REWIRE - Cybersecurity Skills Alliance
A New Vision for Europe

Results of the 2nd Cybersecurity VOOCs delivery

WP4 – R4.5.2

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EXECUTIVE SUMMARY

The "R4.5.1 REWIRE 2nd VOOC Delivery" report documents the subsequent development and usage of the REWIRE Virtual Learning Environment (VLE) as part of the Cybersecurity Skills Alliance.

This platform aims to provide high-quality cybersecurity education through four comprehensive courses: Cyber Incident Responder, Cyber Threat Intelligence Specialist, Penetration Tester, and Chief Information Security Officer (CISO).

Key Report takeaways:

- **Course Enhancements and Content Revamp**: The second delivery period (April 24 – Nov 24) introduced significant updates to the REWIRE VLE courses, including the addition of new video content, expanded resources, and error corrections. These enhancements improved the quality and accessibility of the theoretical and practical components, further solidifying the courses as valuable learning tools.
- **Seamless CyberRange Integration**: The integration of KYPO CyberRange exercises directly into the VLE eliminated the need for external requests, creating a smoother, uninterrupted learning experience. This improvement significantly enhanced the accessibility and engagement with practical components, addressing a key barrier from the first delivery period.
- **Learner Engagement and Growth**: Increased enrolments and higher course completion rates characterized the second delivery period. More learners engaged with practical exercises, forums, and theoretical content, resulting in a substantial rise in participation and certificates issued. These trends demonstrate the program's growing impact.
- **Diverse Learner Base**: The VLE continued to attract a wide range of participants from different countries and professional backgrounds. This diverse audience provided valuable insights into demographic distribution and engagement patterns, reinforcing the program's international relevance and appeal.
- **User Feedback and Practical Challenges**: Evaluations revealed consistently high satisfaction with theoretical content and forums, highlighting the program's strength in delivering foundational knowledge and fostering collaboration. However, practical components and the VLE received mixed feedback, with some users reporting challenges related to accessibility and usability.

1. INTRODUCTION

The REWIRE VLE is taking advantage of the LearnDash technology capabilities and is modified to meet any specifications necessary. LearnDash Learning Management System (LMS) comes as an add-on to any WordPress installation making it an appropriate choice for the REWIRE project since the REWIRE website was developed with the specific technology. The LearnDash solution extends the already deployed capabilities to encompass eLearning under the same look & feel offering a consistent and smooth user experience. In addition, LearnDash is freely installed, exploiting ReadLab's current technical infrastructure. The REWIRE VLE is accessible under the same domain with a different subdomain.

The [REWIRE VLE, developed by ReadLab,](#) consists of 4 courses, namely:

- Cyber Incident Responder
- Cyber Threat Intelligence Specialist
- Penetration Tester
- Chief Information Security Officer (CISO)

The courses provide an online learning experience (theoretical and practical part, forum participation). For the 2nd phase of the VOOC Delivery, an integration between the LearnDash VLE and the practical part (REWIRE Cyber Range) was built, foregoing the need to request access through contacting courses@rewireproject.eu. The instructors act more as facilitators/moderators than Professors lecturing in a campus class environment.

VOOC program and its target audience

The materials for the VOOC program are developed by REWIRE partners under the coordination of URL. Each course module is created by subject matter experts from different institutions, ensuring a diverse and comprehensive curriculum. The materials include:

- **Theoretical Content**: Text-based lessons, PDFs, and presentations covering fundamental and advanced topics in cybersecurity.

- **Practical Exercises**: Interactive tasks and simulations provided through the REWIRE Cyber Range to apply theoretical knowledge.

- **Assessments**: Multiple-choice quizzes and problem-solving activities to test comprehension and practical skills.

The course material covers a broad spectrum of cybersecurity topics, such as:

- Techniques for identifying, managing, and mitigating cybersecurity incidents.
- Methods for gathering, analyzing, and utilizing threat intelligence to protect organizational assets.
- Strategies and tools for performing penetration tests to identify vulnerabilities.
- Best practices and frameworks for managing information security at an organizational level.

The material is addressed to current cybersecurity professionals, IT specialists, and aspiring cybersecurity experts. The content is designed to be relevant and practical, helping learners enhance their skills and knowledge in cybersecurity.

