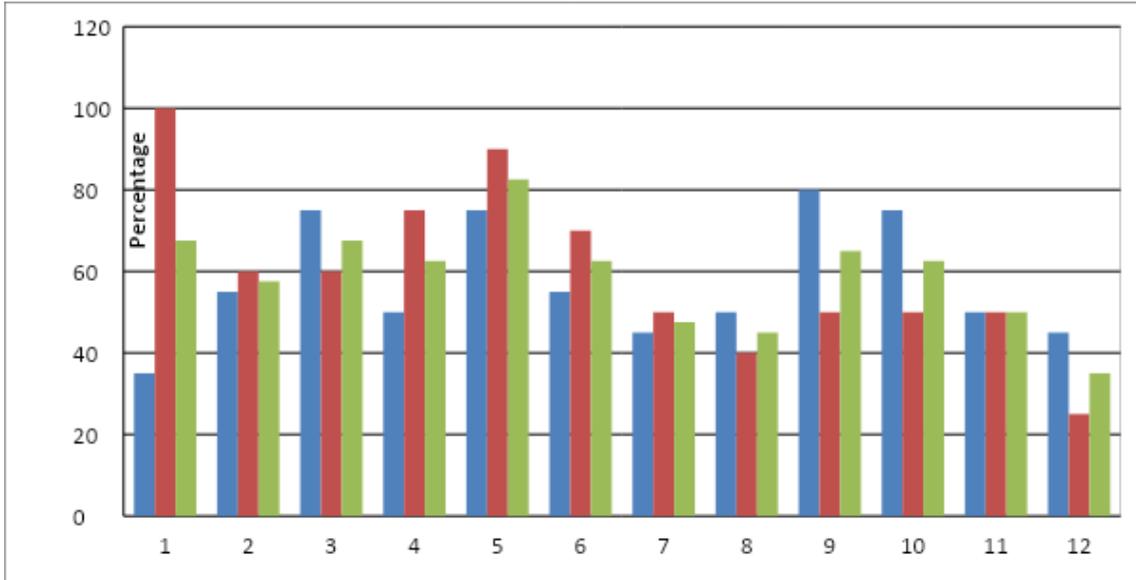


Table 9 - EQ-5L-5D results

This test shows in Denmark a **mean health of 58,75**.

The correlation between EQ-5L-5D and MoCA on one hand and Interaction with new technologies on the other can be computed. The R^2 value is 0,1459 and 0,1193 respectively, so **there is no significant correlation between EQ-5L-5D and MoCA, and between EQ-5L-5D and Interaction with new technologies.**

5.1.3. MoCA

| | | | | | | | | | | | | | | | | | | |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| U | U | U | U | U | U | U | U | U | U1 | U2 | U2 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | 1 | 4 | 5 | 6 | 7 | 8 | 9 | 1 | 2 |
| 23 | 25 | 23 | 24 | 25 | 16 | 28 | 15 | 15 | 25 | 21 | 23 | 17 | 23 | 13 | 18 | 23 | 15 | 22 |

Table 10 - MoCA results in Danish group

Values go from 13 to 28. It is remarkable that **twelve of them** (they are nineteen) **did not study more than twelve years** (as it is shown in the data). Moreover, as it can be seen, **all of them** (except U7) **are less than 26 points**: eleven are between 21 and 26, six are between 14 and 21 and only U17 is

less than 14. Mean value is 20,73 and SD is 4,39, so **they principally are between 16 and 25.**

Just like in the previous case it can be considered the possible correlation between

MoCAis already results done). and In **interaction** this case **R with₂ = 0,37907** new

technologies which is **not** (the sufficient pair MoCA to claimand EQ-5L-5D that any

correlation exists.

5.1.4. SUS

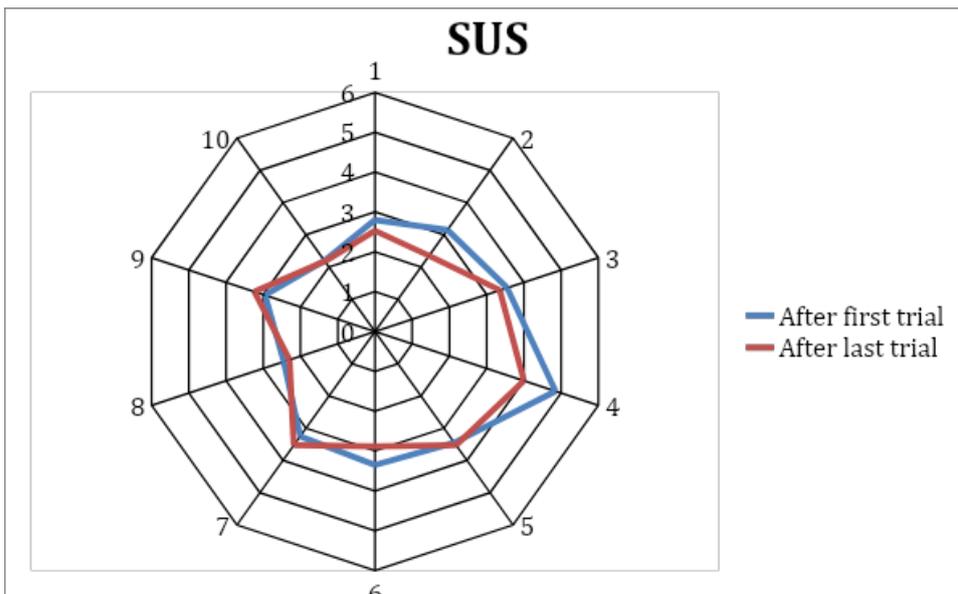


Table 11 - SUS results

| | First trial | Last trial |
|---|-------------|------------|
| 1 | 2,8 | 2,52 |
| 2 | 3,15 | 2,35 |
| 3 | 3,55 | 3,35 |

