INTERNATIONAL JOURNAL OF INNOVATIVE STUDIES

A MONTHLY, INDEXED, REFEREED AND PEER REVIEWED OPEN

ACCESS INTERNATIONAL JOURNAL

RESEARCH ARTICLE

ISSN: 3027-2173

IMMERSION-BASED LEARNING ON SOCIAL SCIENCE PROFICIENCY AMONG GRADE XII STUDENTS

Jovel C. Ogabar [1], Dr. Conrado A. Lombrio [2]

Email1: jovel.ogabar@gmail.com[1], lombrioconrad@gmail.com[2]

[1, 2] Eastern Samar State University – Guiuan Campus, Guiuan, Eastern Samar, Philippines.

ARTICLE INFORMATION

Received: 26th February, 2025

Accepted: 28th March 2025

Published: 4th April 2025

KEYWORDS: Immersion-Based Learning; Social Science; Proficiency

Publisher: Empirical Studies and Communication – (A Research Center)
Website: www.cescd.com.ng

ABSTRACT

The primary goal of this study focused on immersion-based learning on Social Science Proficiency among Grade XII students at Taytay Integrated School and it aimed to answer the mean score result after the conventional lecture method and immersion-based learning approach, also if there is a significant difference in the mean score of students before and after the exposure to using the conventional lecture method and immersion-based learning approach and if there is a significant difference between the mean achievement scores of students exposed to the lecture method and those exposed to the immersion-based learning approach. The study was conducted in Taytay Integrated School at Barangay Taytay, Guiuan, Eastern Samar. The total of the respondents in this study are 67 grade XII students from two tracks HUMSS and TVL (EIM, FCS AND CSS) tallied as follows; HUMSS 16, TVL: EIM 15, CSS, 24 and FCS 12 students from Taytay Integrated School, enrolled in Social Science, Understanding Culture, Society, and Politics were chosen using quasi – experimental design. The findings revealed that the grade 12 students exposed to the Immersion-Based approach in their Social Science subject attained better achievement test results compared to those exposed to the conventional lecture method. Immersion-based learning approach is better than the traditional lecture method employed by the teacher. The mean percentage scores between the students exposed to the lecture method and immersion-based learning approach groups showed that the latter yielded a higher mean increase than the former which yielded a lower increase in mean percentage score. Therefore, the result of this study conforms to the hypothesis that there is a significant difference in the Social Science mean scores between the students exposed to the lecture method and those exposed to the immersion-based approach.

INTRODUCTION

Education facilitates the transmission of knowledge, skills, and attitudes necessary for individuals to navigate their environment effectively (Moshahid & Quraishi, 2022). It also serves as a critical mechanism for social mobility (Nicolas, 2022). Within the K to 12 curriculum, Social Science plays a fundamental role in fostering critical thinking and responsible citizenship. Beyond content acquisition, Social Science cultivates problem-solving, decision-making, and research competencies essential for personal and societal development (Beboso & Bual, 2022).

Social Science instruction in senior high school, particularly in courses such as *Understanding Culture, Society, and Politics*, necessitates experiential learning to enhance student engagement and comprehension. The role of educators is pivotal in ensuring effective pedagogy through the implementation of diverse and evidence-based instructional strategies (Jaganathan, 2023). Research suggests that integrating real-world applications in Social Science education enhances students' cognitive and analytical skills (Mangion & Curmi, 2022).

Student academic performance serves as a primary metric for evaluating instructional efficacy. Despite various governmental and private sector initiatives, the Philippine education system continues to face significant challenges (Nicolas, 2022). This highlights the necessity for research-driven pedagogical improvements.

This study examines the comparative effectiveness of traditional lecture-based instruction and immersion-based learning, employing Piaget's Constructivist Theory as a theoretical framework. Traditional methodologies have demonstrated limitations in addressing the evolving educational demands of the 21st century (Jaganathan, 2023). Research indicates that integrating multimedia, guest lectures, field experiences, and interactive activities may enhance student learning outcomes. Empirical evidence further supports the positive impact of technology-enhanced instruction on academic performance (Wang, 2022). Immersion-based learning, characterized by experiential learning and collaborative engagement, fosters deeper understanding and knowledge retention (Mangion & Curmi, 2022). This study seeks to determine whether the implementation of immersion-based learning contributes to improved academic performance in Social Science education.