Highlights of the Second Delivery Period

The 2nd delivery period (April 24 – Nov 24) was marked by the following elements:

Revamping of the Courses

Significant improvements have been made to the four VLE courses during this delivery period. Dozens of new video pills have been introduced to enhance the learning experience, alongside the addition of supplementary resources to deepen users' understanding. Errors and inconsistencies from the previous iteration have been thoroughly addressed, ensuring a smoother and more reliable course delivery. These updates reflect the project's commitment to providing a high-quality, user-centric educational experience.

Integration of the Cyber Range

One of the most transformative updates this period is the seamless integration of KYPO Cyber Range exercises directly into the REWIRE VLE. Previously, accessing these exercises required users to email courses@rewireproject.eu, which disrupted the flow of learning. With this integration, users can now access the exercises directly within the platform, eliminating the need for additional steps and significantly improving the overall learning experience.

Increase in User Enrolments and Engagement

The second delivery period has seen a notable increase in user enrolments, as detailed later in the analytics section. This growth is coupled with higher course completion rates across all four VLE courses. The expanded user base has led to more learners actively engaging with course content, attempting practical exercises, and participating in forum discussions. This heightened activity has also resulted in a more certificates being issued, underscoring the success of the enhancements made to the platform during this period.

2. VOOC STRUCTURE

The REWIRE VLE consists of 4 courses, namely:

- Cyber Incident Responder

- Cyber Threat Intelligence Specialist

- Penetration Tester

- Chief Information Security Officer (CISO)

REWIRE COURSE 1
CYBER INCIDENT RESPONDER
Start date: 20/11/2023

REWIRE COURSE 2
CYBER THREAT INTELLIGENCE SPECIALIST
Start date: 15/05/2024

REWIRE COURSE 3
PENETRATION TESTER
Start date: 20/11/2023

REWIRE COURSE 4
CISO
Start date: 20/11/2023

Figure 1 Course selection screen

The courses provide an online learning experience (theoretical and practical part, forum participation).

Each module contains some brief multiple-choice question quizzes which are intended to help learners test their knowledge.

Figure 2 Example module structure:

Figure 3 Example Quiz

Cyber Range

The REWIRE Cyber Range contains practical exercises which the student is directed to attempt as they progress in a course. As of the 2nd phase of the VOOC Delivery, the KYPO exercises are <u>fully accessible</u> through the REWIRE VLE which attests the innovative nature of the REWIRE courses.
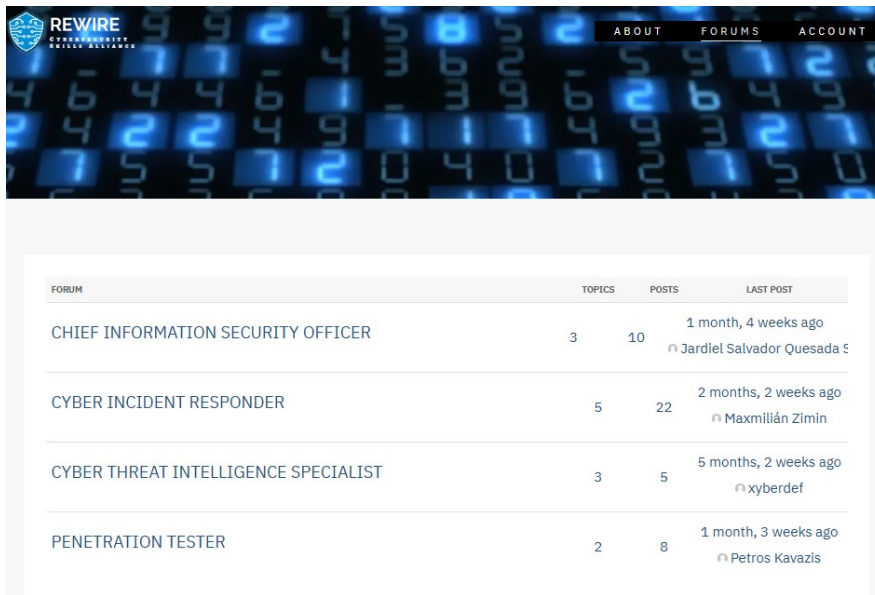

Figure 4 Example Exercise Placement

Figure 5 Example CyberRange Exercise

Forums

The forums in the REWIRE courses are designed to be an integral part of the learning experience, fostering interaction and engagement among participants. They serve as a platform where students can create topics, post comments, and engage in discussions related to the course material.