| | | |
|----|------|------|
| 4 | 4,85 | 4 |
| 5 | 3,45 | 3,52 |
| 6 | 3,35 | 2,88 |
| 7 | 3,25 | 3,52 |
| 8 | 2,45 | 2,29 |
| 9 | 2,95 | 3,23 |
| 10 | 2,2 | 2,17 |

Table 12 - Mean scores for each item in SUS tests after first and last trial

It is clear that **items from NO got lower scores**. Using a Wilcoxon, it is seen that with a significance level $\alpha = 0.1$ **items after first trial and after last trial are statistically different** for items in NO. On the other hand, if a significance level $\alpha = 0.1$ is fixed too, it cannot be asserted that items after first trial and after last trial are statistically different for items in PO.

After this, it can be said that **after getting used with the game it becomes more usable**.

Moreover, almost every item in **PO increased its score**

5.1.5. Kwido

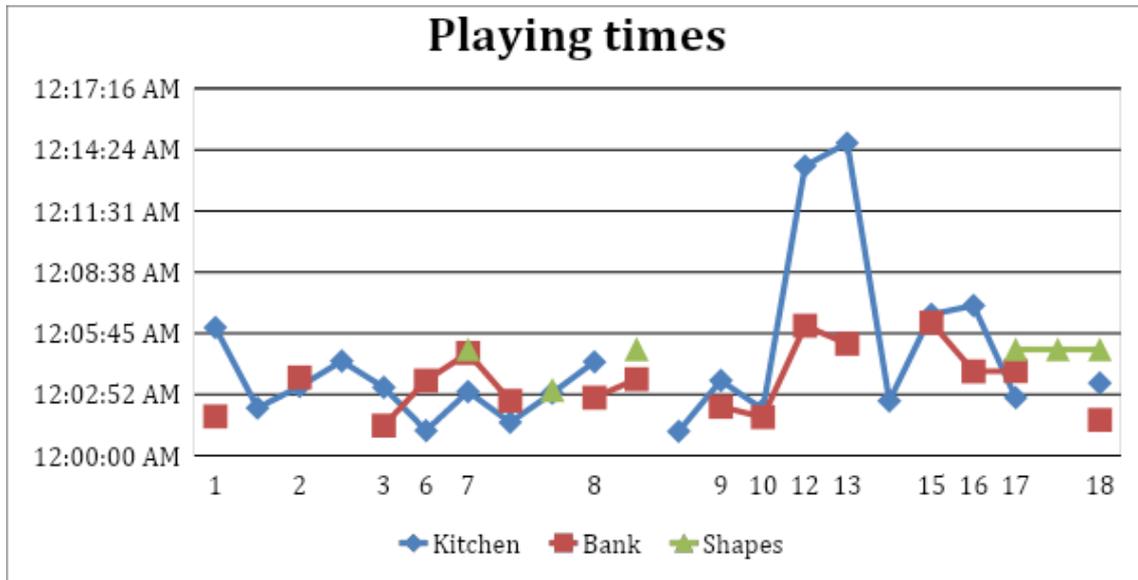


Table 13 - Playing Times

| | Kitchen | Bank | Forms |
|------------|---------|---------|---------|
| Attempts | 21 | 16 | 7 |
| Total time | 1:42:25 | 0:55:38 | 0:33:07 |
| Mean time | 0:04:53 | 0:03:29 | 0:04:44 |

Table 14 - Attempts and timing from Kwido platform

| U1 | U2 | U3 | U6 | U7 | U8 | U9 | U10 | U12 | U13 | U15 | U16 | U17 | U18 |
|-------|----|------|------|----|----|----|------|------|-----|-----|------|-------|------|
| 73,33 | 72 | 72,5 | 80,5 | 76 | 72 | 82 | 77,5 | 80,5 | 71 | 62 | 83,5 | 59,75 | 75,8 |

Table 15 - GCL (General Cognitive Level) from Kwido platform

From Kwido platform it is obtained the graphic which shows how many times users played the games and how much it took them. Furthermore, it is seen that the **most played game was Kitchen.**

5.2. Romania

In Romania thirty-three people played the games. Tests which were used were Socio-demographic), EQ-5L-5D, MoCA, SUS (one for Oculus and other for HTC Vive), PTQ-ANA

5.2.1. Socio-demographic

| Women | Men | Total |
|-------|-----|-------|
| 25 | 8 | 33 |

Table 16 - Gender distribution

| | Education level | Living status |
|------------|-----------------|---------------|
| Mean value | 2,66 | 1,73 |
| SD | 1,16 | 0,67 |
| Main value | 3 | 2 |