1.1 Research Objectives

This study aims to achieve the following objectives:

- To determine the pre-test mean score of students using the conventional lecture method and the immersion-based learning approach.
- To determine the post-test mean score of students using the conventional lecture method and the immersion-based learning approach.
- To analyze whether there is a significant difference in the mean scores of students before and after exposure to the conventional lecture method and the immersion-based learning approach.
- To compare the mean achievement scores of students exposed to the lecture method and those exposed to the immersion-based learning approach.

1.2 Research Gap

While existing research extensively supports constructivist and immersion-based learning in enhancing student engagement and conceptual understanding across various disciplines (Chen, 2019; Moshahid & Quraishi, 2022; Mangion & Curmi, 2022), there remains a significant gap in its application to Social Science proficiency among senior high school students. Current studies primarily focus on cognitive and skill-based improvements without explicitly addressing the unique competencies required in Social Science, such as critical thinking, civic awareness, and the ability to analyze cultural, societal, and political issues (Nino, 2023). Furthermore, while immersion-based learning is widely applied in Science and Language education, its potential to strengthen interdisciplinary connections and foster deeper engagement in Social Science has been underexplored. Additionally, there is a lack of structured, empirically validated lesson plans tailored to immersion-based Social Science instruction in secondary education. This study seeks to bridge these gaps by examining the effectiveness of an immersion-based learning approach in enhancing Social Science proficiency among Grade XII students. Through an experimental research design and the validation of an immersion-based lesson plan, this study aims to contribute to the development of more contextually relevant and student-centered instructional methodologies in Social Science education.

2. Literature Review

This study advocates the theory of constructivism, which has shifted teaching methodology towards student-driven learning. Constructivism replaces authoritarian, content-based learning with an active, skills-based, collaborative approach (Nino 2023). Social constructivism, based on Vygotsky's sociocultural theory, suggests cognitive development is shaped by social and cultural context. (Nino 2023) Dewey emphasized creating real-world contexts where students pursue their interests. Teachers using immersion teaching should integrate diverse media, including films and participative observation, to enhance engagement. (Chen 2019)

For effective learning, students should engage in structured activities such as puzzles, role plays, and reading. (Moshahid & Quraishi 2022) Immersive learning also occurs through seminars, collaborative projects, service learning, internships, and research. (Mangion & Curmi 2022) Dewey's theory supports hands-on learning, reinforcing the importance of participative observation. (Nino 2023) Immersion fosters skills, civic awareness, and responsibility. (Beboso & Bual 2022) It is often linked to realism and presence, though the concept remains broad. (Agrawal et al. 2019)

Active involvement enhances conceptual understanding, requiring alignment of learning objectives and teaching methods. Social Science competencies demand adaptability to cultural and societal issues, supporting immersion-based activities. Vygotsky's experiential learning approach aligns with this, as learning is socially constructed (Nino 2023) Active learning shifts focus from teachers to students, involving problem-solving, discussions, and teamwork. (Azzalis et al.). Piaget and Vygotsky both highlight active learning but differ in emphasizing individual cognitive development versus social interaction (Nino 2023).

Constructivist learning individualizes and contextualizes experiences, engaging students with authentic tasks (Mangion & Curmi 2022). This study, grounded in constructivism, proposes an immersion-based lesson plan validated by teachers to enhance learning and improve National Achievement Test (NAT) scores.

The 5E Instructional Model is rooted in cognitive psychology and constructivist theory, facilitating concept refinement through self-reflection and peer interaction (Gungoren et al. 2020). It personalizes lessons to student needs and has been shown to improve understanding, scientific reasoning, and attitudes toward learning (Duran 2024). Constructivism encourages exploration over rote memorization. The proposed immersion-based lesson plan follows the 5E model, allowing learners to integrate new knowledge with existing understanding (Nguyen 2024).

The 5E instructional model consists of five phases: Engage, which captures students' interest and activates prior knowledge; Explore, which promotes hands-on discovery before formal instruction (Duran & Duran, 2024); Explain, where students articulate their findings and inquire further; Elaborate, which enhances understanding through additional investigations and technology integration (Nguyen, 2024); and Evaluate, which employs diverse assessment methods, including portfolios, concept maps, and performance-based tasks (Gungoren et al., 2020).