The REWIRE VLE was configured to support open discussion activities in the form of forums. All registered users have access to REWIRE forum activities (one account access courses and discussions). At the time, all topics are created around the four offered REWIRE Courses, as depicted below.

Figure 6 Forum top directory

Figure 7 Forum thread example

Upon completion of the required activities (Having accessed Cyber Range, having scored >50% in the quizzes and having participated in the forums) the student can attain a **Certificate of Attendance**.

Figure 8 Certificate template

3. LEARNERS PROFILE

According to the proposal, the courses should reach in total 1200 learners by the end of the project with an equal participation of women and men (maximum divergence 65%-35%).

In fact, at the end of the project there were 1713 accounts, from which **894 users** were enrolled in at least 1 course, leading up to a total of **1751 enrollments.**
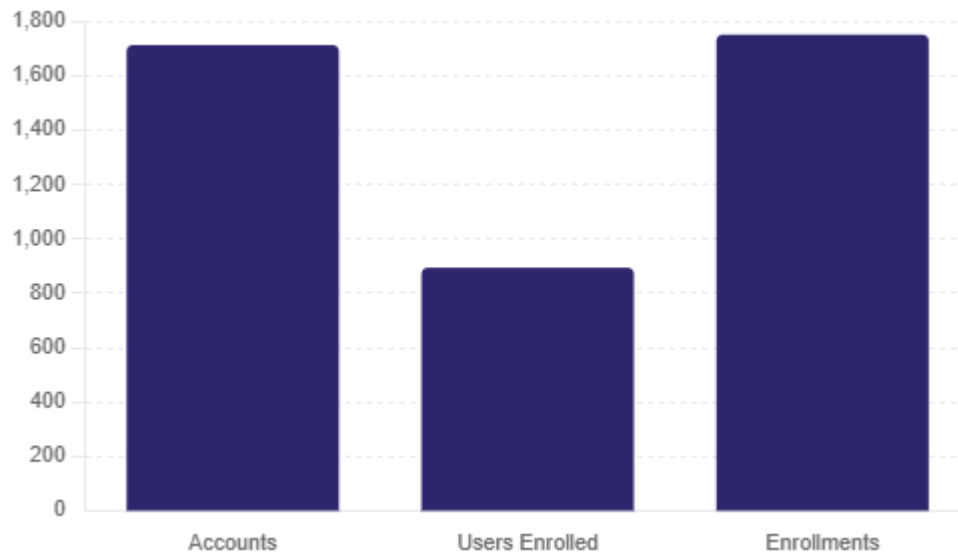
Figure 9 VLE accounts and enrolments

The following provides a detailed analysis of the Learner's Profile, categorized by Gender and Country, based on data provided during user registration.

3.1 Gender

Upon the creation of an account, users are required to select an option from the gender drop-down menu. At the end of the 2nd period, out of a total of 636 responses, 19 did not specify their gender and were excluded from the analysis. Of the remaining 617 participants, 18.1% opted for "Prefer not to say." Among those who shared their gender identity, the majority (65.3%) identified as male. Female respondents accounted for 18.2%, while 0.8% identified as non-binary or non-conforming, and 0.6% selected "Other." This data indicates a predominant male representation among those who disclosed their gender, alongside smaller yet diverse groups of female, other, and non-binary/non-conforming identities.
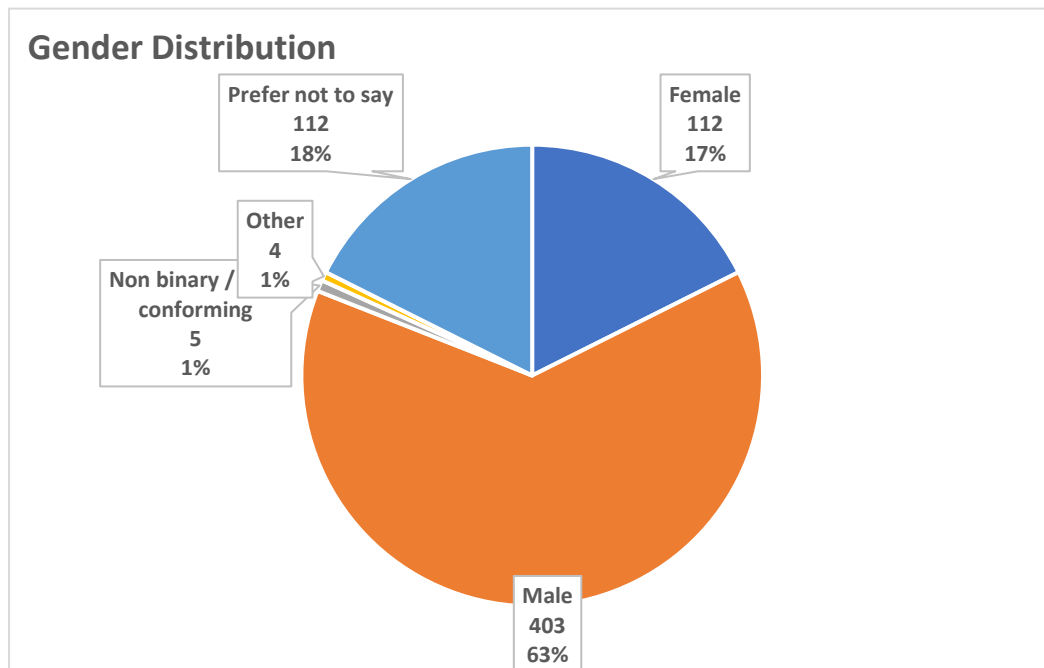
Figure 10 Final User Gender Distribution