Table 17 - Socio demographic data

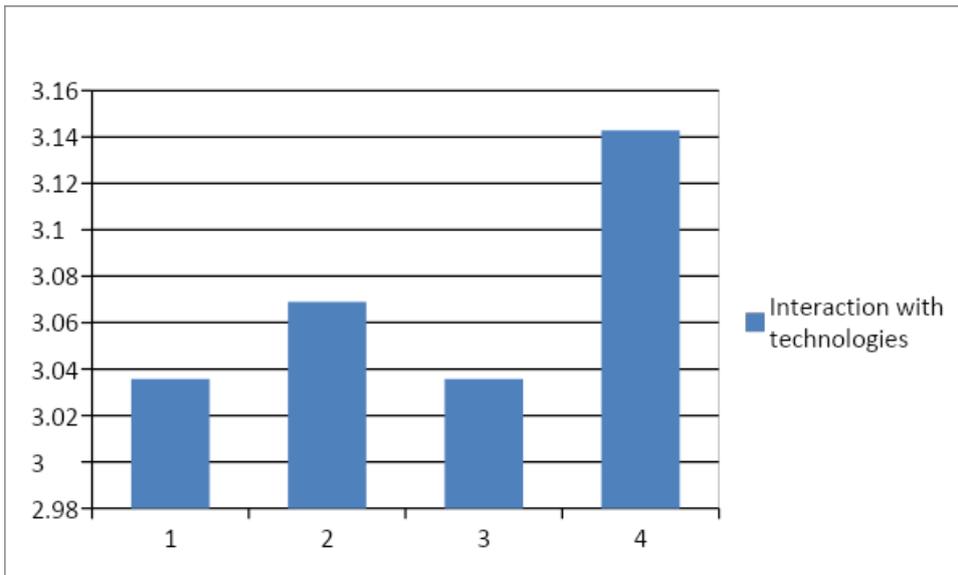


Table 18 - Interaction with technologies

Here 1, 2, 3 and 4 are again 'I like testing the functions of new technologies.', 'When I have a new technical system in front of me, I try it out intensively.', 'I enjoy spending time becoming acquainted with a new technology.', 'I think that new technologies could be useful for my everyday life.'

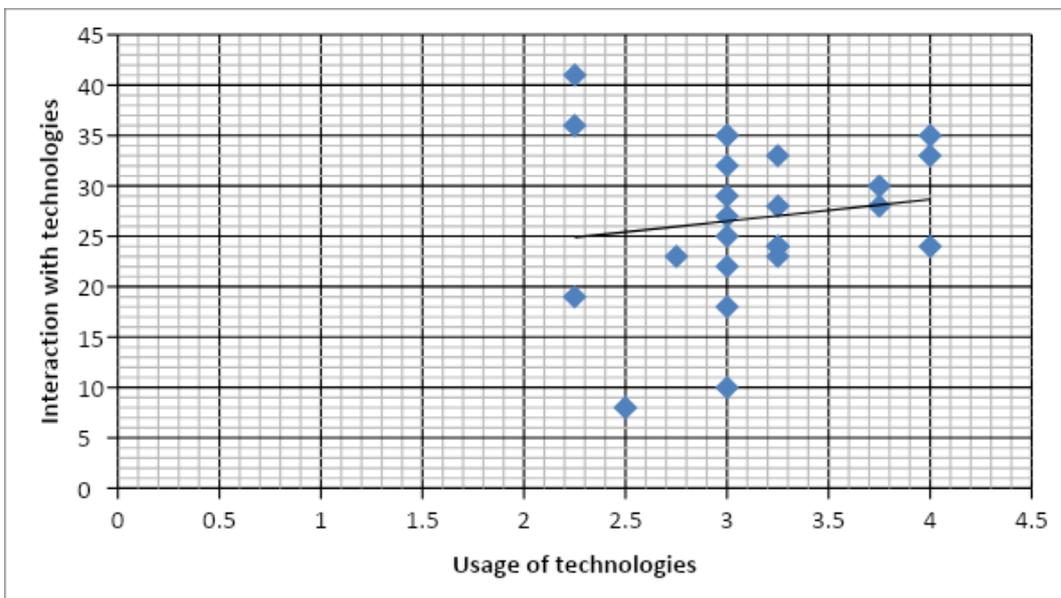


Table 19 - Interaction with technologies / Usage of technologies

25 Of the total were women and 8 were men; this means 75 ,75% were **women** . All of them answered to education level and living status questions with the following result. Educational level values go from 'high-school' (1) to 'other' (5). The mean education level (2,66 points) is near to 'superior studies'

(3), standard deviation is 1,16 points and this mean it can go from 'professional school' studies to 'post university' studies. But in this case, the main value is '**superior studies**' (3) which appears sixteen times, so it can be said that this is the **most common educational level**. Only user number 29 answered 'other' and more precisely '8 years of schooling'.

This time, studying living status, whose values go from (1) to 'spouse and family' (3), it is got a mean level of 1,73, a standard deviation of 0,67 points and a main value which is **living with spouse** (2). It appears sixteen times too, so it can be asserted that this is the **most common living status**.

All mean interaction with new technologies are over 3, so it is a **relatively high interaction with new technologies level**.

The **common usage** of devices, apps, etc., moves from 8 to 41, but 8 only appears one time and the next higher value is 16. It is obtained a mean value of **26 ,06 points over 55 points** they can get in total.

