D3.3. 2nd Data analysis

Video gamEs foR Skills trAining (VERSA)

EU Horizon 2020 SWAFS project (topic 8)
Grant agreement No. 101006420

Document creator team	GECON.es Foundation	**Work Package**	3
Participating partners	All	**Delivery date (according to calendar)**	31 January 2023

This project has received funding from the European Union's Horizon 2020 Science with and for Society Call (Swafs-2020 Topic 8) under grant agreement No. 101006420.

Introduction

As shown in the previous deliverables, the main objective of the VERSA project is the stimulation and training of various soft skills linked to entrepreneurship and open science in doctoral students from universities in the European AURORA network (URV, UIBK, VU). To do this, as we have already demonstrated in the previous training modules, we use commercial video games for periods of 2-3 months of play, accompanied with a pre-post test evaluation procedure through the use of standardized tests, previously validated by the scientific community.

As mentioned in the D3.2. 1st Data analysis, the measuring of the soft skills individually before and after each module and the variation of the students number remain the same.

In this way, each VERSA module offers a varied type of data that need to be analyzed with different statistical tests to contrast said progress and interpret the results with the least amount of bias possible. Prior to that point, the type of data and variables in the current analyzed modules are presented.

Data typology

Given the application of different measurement tools in the project, different types of data arise.

On the one hand, the data is generated through the application of standardized tests, with the aim of quantifying the levels of soft skills both before and after the intervention with the video games as training tools. Below are the different standardized tests applied in the last 3 modules of VERSA.

- **Module 6. Time Management**

To measure Time Management we applied the Time Management Questionnaire (Britton and Tesser, 1991). The time management questionnaire included 35 items, each answered on a 5-point scale consisting of the responses always, frequently, sometimes, infrequently, and never. In scoring, 5 points were assigned to the response at the end of the scale that we defined a priori as the "good" practice and 1 point was assigned to the response at the other end of the scale, with intermediate values given for the other responses. Higher values on the scale correspond to better time management practices.

- **Module 7. Judgment and Decision Making**

In the seventh module we applied the Life Skills Development Scale (Darden et al., 1996), as we did in the fourth module (complex problem solving). With 15 Likert-type 4 questions, the test has been validated as a subscale for measuring judgment and decision making (since it is part of a test with more than 60 questions), comparing the results with other assessment tools (Heppner, 1988). There were significant correlations with instruments purported to not

relate to problem solving/decision making skills (e.g., Miller Social Intimacy Scale, The Ego Identity Scale, and The Physical Self-Efficacy Scale). This suggests significant overlap between the constructs.

- **Module 8. Goal Setting**

In the final module of the VERSA project, we applied the Goal Setting Questionnaire (Gaumer Erickson et al., 2017) in order to measure the goal setting soft skill. This test presents 19 items on a 5 point Liker scale, that ranges from 1 (Not very like me) to 5 (Very like me). In scoring, assigning 5 points to Very like me answers and 1 to Not very like me, higher values on the scale correspond to better goal setting skills.

On the other hand, the data is generated through the telemetry of the video game, thanks to the use of the different video games and the softskills.games platform, with an algorithm, based on a theoretical and hypothetical model, capable of transforming the performance of players to levels of soft skills. Given the current structure of the platform, this data is represented by thresholds or levels, as explained in the previous deliverable. This way, the data analysis is limited to the study of the first two thresholds. So here we would be talking about a qualitative ordinal variable, which shows whether the user has exceeded the threshold (1) or not (0), for each of the thresholds (level 1 and 2).

In a complementary way, sociodemographic data are also added with the aim of expanding the hypotheses with the aim of finding interesting data and results. For this reason, qualitative variables such as gender (male/female) or the area of study/research field of the students (biology, engineering, etc.) are also present.

Objectives

The objectives of the current project are described on the previous deliverable (D3.2. 1st Data analysis), so in order to keep the information here relevant, the objectives section and the next one are summarized. If the bibliography justification of the following hypothesis is a target of interest, please refer to the deliverable D3.2. 1st Data analysis.