3.2 Country

Similarly, when it came to their country, a notable portion of users did not disclose theirs, with 48% (884 out of 1712 users) not sharing this information.

Of the 828 users who did, the majority of responses came from Spain, followed by France and Czechia. Other countries with significant representation include Greece, Portugal, and Lithuania Hungary and Cyprus, all consortium member countries. In total participants came from 54 different countries.
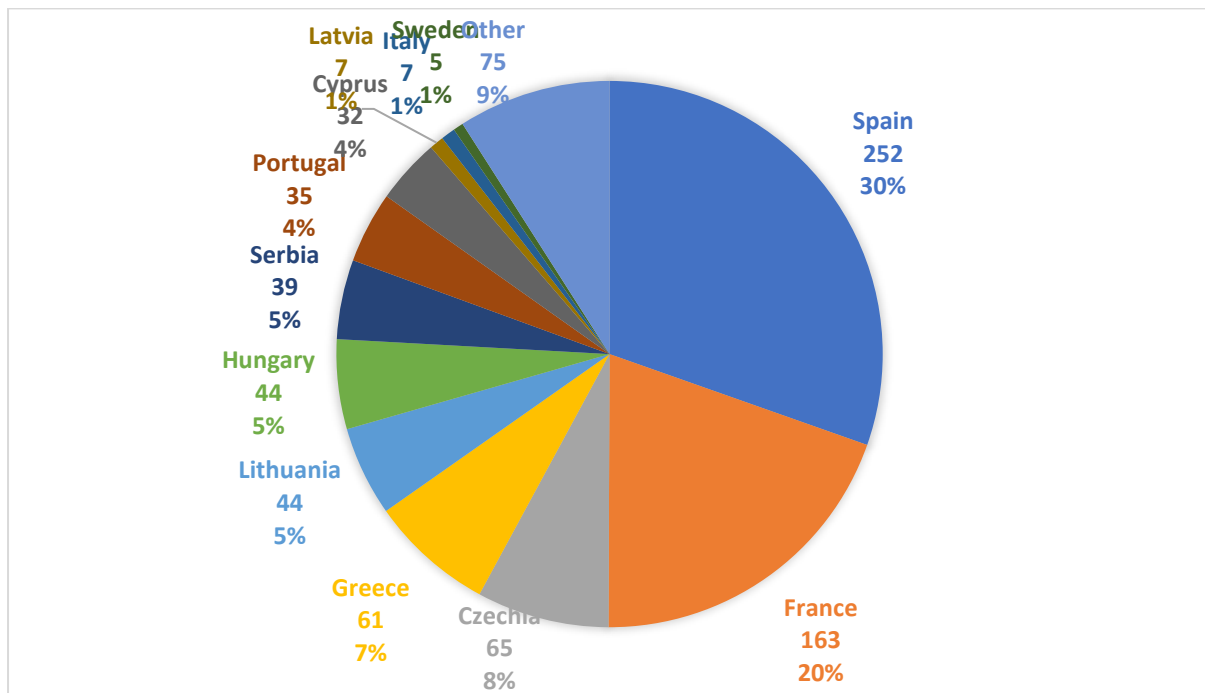
Figure 11 Final User country distribution