In this case, it cannot be asserted that there is any correlation; even more, they are in fact **almost independent**. ($R^2 = 0,0746$)

5.2.2. EQ-5L-5D

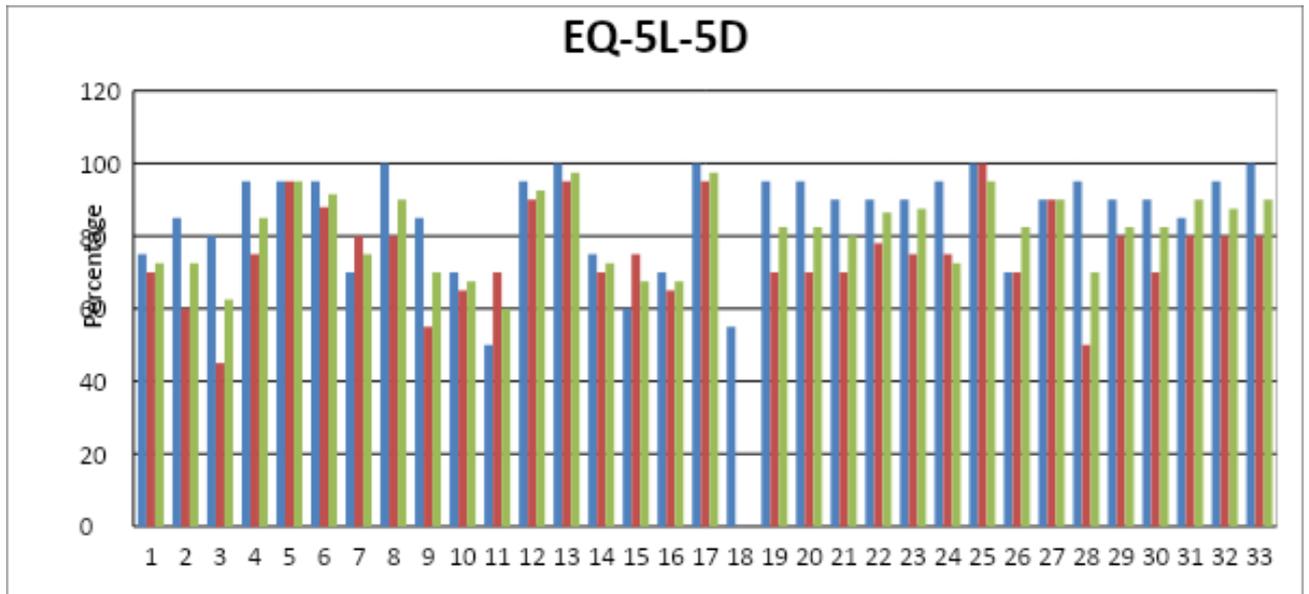


Table 20 - EQ-5L-5D results

This test shows in Romania that health oscillates between 62,5 and 97,5. The **mean health is 80,9**.

As it been said it can computed the correlation between EQ-5L-5D and MoCA on one hand and **Interaction with new technologies on the other**:

EQ-5L-5D and MoCA: $R^2 = 0,0525$.

EQ-5L-5D and Interaction with new technologies on the other: $R^2 = 0,0001339$.

Then it is **far from exist significant correlation**.

5.2.3. MoCA

| | | | | | | | | | | | | | | | |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| U | U | U | U | U | U | U | U | U | U1 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | 1 | 2 | 3 | 4 | 5 | 7 |
| 25 | 27 | 23 | 29 | 27 | 28 | 27 | 26 | 28 | 25 | 25 | 30 | 28 | 26 | 30 | 24 |

| | | | | | | | | | | | | | | | | |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| U1 | U1 | U2 | U3 | U3 | U3 | U3 |
| 8 | 9 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | 1 | 3 | 4 | 5 |
| 26 | 23 | 26 | 23 | 22 | 30 | 26 | 28 | 28 | 25 | 30 | 27 | 27 | 29 | 21 | 24 | 28 |

Table 21 - MoCA results in the Romanian group

Values moves **from 21 to 30**. It is extraordinary that **any of them is under 21**: twenty-two are greater or equal to 26 and eleven are between 21 and 26. Mean value is 26,39 and SD is 2,41, so **they principally are between 24 and 28**.

Just like in the previous case it can be considered the possible **correlation between MoCA results and interaction with new technologies**.

MoCA results and interaction with new technologies: $R^2 = 0,002761$

This is **not** either **sufficient** to claim that any correlation exists.