Hypothesis 1: There are changes in soft skill due to playing the video game. After the use of the video game, the players will have increased their soft skill level.

Hypothesis 2: Both measurement tools (standardized test and softskills.games platform) are positively correlated. Gecon.es is applying its own soft skills measurement methodology through the use of commercial video games called softskills.games.

Hypothesis 3: There is a significant difference between genders and soft skills improvements, indicating that one specific gender has improved more than the other.

Hypothesis 4: There is a significant difference between genders and soft skills previous score, indicating that one specific gender has a higher soft skill level than the other.

Hypothesis 5: There is a significant difference between study area and soft skills improvement, indicating that students of a specific study field have improved more than others.

Hypothesis 6: There is a significant difference between study field and soft skills previous score, indicating that students of a specific study field have a higher soft skill level than the others.

Hypothesis 7: Gender and field of study are predictors of the soft skills level.

Analysis methodology

As mentioned before in the deliverable D3.2. 1st Data analysis, here the statistical analysis summarized on each hypothesis is exposed, again utilizing the JAMOVI software:

- Hypothesis 1: T-test for dependent measures and the Student's t statistician or Wilcoxon's W if the distribution is not normal.
- Hypothesis 2: Spearman's statistician to discover how these variables correlate.
- Hypothesis 3 and 4: T-test for independent samples and the Student's t statistician if the distribution is normal or Welch's t if the variance homogeneity assumption is not met. If the sample is not normally distributed we used the Mann-Whitney U-test.
- Hypothesis 5 and 6: ANOVA and the Fisher's f statistician if the variances are homogenous or Welch's t if the variance homogeneity assumption is not met. At the end, we used a Post-Hoc Test to see the comparison between each group. If we can assume equal variances we used Tukey test, if they are not equal we used Games-Howell test.
- Hypothesis 7: Regression analysis to see how much of the variation in soft skills is explained by gender and how much by the field of study.

Results

Having seen the different types of data that VERSA generates and how to analyze them to contrast the different hypotheses that arise naturally in an application with an educational objective, the results of the second half of the VERSA project are presented below.

Module 6, 7 and 8 are temporarily embargoed to avoid potential conflicts with future releases.

Summary

As a summary, the results of each of the hypotheses for each of the modules are presented below, showing "Yes" if the hypothesis is accepted or "No" if it is rejected:

	Hypothesis 1	Hypothesis 2	Hypothesis 3	Hypothesis 4	Hypothesis 5	Hypothesis 6	Hypothesis 7
Module 6	Yes	No	Yes (m>f)	No	No	No	No
Module 7	Yes	No	Yes (f>m)	No	No	No	No
Module 8	Yes	No	No	No	No	No	No

Conclusions

According to the data presented we can keep providing evidence on the application of video games as educational tools.

First of all, regarding hypothesis 1, as in the previous deliverable (3.2), all the modules present data that supports the idea that the video games had a positive influence on the soft skills development, at least in a perceptual level, comparing the scores of the corresponding standardized test applied in a pre-post mode. Specifically, regarding each module, we can assume that in the module 6, the use of Minion Masters video game has increased the Time Management soft skill ($t=-3.17$, $p<.001$), in the module 7, the use of Gems of War video game has increased the Judgment and Decision Making soft skill ($t=-5.11$ $p<.001$) and finally in the module 8, the use of Alien Swarm Reactive Drop video game has increased the Goal Setting soft skill ($t=-4.97$, $p<.001$).

All these results act, again, as Key Performance Indicators that reflect, per module, the success of applying video games as educational tools for improving entrepreneurial and open science soft skills as the main VERSA objective. Providing more evidence about the educational potential of video games, a hypothesis investigated by several authors with a large pool of data and evidence behind. Just is the case about Judgment and Decision Making research regarding video games use, showing positively their influence in this specific soft skill development (Ball, 1978; Green et al., 2010; Joeckel et al., 2012; Buelow et al., 2015). This phenomenon also happens regarding Goal Setting and its development through video games (Griffiths, 2002; Nebel et al., 2017), a hypothesis also supported by VERSA data.