4. ANALYTICS FOR BOTH PERIODS OF PROGRAMME DELIVERY

	Users enrolled in the VLE platform 1st Round (Nov 23 - March 24)			Users enrolled in the VLE platform 2nd Round (April 24 – Nov 24)			Total		
	# users (total)	At least 50% completed	Course ended (90-100% completed)	# users (total)	At least 50% completed	Course ended (90-100% completed)	# users (total)	At least 50% completed	Course ended (90-100% completed)
Users enrolled in the CISO Course	248	0	6	97	88	19	462	73	44
Users enrolled in the CTI Course	250	0	51	32	32	0	301	6	5
Users enrolled in the PENTESTER Course	247	0	4	72	76	0	484	8	8
Users enrolled in the CIR Course	246	0	6	194	125	8	494	11	63

Figure 12 Table of Course completion data

Enrollment and Participation

The course enrolments varied from just over 300 to just under 500. The majority of the enrolled users did not progress significantly into the course with a significant drop-off in participation before reaching the 50% completion milestone. However, once participants surpassed the 50% mark, they tended to complete the courses.

Figure 13 Course Enrolments, Participation and Completion

Course Completion Rates

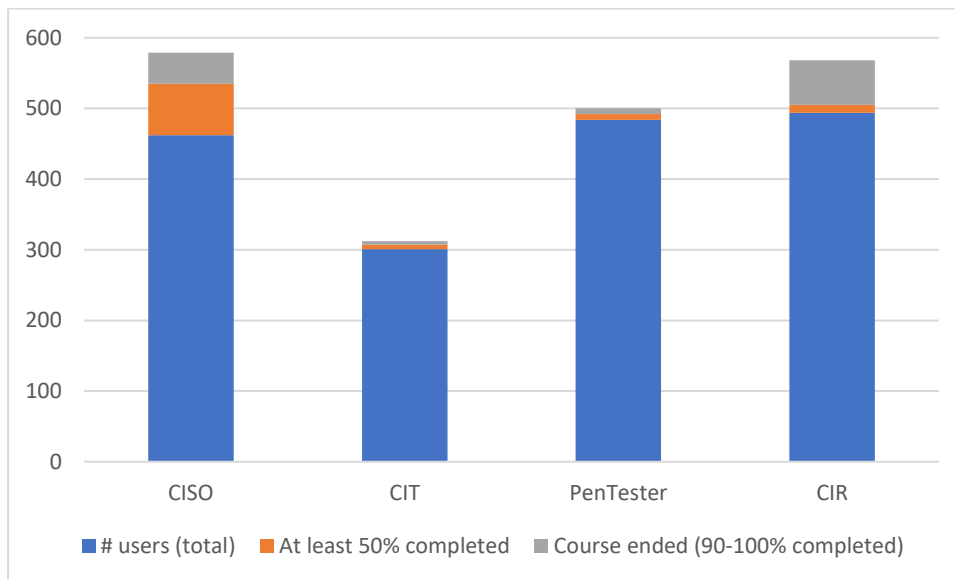When examining course completion at the highest level—90-100% completion—the data suggests differing levels of success. The CISO course had 44 users complete the course in full, representing 9.5% of total enrolments. The CIR course had the highest proportion, with 63 users completing the course in full, representing 12.8% of its total enrolments. The CTI and Pentester courses had lower completion rates of around 2%. This data suggests that CIR not only attracted significant enrolment but also demonstrated a relatively strong completion rate compared to the other courses.

Comparison of Initial Delivery Period and Final total

Analysing the completion rates of the courses over their respective delivery periods highlights varying levels of user engagement and success. In the initial delivery period, participation rates in all courses were modest, with only a fraction of users reaching at least 50% completion. For instance, in the CISO course, 16% of enrolled users engaged beyond the halfway mark, while CTI saw an engagement of 2.0%. Similarly, the PENTESTER and CIR courses reported mid-period participation rates of 1.6% and 2.2%, respectively, showcasing limited initial user involvement across all courses.

By the end of the course delivery period, final completion rates (90-100% completed) demonstrated an increase, though the levels of improvement varied across courses. The CISO course achieved a final completion rate of 9.5%, marking a gap between initial participation and those who reached full completion. The CIR course showed the most substantial improvement, with 12.8% of users completing the course fully—a significant increase from its earlier engagement levels. The PENTESTER and CTI courses maintained consistency, with a final completion rate of around 2%, matching its earlier 50% completion rate.