5.2.4. GSD

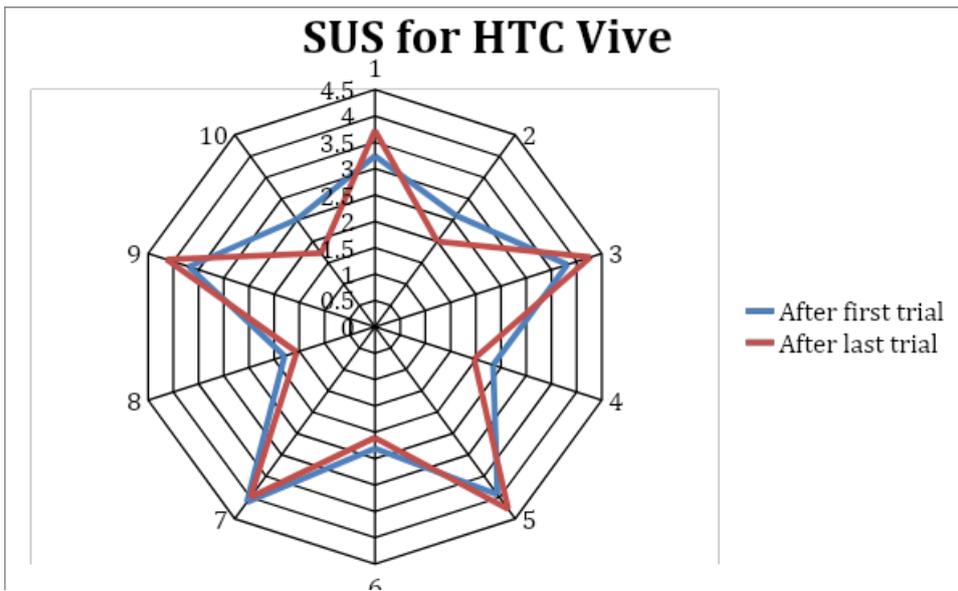
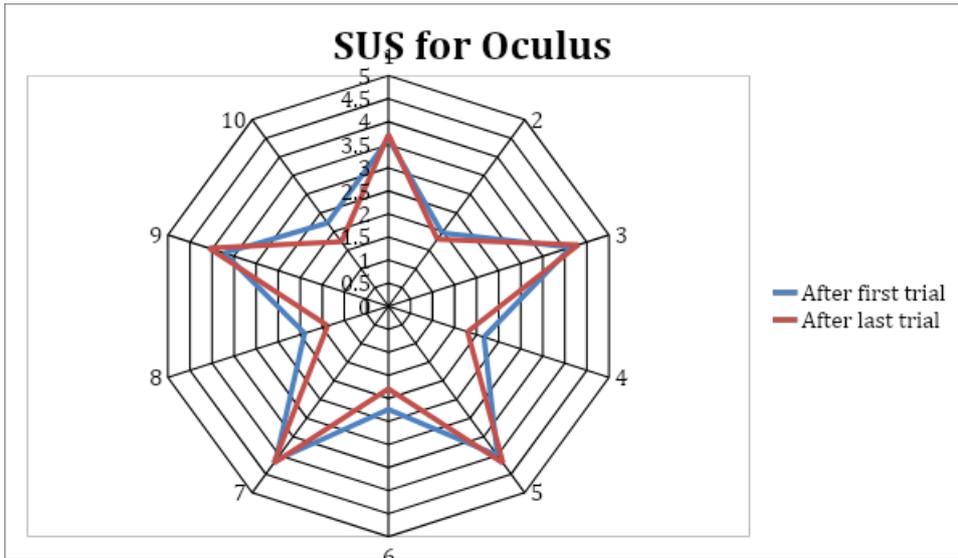
| | | | | | | | | | | | | | | | | | |
|--------|--------|--|--|--------|--------|--------|--------|--------|--------|--------|---------|---------|---------|---------|---------|---------|---------|
| U 1 | U 2 | | | U 3 | U 4 | U 5 | U 6 | U 7 | U 8 | U 9 | U1 0 | U1 1 | U1 2 | U1 3 | U1 4 | U1 5 | U1 7 |
| 5 | 5 | | | 1 | 6 | 0 | 6 | 5 | 2 | 4 | 4 | 1 | 1 | 0 | 4 | 2 | 2 |

| | | | | | | | | | | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| U1 8 | U1 9 | U2 0 | U2 1 | U2 2 | U2 3 | U2 4 | U2 5 | U2 6 | U2 7 | U2 8 | U2 9 | U3 0 | U3 1 | U3 3 | U3 4 | U3 5 |
| 1 | 8 | 1 | 4 | 7 | 6 | 0 | 7 | 0 | 4 | 0 | 9 | 6 | 1 | 1 | 8 | 1 |

Table 22 - GDS results in Romanian group

This table shows that there are **nine people** (27,2727 %) who **could have depression**.

5.2.5. SUS



Tables 22 & 23 - SUS for HTC and Oculus

| | Oculus | | HTC Vive | |
|---|-------------|------------|-------------|------------|
| | First trial | Last trial | First trial | Last trial |
| 1 | 3,63 | 3,72 | 3,24 | 3,72 |
| 2 | 1,96 | 1,79 | 2,607 | 2 |

| | | | | |
|----|------|-------|------|------|
| 3 | 4,13 | 4,31 | 3,81 | 4,2 |
| 4 | 2,16 | 1,79 | 2,34 | 1,96 |
| 5 | 4 | 4,206 | 3,93 | 4,27 |
| 6 | 2,24 | 1,79 | 2,31 | 2,10 |
| 7 | 4,13 | 4,206 | 4,11 | 4 |
| 8 | 1,9 | 1,37 | 1,79 | 1,55 |
| 9 | 3,72 | 4,06 | 3,68 | 4,13 |
| 10 | 2,23 | 1,72 | 2,51 | 1,72 |

Table 24 - Technology usage questions, mean scores for each item in SUS tests for Oculus and HTC Vive after first and last trial