Same as before, some unknowns related to the improvement of the soft skills in each of the modules are questioned after the application, together with the presence of other variables that may be affecting said perceptual improvement. As mentioned in the deliverable 3.2, age

may be playing an important role here as well as previous gaming experience or digital skills that allow the players to habituate more quickly to video games.

Regarding hypothesis 2, all the modules show a non significant relationship between the measurements carried out with the standardized tests and the softskills.games platform. In fact, with an afterwards analysis, this makes a lot of sense. We are comparing here two different measurement tools that measure two completely different things. On one hand, the softskills.games platform provided by Gecon.es Foundation is measuring the achievements that players get inside the video game. Those are behavioral indicators. On the other hand, the standardized tests applied are measuring the perception of the soft skills, asking, for example, how good you think you are in a specific soft skill. So even if the correlation coefficient was positive and significant, it would be irrelevant, since both measurement tools are not measuring the same concept (taking into account that one of the alternative objectives was to prove the softskills.games validity as a measurement tool). This is something that will be corrected on the posterior VERSA application or project evolution, changing the perceptual standard tests for behavioral ones, in order to match the resulting data with softskills.games platform data.

In relation to hypothesis 3, on the contrary from the data presented in the deliverable 3.2 about the previous models, model 6 and 7 do present significant differences regarding gender and the perceptual improvement of the associated soft skills. Specifically, the data shows that men seem to perceive better improvement ($t=-3.18$, $p= .002$) in Time Management, and women perceive better improvement in Judgment and Decision Making ($t=-2.32$, $p= .024$). This data is not supported by the bibliography mentioned in the hypothesis justification in the previous deliverable (3.2) (Levant et al., 2016; Tomić et al., 2019), but we think we are providing specific data that the scientific community has not reported yet, since they are not specific research about soft skills perceptual improvement regarding Time Management and Judgment and Decision Making soft skills.

Also, looking at hypothesis 4, the results are very clear. None of the modules presented significant difference, indicating that there were no significant differences prior to the training between genders regarding the levels of Time Management, Judgment and Decision Making and Goal Setting. These results support the conclusions of the previous investigations (Ahmad, 2013; Balcar, 2014; 2016; Ismail et al., 2017).

Regarding hypothesis 5 and 6, as in the previous deliverable (3.2) none of the modules present significant differences between the different study fields and both the soft skills improvement and the previous soft skills levels. This supposses more evidence supporting the idea that any of the fields of study analyzed (Natural and Health sciences, Social sciences and humanities and Engineering and Technology) have an influence on soft skills, showing the same soft skills levels prior to the training and the same soft skills perceptual acquisition or improvement. Which, again, benefits all students to face the transversal demands of soft skills from a work context (Williams, 2015; Cimatti, 2016; Rao, 2018).

Finally, regarding hypothesis 7, again, none of the modules present a solid significant predictor model. Meaning that gender and field of study seem not to have an influence on soft skills levels, prior to the training. This result is consistent with the results provided on

the rest of the qualitative variables hypothesis, with the general conclusion that no direct relationship between gender or study field and soft skills levels can be shown. Assuming that both gender and field of study do not act as predictors. There is no research that has tried to explore what predictors soft skills have, beyond isolated works (Lapiski, 2021), thus making the present results a basis for this more specific line of research. An alternative that could be investigated in the future, especially in a video game training context, is to consider other qualitative variables as predictors. For example, the variables mentioned already in this document, how age or previous experience with video games could be determining factors.

As a final conclusion of the second half of the project, a total success can be inferred in terms of soft skills development of the participants. In addition to mentioning the exploration of different hypotheses derived from sociodemographic data.