This comparison illustrates that while most courses struggled to convert initial participation into high completion rates, CIR stood out as the most successful in fostering user retention and achieving higher end-of-period completion. The data underscores the importance of addressing mid-course engagement to improve overall completion outcomes

Forum and Practical Exercise Participation

In addition to course completion, the courses saw active participation in forums and practical exercises, which contributed significantly to the learning experience. Many students engaged in practical exercises through the KYPO/Cyber Range platform, which allowed them to apply theoretical knowledge in simulated environments, enhancing their practical skills. At least 48 completed all the practical exercises.

Certification

Users who had completed all 3 criteria, namely full course completion, forum participation and practical exercise completion were issued Certificates of attendance were issued to those who completed the courses, participated in the forums and completed the practical exercises. In total 21 Certificates were issued.

5. FINDINGS FROM COURSE EVALUATION

5.1 Evaluation Methodology

The evaluation of the second delivery period (April 24 – Nov 24) of REWIRE courses was conducted through a structured post-course survey completed by 20 students. The survey aimed to capture both quantitative and qualitative feedback on key aspects of the courses, including theoretical content, practical components, quizzes, forums, and the virtual learning environment (VLE).

Data Collection

1. **Quantitative Data**: Students rated various aspects of the courses on a scale from 1 to 5, including their satisfaction with the theoretical and practical components, quizzes, forums, and the VLE. Additionally, they assessed the quality, structure, relevance, and applicability of the course content.
2. **Qualitative Data**: Open-ended questions allowed students to highlight the strengths of the training and suggest improvements.

Analysis

The collected data were analyzed to determine overall satisfaction levels and to identify common themes in the qualitative feedback. Quantitative responses were summarized using descriptive statistics, including mean ratings and the percentage of high ratings (4 or 5). Qualitative responses were reviewed to extract recurring themes and specific suggestions for improvement.

Sample Size

The survey was completed by users from various countries who took different REWIRE courses. The users were majority students but over one quarter were professionally employed in ICT, with roles varying from Cyber Security Specialists and IT Consultants to ISOs. While the sample size was moderately small, the responses provided valuable insights into the effectiveness of the pilot courses and areas needing enhancement.

5.2 Learner Feedback and Satisfaction

Analysis of REWIRE Course Feedback

The overall feedback for the second delivery period reflects moderate to high satisfaction among participants, with notable improvements in certain areas compared to the first delivery period.

Course Content

Feedback on the course content reflects a strong overall performance. A majority of participants (55.6%) agreed or strongly agreed that the content was of high quality, underscoring the program's success in delivering valuable material. While a smaller proportion (16.7%) disagreed, this reflects the diversity of learner expectations and experiences.
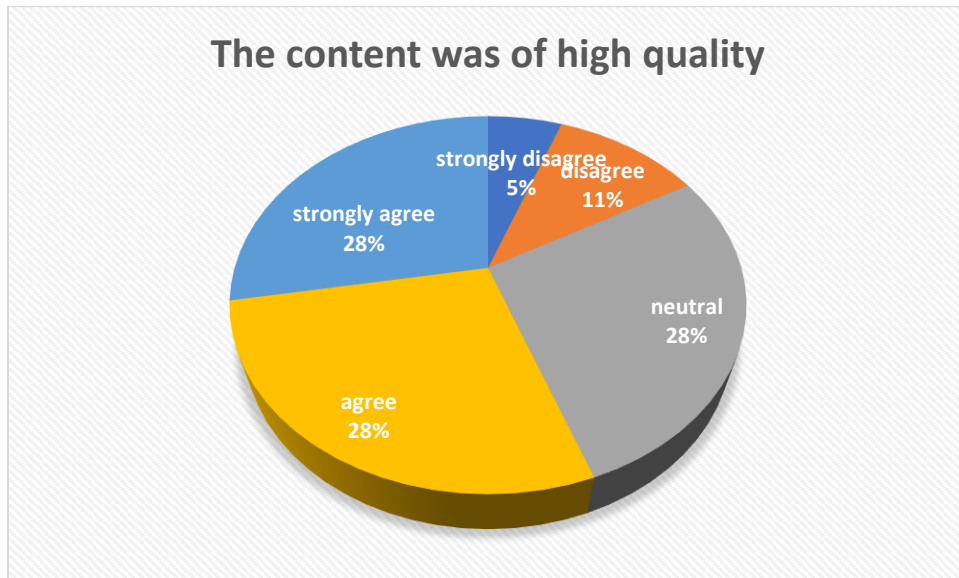

Figure 14 Course Quality Satisfaction results

The structure and engagement of the content were also well-received, with **56%** of respondents agreeing or strongly agreeing that it was well-structured and easy to follow. This demonstrates that the program effectively balanced comprehensive content delivery with accessibility for learners.