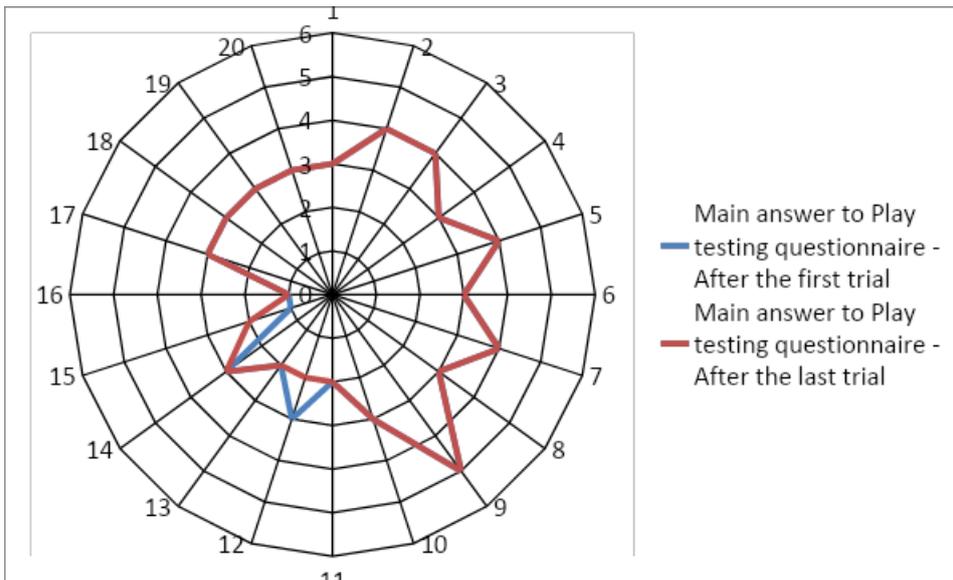
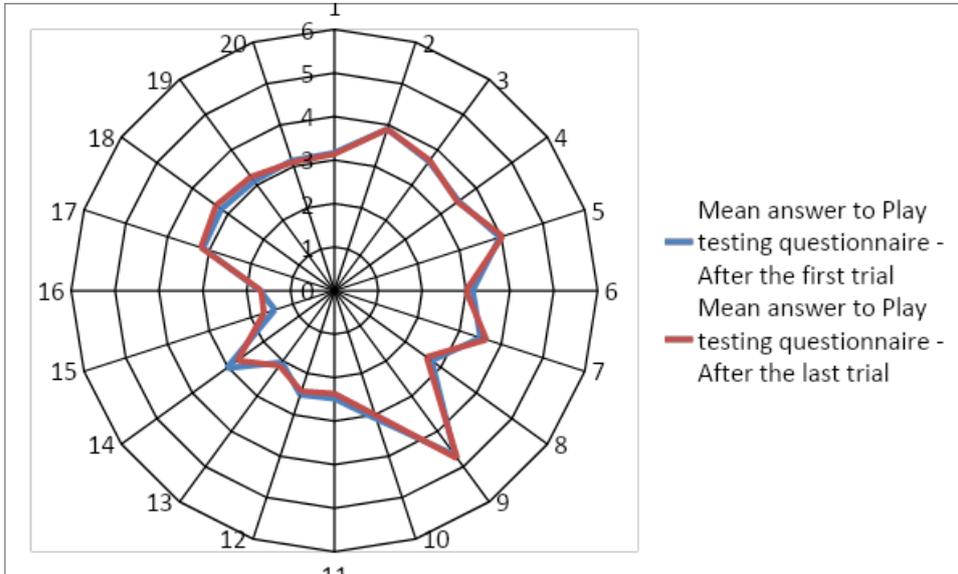
As it is noticed before, the Romanian partner did one SUS test for Oculus and other for HTC Vive. Again, the defined sets PO and NO are considered.

It is relevant to notice that for these users' items in **PO** are **relatively quite good** and also items in **NO** have **relatively low scores**. This can be explained saying that there could be correlation between MoCA test and how much usable they found the games: **the more cognitively capable they are, the easier the games become for them**.

Moreover, it is observed that **scores for NO items decrease** and the ones for **PO scores increase** in general (it is not true only for the seventh item from HTC Vive test).

In SUS for Oculus, using again a Wilcoxon test, it is seen that with a significance level $\alpha = 0.1$ **items after first trial and after last trial are statistically different for items in PO and NO** respectively. On the other hand in SUS for HTC Vive, if a significance level $\alpha = 0.1$ is fixed, it can be asserted that **items after first trial and after last trial are statistically different for items in NO**, but in this case it cannot be asserted that items after first trial and after last trial are statistically different for items in NO.