This research follows a three-stage design by Sviridova et al. (2023): preparatory (assessing prior knowledge), practical (implementing immersion-based learning with an experimental group while a control group follows traditional lectures), and summarizing (post-test evaluation). The experiment spans two semesters, incorporating pre- and post-tests and lesson plan validation.

3. Research Methodology

The study employed a quasi-experimental design to compare the effectiveness of immersion-based learning and the conventional lecture method in enhancing Social Science proficiency among Grade XII students. A pre-test and post-test assessment was conducted to measure learning outcomes, ensuring empirical evaluation. The three-phase research design (adapted from Sviridova et al., 2023) included the Preparatory Phase, which involved developing instructional materials, validating the immersion-based lesson plan, and selecting participants; the Practical Phase, where the quasi-experiment was conducted with 67 students from Taytay Integrated School across two academic tracks (HUMSS and TVL), implementing both instructional methods; and the Summarizing Phase, which analyzed data to compare the effectiveness of the two teaching approaches.

The study utilized a validated teacher-made test questionnaire, ensuring reliability through a test-retest method. Before implementation, the immersion-based lesson plan was validated by five Social Science experts using the DepEd Lesson Plan Validation Checklist. The intervention involved experiential learning activities, such as attending community events, observing public social interactions, and engaging with marginalized communities, which aimed to develop students' cultural and social awareness. The post-test was administered after the intervention, and the collected data were analyzed statistically to determine the impact of immersion-based learning on student performance.

4. Analysis and Discussion

This section presents the results that provide the necessary answers to the research questions. Its purpose is to analyze the data collected on immersion-based learning and its impact on social science proficiency among Grade 12 students.

Table 1. Pretest and Posttest Scores of the Lecture Method

RESPONDENTS	PRE-TEST	POST- TEST
1	13	33
2	15	35
3	17	25
4	18	25
5	20	35
6	20	40
7	22	40
8	25	35
9	25	44
10	27	30
11	27	35
12	29	40
13	10	29
14	28	38
15	32	32
16	30	33
17	28	28
18	25	35
19	25	35
20	13	43
21	28	38
22	30	33
23	28	35
24	30	35
25	38	28
26	30	30
27	20	25
28	38	33
29	25	25
30	21	30
31	28	30

Table 1 presents the pre-test and post-test results of students who underwent the conventional lecture method. The data reveal that a majority of the students, 84% (26 out of 31), demonstrated an increase in their scores after receiving instruction through the conventional method. This improvement suggests that the lecture-based approach contributed to their learning progress. However, 13% of the students (4 out of 31) showed no improvement, as their post-test scores remained the same as their pre-test scores, indicating that the method had little to no impact on their performance. Additionally, 3% (1 student) experienced a decrease in their post-test score compared to their pre-test result, suggesting possible challenges in comprehension, retention, or external factors that may have affected their performance. These findings highlight the varied effects of the conventional lecture method on student learning outcomes.

Table 2. Pretest and Posttest Scores of Immersion-Based Learning

RESPONDENTS	PRE- TEST SCORES	POST-TEST SCORES
1	28	44
2	17	37
3	9	39
4	11	41
5	17	40
6	20	40
7	13	33
8	15	35
9	20	40
10	22	42
11	19	39
12	30	44
13	34	34
14	32	38
15	30	30
16	35	35
17	30	30
18	28	48
19	28	38
20	32	42
21	25	35
22	35	35
23	35	45
24	30	40
25	30	31
26	25	35
27	17	37
28	17	38
29	19	43
30	21	43
31	25	35
32	28	38
33	30	35
34	28	40
35	35	38
36	39	38

Table 2 presents the pre-test and post-test results of students who underwent the immersion-based learning approach. The results indicate that 83% (30 students) showed an increase in their scores after engaging in immersion-based learning, demonstrating the effectiveness of this approach in enhancing their understanding. Meanwhile, 14% (5 students) maintained the same scores in both the pre-test and post-test, suggesting that their level of proficiency

remained unchanged despite the intervention. However, 3% (1 student) experienced a decrease in their post-test score compared to their pre-test result, indicating possible difficulties in adapting to the immersion-based learning method. These findings provide insight into the impact of immersion-based learning on student performance.