Figure 15 Course Structure and engagement results

The structure and engagement of the content were also well-received, with **55%** of respondents agreeing or strongly agreeing that it was well-structured and easy to follow. This demonstrates that the program effectively balanced comprehensive content delivery with accessibility for learners.
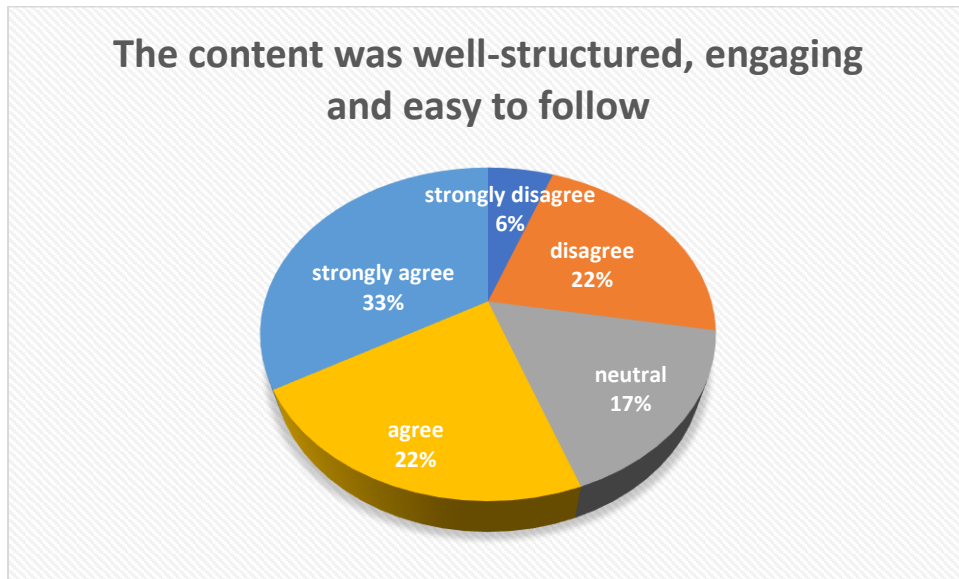

Figure 16 Satisfaction with knowledge and skills improvement results

The courses were particularly successful in enhancing participants' knowledge and skills. A significant 61% agreed or strongly agreed that the training improved their competencies, highlighting the program's impact in equipping learners with practical and applicable knowledge.

Figure 17 Applicability to work results

Finally, with regard to the applicability of the training to their work, the results were more mixed. While many indicated they could apply what they learned, the varying degree of ratings highlights an opportunity to better connect the course material to practical, real-world applications.