5.2.6. PTQ-ANA



Tables 25 & 26- PTQ results

| | Item | First trial | Last trial |
|---|------------|-------------|------------|
| 1 | Brightness | just right | just right |
| 2 | 3D effect | ok | ok |
| 3 | Models | nice | nice |

| | | | |
|----|-------------------------------|---------------|---------------|
| 4 | Lighting | ok | ok |
| 5 | Game graphics overall opinion | nice | nice |
| 6 | Sound volume | well balanced | well balanced |
| 7 | Sound effects | nice | nice |
| 8 | Steering | just right | just right |
| 9 | Game targets | no problem | no problem |
| 10 | Game speed | just right | just right |
| 11 | Frying the egg | easy | easy |
| 12 | Introducing forms | just right | easy |
| 13 | Taking the money | easy | easy |
| 14 | Grabbing objects | just right | just right |
| 15 | Best device | Oculus | HTC Vive |
| 16 | Best Game | Forms | Forms |
| 17 | Forms | Pleasant | Pleasant |
| 18 | Bank | Pleasant | Pleasant |
| 19 | Kitchen HTC Vive | Pleasant | Pleasant |
| 20 | Kitchen Oculus | Pleasant | Pleasant |

Table 27 - PTQ - ANA interpreted mean results

| | HTC Vive | | | Oculus |
|------------|----------|---------|---------|---------|
| | Forms | Kitchen | Bank | Kitchen |
| Attempts | 89 | 88 | 86 | 94 |
| Total time | 3:41:39 | 1:15:48 | 1:51:33 | 2:11:46 |
| Mean time | 0:02:29 | 0:00:52 | 0:01:18 | 0:01:24 |

Table 28 - Attempts and timing

The first graphic shows the mean answer for each item after first trial (blue) and after last trial (red). The second one shows the main (most repeated) answer for each item after first trial (blue) and after last trial (red). It is clear that **both** graphics are **almost the same**; but taking the second one into account, it is seen that **users changed their preferences from Oculus to HTC Vive** (we can see it more clearly in the table). The rest is almost the same and it is interpreted in the table.

In general, all **items** are **well scored** and **games** are considered as **easy and pleasant**.

The **most played** game was **Forms**, which is the same that the best game voted in PTQ-ANA.

5.3. Relationship between Denmark and Romania

The possible relationship between both groups can be studied. Attending to the health, the usage of technologies and MoCA results in both groups it is seen that they are quite different. As it is said before, thanks to the Mann-Whitney U-test it can be claimed that, with a significant level $\alpha = 0.01$, both set of data are statistically different. This means that **health, technology usage and MoCA results all in Romania group are greater than in Denmark one**.

6. Conclusions

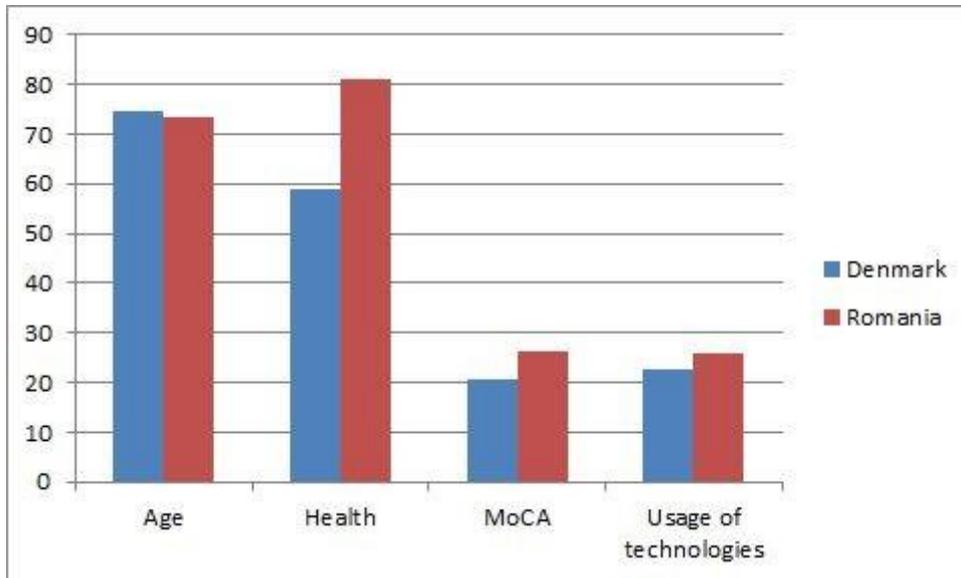
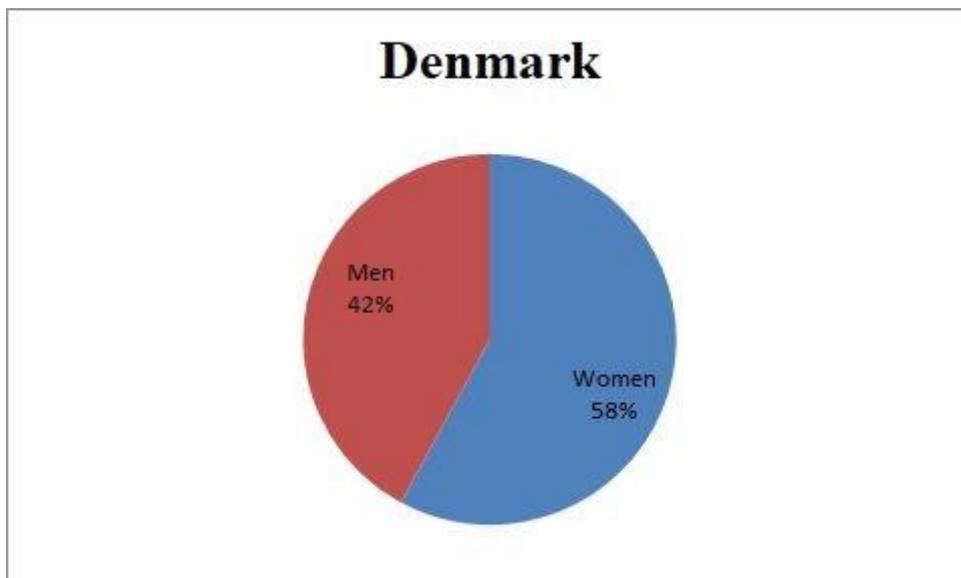
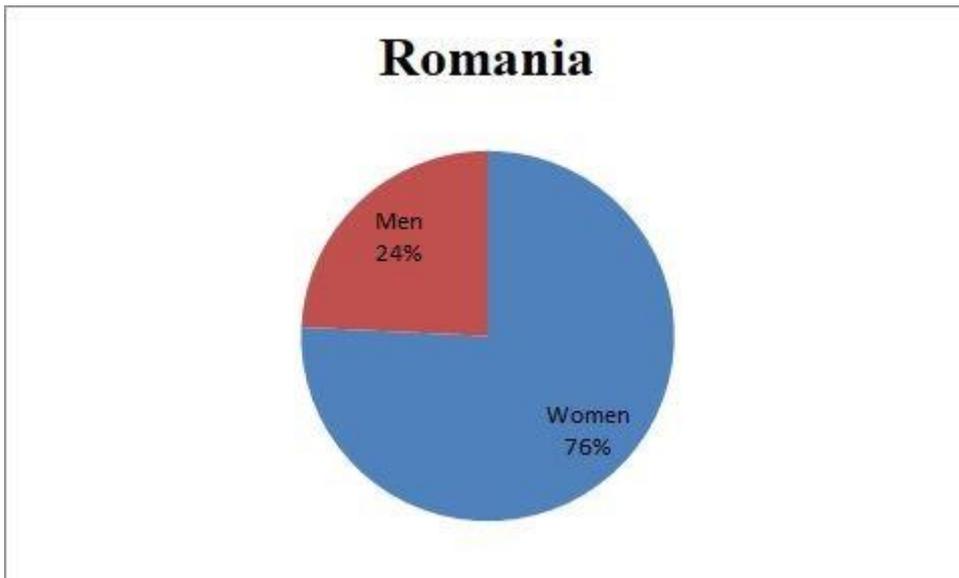