The findings of this study have significant implications for teaching strategies in Social Science education, particularly in determining the effectiveness of immersion-based learning compared to the conventional lecture method. The results indicate that a higher percentage of students improved their scores after immersion-based learning than through the lecture method, suggesting that active, experiential learning experiences may lead to better retention and understanding of concepts. This supports the idea that engagement with real-world scenarios enhances learning outcomes by making lessons more meaningful and interactive.

Moreover, the fact that some students maintained or even decreased their scores highlights the need for differentiated instructional strategies to accommodate diverse learning styles. For instance, while immersion-based learning proved effective for most students, some may still benefit from a more structured or traditional approach. Educators should consider blended learning methods that integrate both lecture-based instruction and immersive experiences to cater to varied learner needs.

Additionally, these findings emphasize the importance of curriculum innovation in secondary education. Schools should explore the potential of experiential learning models in other subjects to determine their broader applicability. Furthermore, teacher training programs should include immersion-based pedagogies to equip educators with the skills needed to implement these methods effectively.

Table 3. Mean Difference of Pre-test and Post Test using Lecture Discussion and Immersion-based learning

	Test (Mean)				
Method	**Pretest**	**Posttest**	**t-test**	**P value**	**Interpretation**
Lecture Method	24.64	33.29	5.59	.000	Significant
Immersion-Based Learning	24.16	38.20	8.65	.000	Significant

As indicated from the table above the result of the Post-Test of all learners taking up Understanding Society, Culture, and Politics on Social Science curriculum after the exposure of the fifty percent population of Grade 12 to Immersion-Based Learning. The respondents answered the validated teacher-made Post-Test questionnaire for Grade 12 under the subject Social Science (Understanding society, culture, and politics). There was a total of 67 Grade 12 students from four sections: 16 students from Gabriela Silang (Humanities and Social Sciences Strand) and15 students from Jose Abad Santos (Electronic Installation and Maintenance – TVL Strand) under the modified program immersion-based learning and 12

students from Josefa Llanes Escoda (TVL Track - Food Consumer Services Strand) with 24 students from Vicente Lim (TVL Track- Computer System Servicing Strand) who were exposed to the conventional lecture method. These same students from two Sections took a 50-item validated Post-test.

The table presents the statistical comparison of pre-test and post-test mean scores for students who underwent both the lecture method and immersion-based learning approach. The results provide a clear indication of the effectiveness of each method in enhancing student performance in Social Science.

Lecture Method. The mean pre-test score for students taught using the lecture method was 24.64, which increased to 33.29 in the post-test. The t-test value of 5.59 and the p-value of .000 indicate a statistically significant difference between the pre-test and post-test scores. This suggests that the lecture method contributed to an improvement in students' understanding and performance, but the extent of progress remains moderate.

Immersion-Based Learning. For students who experienced immersion-based learning, the mean pre-test score was 24.16, which rose significantly to 38.20 in the post-test. The t-test value of 8.65 and the p-value of .000 also indicate a statistically significant improvement in student performance. Notably, the increase in mean scores for students exposed to immersion-based learning was higher than that of those who underwent the lecture method, suggesting a greater impact on student learning outcomes.

Both instructional methods yielded statistically significant improvements, as indicated by the p-values (.000), which are below the standard significance level of 0.05. However, immersion-based learning resulted in a higher post-test mean score (38.20) compared to the lecture method (33.29), with a greater t-test value (8.65 vs. 5.59), indicating that students benefited more from this approach.

This suggests that immersion-based learning is a more effective instructional strategy in enhancing student comprehension and application of concepts in Social Science. The hands-on, experiential approach likely contributed to deeper engagement, active participation, and better retention of knowledge compared to traditional lectures. Consequently, educators may consider integrating immersion-based learning strategies into their teaching methodologies to improve student performance and learning experiences.

As indicated the result of the Post-test from both groups shows significance with a critical value of .000 which is smaller than the T-value which is 4.037. This explains that the group from Immersion-Based learning showed better results than the Lecture Method. Hence the H0 is rejected. This also conforms with the study of (Jaunzems-Fernuk, J. et.al. (2024) This form of learning allows for a type of psychological engagement that builds an attachment to the content not afforded in passive learning environments.