Bibliographic references

Ahmad, S. B. S. (2013). Soft skills level of Malaysian students at a tertiary institution: A comparative case study based on gender, area of residence and type of schools. *International Journal of Asian Social Science, 3*(9), 1929–1937.

Balcar, J. (2014). Soft skills and their wage returns: Overview of empirical literature. *Review of Economic Perspectives, 14*(1), 3–15. https://doi.org/10.2478/revecp-2014-0001

Balcar, J. (2016). Is it better to invest in hard or soft skills? *The Economic and Labour Relations Review, 27*(4), 453–470. https://doi.org/10.1177/1035304616674613

Ball, H. G. (1978). Telegames Teach More Than You Think. *Audio-Visual Instruction*, 23, 24–26.

Britton, B. K., and Tesser, A. (1991). Effects of time-management practices on college grades. *Journal of Educational Psychology, 83*(3), 405–410. https://doi.org/10.1037/0022-0663.83.3.405

Buelow, M. T., Okdie, B. M., and Cooper, A. B. (2015). The influence of video games on executive functions in college students. *Computers in Human Behavior, 45*, 228–234. https://doi.org/10.1016/j.chb.2014.12.029

Cimatti, B. (2016). Definition, development, assessment of soft skills and their role for the quality of organizations and enterprises. *International Journal for Quality Research, 10*(1).

Darden, C. A., Ginter, E. J., and Gazda, G. M. (1996). Life-skills development scale - adolescent form: the theoretical and therapeutic relevance of life-skills. *Journal of Mental Health Counseling, 18*, 142–163.

Gaumer Erickson, A. S., Soukup, J. H., Noonan, P. M., Monroe, K. M., and Mcgun, L. (2017). Goal Setting Questionnaire.

Green, C. S., Pouget, A., and Bavelier, D. (2010). Improved probabilistic inference as a general learning mechanism with action video games. *Current Biology: CB, 20*(17), 1573–1579. https://doi.org/10.1016/j.cub.2010.07.040

Griffiths, M. D. (2002). The educational benefits of video games. *Education and Health, 20*(3), 47–51.

Heppner, P. (1988). *The problem solving inventory*. Consulting Psychologists Press.

Ismail, I., Ahmad, A. R., and Awang, M. M. (2017). A study of soft skills among polytechnic students. *Open Journal of Social Sciences, 05*(08), 295–311. https://doi.org/10.4236/jss.2017.58025

Joeckel, S., Bowman, N. D., and Dogruel, L. (2012). Gut or game? The influence of moral intuitions on decisions in video games. *Media Psychology, 15*(4), 460–485. https://doi.org/10.1080/15213269.2012.727218

Lapinski, L. M. (2021). *Relationship Between Technology Student Association Participation and Soft Skills Development, Controlling for Gender (Doctoral dissertation).*

Levant, Y., Coulmont, M., and Sandu, R. (2016). Business simulation as an active learning activity for developing soft skills. *Accounting Education, 25*(4), 368–395. https://doi.org/10.1080/09639284.2016.1191272

Nebel, S., Schneider, S., Schledjewski, J., and Rey, G. D. (2017). Goal-setting in educational video games: Comparing goal-setting theory and the goal-free effect. *Simulation and Gaming, 48*(1), 98–130.

Rao, M. S. (2018). Soft skills: toward a sanctimonious discipline. *On the Horizon, 26*(3), 215–224. https://doi.org/10.1108/oth-06-2017-0034

Tomić, B., Jovanović, J., Milikić, N., Devedžić, V., Dimitrijević, S., Đurić, D., and Ševarac, Z. (2019). Grading students' programming and soft skills with open badges: A case study: Grading programming and soft skills with badges. *British Journal of Educational Technology: Journal of the Council for Educational Technology, 50*(2), 518–530. https://doi.org/10.1111/bjet.12564

Williams, A. M. (2015). *Soft skills perceived by students and employers as relevant employability skills (Doctoral dissertation).*