Table 29 - Denmark / Romania comparison





Tables 30 & 31 - Gender distribution in Denmark and Romania

Most important facts are:

Denmark:

- The ratio women/men is **57, 895%**.
- **Four educational** levels appeared the **same number of times**: 'high school', 'professional school', 'superior studies' and 'other'. These others are: 'tailor (4 years education)', 'similar to nowadays 7th grade but in the old school system in Denmark' and 'have worked on a farm/housework'.
- The most common living status is **living alone**.
- They got **22,5/55** points in **usage** of new technologies and it is **slightly-medium correlated** with their **interaction with new technologies**.
- They got **58, 75%** of mean health in **EQ-5L-5D**.
- **MoCA** test situated them **between 16 and 25**. - The most played game was **Kitchen**.

Romania:

- The ratio women/men is **75, 75%**.
- The most common educational level is **superior studies**.
- The most common living status is **living with spouse**.
- They got **26,5/55** points in **usage** of new technologies, but it is **not correlated** with their interaction with new technologies.

- They got **80 , 9%** of mean health in **EQ-5L-5D**. - **MoCA** test situated them **between 24 and 28** . - **Nine people** are possible to have **depression**.
- **Games** are considered **easy** and **pleasant**. - The most played game was **Forms**.

Summing up, there are **two very different groups** and that Romanian one had better health condition, so this could make them to consider the games to be easier than in Danish group whom integrant had more issues. Those issues made them need more assistance and then they could consider the games to be more difficult or just less usable.

Although the data related to the cognitive level does not show a great improvement, and maybe we lack more sessions, a control group, etc., the obtained results also indicate that the cognitive functions were maintained or even slightly improved during the project.

Results from qualitative analysis of the data:

Generally, equipment is not a problem for users but some of them had glasses and they were not able to use them, so they did not see as well as it was supposed to be.

There were also users who had to use a wheelchair and this made harder playing to Shapes game to them. That's why a wheelchair mode was created. Moreover, they have to take care of the wire of the equipment.

Some of them complained about the weight of HTC Vive headset.

In Kitchen, many users said some problems. First of all, the pan tends to fly around and it is hard to grab it. The second thing is that they can not turn it on with the left hand, and this is a problem for people who have an issue in their right arm. One more issue is that, when they fried eggs, many times eggs put one on top of each other and this is not realistic. The size of the written text supposed a problem too because they weren't able to see it. Moreover, both in Denmark and Romania complained about the language, because several things are only in English and in Denmark, there were translated things but there were some mistakes.



In Bank, some of them got angry because the ATM's keyboard was too high for them and also the money disappears very quickly so they were not able to catch it. Anyway, a control for adjusting height was included.

In Forms, sometimes the shapes flew away from the user and they were hard to grab too.

In general, users and therapists said that games were too easy and they wanted the games to let them increase the difficulty.

Almost every user did not feel any dizziness neither during the games neither after them.