Table 4. Summary of difference in Mean Percentage Score for Lecture Method and Immersion-Based Learning Approach

Method	Posttest	t-test	P value	Interpretation
Lecture Method	33.29	4.2925	.002	Significant
Immersion-Based Learning	38.20			

As shown in the table above, through the introduction of an immersion-based learning approach there were positive changes. The pattern of progress was eminent in the experimental group. The students who underwent the lecture method achieved an average post-test score of 33.29. The t-test value of 4.2925 and the p-value of .002 indicate that the observed improvements in student performance were statistically significant. This means that the lecture method contributed to knowledge acquisition and skill enhancement, reinforcing its effectiveness as a traditional teaching strategy.

While the post-test mean score for students exposed to immersion-based learning was 38.20. However, since the immersion-based learning post-test mean score is higher than the lecture method's score (38.20 vs. 33.29), it suggests that students who engaged in real-world, hands-on learning experiences performed better than those who learned through conventional lectures.

The findings indicate that while both instructional methods are effective in enhancing student learning, immersion-based learning resulted in a higher post-test performance than the lecture method. The experiential nature of immersion-based learning likely allowed students to develop a deeper understanding of concepts, leading to better knowledge retention and application.

The results suggest that educators should consider incorporating immersion-based learning strategies alongside traditional lectures to create a more engaging and effective learning environment. By doing so, students may achieve higher academic performance, increased critical thinking skills, and greater real-world application of Social Science concepts. Further analysis, including an explicit statistical comparison between the two post-test results, would strengthen these findings.

In line with the study of Appert et al 2022, there is a growing emphasis on integrating social and emotional learning into curricula through immersion-based learning. These equip students with essential skills such as empathy, self-awareness, and emotional regulation, which are crucial for success in our rapidly evolving society. By fostering these skills, educators can help students navigate the complexities of modern life, collaborate effectively with others, and develop resilience in the face of challenges.

Moreover, this approach not only addresses academic needs but also supports the overall well-being of students, preparing them to thrive both personally and professionally. As we continue to advance, the ability to adapt, empathize, and communicate effectively will be invaluable, making these educational strategies more relevant than ever.

5. Research Future Opportunities

While this study provides valuable insights into the effectiveness of immersion-based learning in enhancing Social Science proficiency among Grade XII students, several research opportunities remain to deepen our understanding of this instructional approach:

- Longitudinal Impact of Immersion-Based Learning: Future studies can explore the long-term effects of immersion-based learning on students' retention of Social Science concepts and their application in higher education or real-world scenarios.
- Comparative Analysis Across Disciplines: Research could examine the effectiveness of immersion-based learning in other academic subjects to determine whether its benefits extend beyond Social Science.

- Personalized Learning Approaches: Further investigation can be conducted on how students with different learning styles respond to immersion-based learning and whether adaptive or blended instructional strategies yield better outcomes.

- Teacher Readiness and Implementation Challenges: A study could analyze the preparedness of educators to implement immersion-based learning effectively and identify barriers to its integration in secondary education.

- Integration of Technology in Immersion-Based Learning: Exploring the role of digital tools, virtual simulations, or augmented reality in enhancing immersion-based learning experiences could provide valuable insights into modernizing this approach.

6. Conclusion

The findings of this study indicate that immersion-based learning is a more effective instructional approach than the conventional lecture method in enhancing Social Science proficiency among Grade 12 students. Students who engaged in immersion-based activities demonstrated higher achievement test scores and a more substantial improvement in their performance compared to those who received traditional instruction. The significant difference in mean percentage scores between the two groups supports the hypothesis that experiential learning fosters greater student engagement, deeper comprehension, and improved academic outcomes. These results underscore the value of interactive and contextually relevant learning experiences in strengthening students' understanding of Social Science concepts, reinforcing the importance of integrating immersion-based strategies into instructional practices to optimize learning effectiveness.

Acknowledgment: The researcher expresses gratitude to the Schools Division Superintendent of Eastern Samar, the Principal of Taytay Integrated School, and the research adviser for their support and approval of this study. Appreciation is extended to the Grade 12 students and Social Science teachers for their participation, which was integral to the research. Acknowledgment is also given to colleagues, mentors, and peers for their valuable insights, as well as to the scholars whose works provided the theoretical foundation. Lastly, gratitude is extended to the researcher's family and friends for their unwavering encouragement throughout the study.

Data Availability Statement: Data supporting the findings are available from the corresponding author upon request.

Funding Statement: No specific funding was received for this research.

Conflicts of Interest Statement: The authors affirm that they have no financial, personal, or professional conflicts of interest that could have influenced the research, its results, or the manuscript's content.

Ethics and Consent Statement: This study adhered to ethical research standards to ensure the protection of all participants. Approval to conduct the research was obtained from the Schools Division Superintendent of Eastern Samar and the Principal of Taytay Integrated School, with the recommending approval of the research adviser. Prior to data collection, informed consent was secured from all participants, ensuring they were fully aware of the study's purpose, procedures, potential risks, and benefits. Participation was voluntary, and respondents had the right to withdraw at any stage without consequences. Confidentiality and anonymity were strictly maintained, with all collected data used solely for academic

purposes. The study also followed ethical guidelines for educational research, ensuring fairness, integrity, and respect for all participants.

References

Agrawal, S., Simon, A., Bech, S., Bærentsen, K., & Forchhammer, S. (2019). Defining immersion: Literature review and implications for research on immersive audiovisual experiences. *Journal of Audio Engineering Society, 68*(6), 404–417. https://doi.org/10.17743/jaes.2020.003

Appert, C., Barbosa, S., Lampe, C., & Shamma, D. A. (2024). Enhancing students' social and emotional learning in educational virtual heritage through projective augmented reality. *CHI EA '22: Extended Abstracts of the 2022 CHI Conference on Human Factors in Computing Systems*, 3066 pages. https://doi.org/10.1145/3491101

Beboso, C. G. T., & Bual, J. M. (2022). Students' motivation and perception in learning social science using distance learning modality during COVID-19 pandemic. *Asian Journal of Education and Social Studies, 31*(3), 16-28. https://doi.org/10.9734/ajess/2022/v31i3814
ISSN: 2581-6268

Chen, Z. (2019). An exploration of the immersion English teaching model. *Advances in Social Science, Education and Humanities Research, 311*. Atlantis Press.

Güngören, S. Ç., Hasançebi, F. Y., & Mesci, G. (2020). The effect of teacher evaluation and self-evaluation on pre-service teachers' inquiry-based 5E lesson plan design and teaching practice. *Educational Policy Analysis and Strategic Research, 15*(4).

Jaganathan, P. (2023). Methods of teaching social science. *International Journal of Creative Research Thoughts (IJCRT), 11*(6). www.ijcrt.org
ISSN: 2320-2882

Jaunzems-Fernuk, J., Gaetz, C., McArthur, A., & MacDowell, P. (2024). Immersive education in practice: pedagogical considerations for designing deep and meaningful immersive learning experiences. *Immersive Learning Research - Practitioner,* 1(1), 20–24. https://doi.org/10.56198/5M1RHS0FV

Mangion, M., & Curmi, F. (2022). Immersive learning as a pedagogical method in higher education. *8th International Conference on Higher Education Advances (HEAd'22)*. Universitat Politecnica de València. http://dx.doi.org/10.4995/HEAd22.2022.14522

Moshahid, M., & Quraishi, M. N. (2022). A study of social science achievement of secondary school students in relation to their intelligence. *International Journal of Applied Research, 8*(7), 263-266. http://www.allresearchjournal.com/
https://doi.org/10.22271/allresearch.2022.v8.i7d.9994

Nguyen, H. (2024). The effectiveness of the 5E instructional model in developing scientific competency of primary students. *Ho Chi Minh City University of Education, Vietnam.*

Nicolas, R. E. (2022). Selected profile and factors affecting the academic performance in social studies of grade 10 students: Input for an intervention program. *International Journal of Multidisciplinary: Applied Business and Education Research, 3*(12), 2655–2668. http://dx.doi.org/10.11594/ijmaber.03.12.18

Nino, T. (2023). Constructivism as a theory of learning (foundations and significance). *The 9th International Scientific and Practical Conference: Basics of Learning the Latest Theories and Methods* (March 07–10, 2023). International Science Group.

Sviridova, E., Yastrebova, E., Bakirova, G., & Rebrina, F. (2023). Immersive technologies as an innovative tool to increase academic success and motivation in higher education. *Frontiers in Education, 8,* 1192760. https://doi.org/10.3389/feduc.2023.1192760

Wang, Y. (2022). A comparative study on the effectiveness of traditional and modern teaching methods. In A. Holl et al. (Eds.), *ICHESS 2022, ASSEHR 720* (pp. 270–277). https://doi.org/10.2991/978-2-494069-89-3_32