Constituent Aspects

The analysis of satisfaction levels across specific aspects of the courses reflects a nuanced yet overall positive reception. The theoretical components were particularly well-received, with a significant portion of participants expressing satisfaction. This reinforces the program's success in delivering foundational knowledge effectively and establishing a strong intellectual base for learners. Participants frequently highlighted the clarity and depth of the theoretical material, underscoring its role as a cornerstone of the program's success
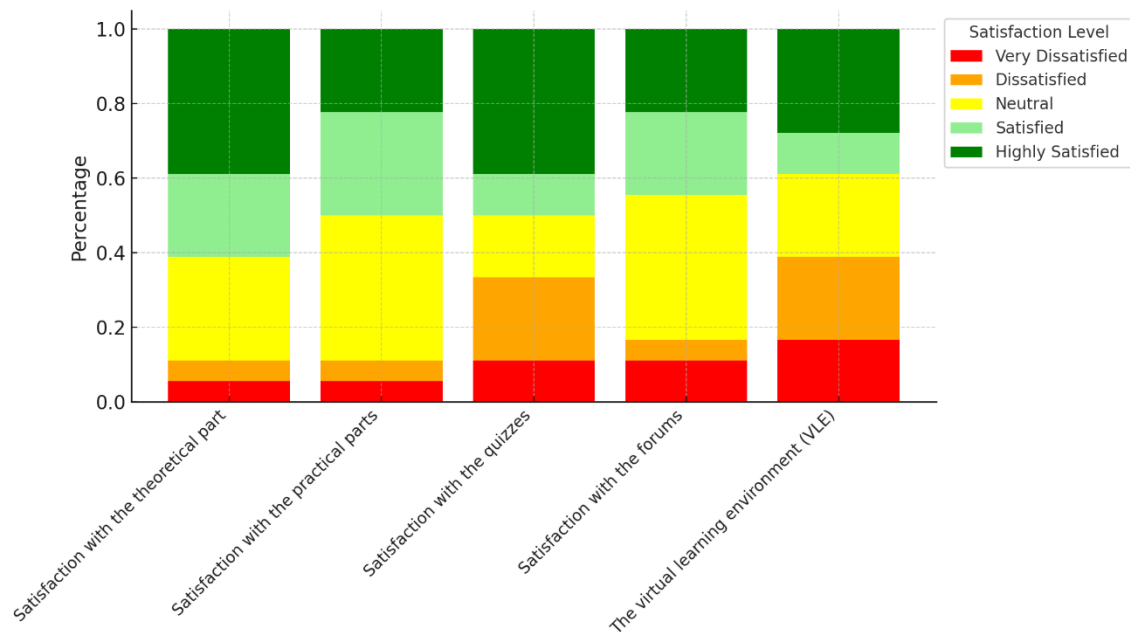

Figure 18 Satisfaction Levels for Rewire Course Aspects

Forums

Satisfaction with the forums also stood out as a key strength, with many participants praising their structure and accessibility. The forums provided an effective platform for interaction, enabling learners to engage in discussions and share insights

Practical Components & Quizzes

While feedback on practical components and quizzes showed a more diverse range of responses, these elements still garnered positive ratings from many participants, demonstrating their value as key components of the learning experience.

Virtual Learning Environment (VLE)

The virtual learning environment (VLE) received a mix of feedback, with many participants acknowledging its user-friendliness and its ability to facilitate the learning process. While a subset of respondents noted areas where navigation or interface design could be more intuitive, the overall sentiment indicates that the VLE provided a reliable foundation for the program's delivery. This feedback underscores the significant role of the VLE in supporting diverse course elements and ensuring learners could focus on content and interaction.

Open-Ended Feedback Analysis

Participants were asked to provide insights into the strengths and weaknesses of the REWIRE courses through open-text responses. The feedback highlights both key areas of success and aspects where improvements were suggested.

Course Strengths

A recurring theme in the feedback was the *comprehensive and high-quality theoretical content*. Participants appreciated the detailed references to established standards and frameworks, such as those provided by SANS, NIST, and ISO 27001. These references were noted to be particularly valuable for learners aiming to establish a foundational understanding of cybersecurity practices and methodologies.

Several respondents highlighted the *self-paced format and ease of understanding* as significant strengths, which allowed participants to progress through the material at their own pace. The *quizzes* were also praised by some learners for their effective structure and appropriate quantity, reinforcing key concepts and facilitating knowledge retention.

Additionally, specific aspects of the course, such as the reinforcement of the ISMS theme and security controls under ISO 27001, were highlighted as providing critical practical insights that are applicable to real-world scenarios.

Areas for Improvement

The feedback also revealed areas for improvement. One common concern was related to the accessibility and usability of certain course components. For example, some participants found the open-question system in the tests to be limiting, as it did not truly allow for open-ended responses. Similarly, lengthy documents were seen as a potential barrier to learning, particularly when they were inaccessible or overwhelming.

Several participants expressed challenges in engaging with the practical components, such as the KYPO CPR labs, which lacked clear guidance or links to connect to the exercises. Missing quizzes, such as those for LM3 Lessons 1 and 2, were also noted as gaps in the course structure.

There was a call for more in-depth content in some areas, with participants requesting additional material on certain topics, longer quizzes, and more test cases. While one participant expressed no criticisms of the course, others emphasized that extending the content or providing additional resources could significantly enhance the learning experience.

CONCLUSION

The REWIRE VLE 2nd VOOC delivery report marks the end of the REWIRE project's contributions to developing an effective online learning platform for cybersecurity education. The second delivery period (April 24 – Nov 24) of the REWIRE courses marked significant progress, building on insights gained from the initial phase and incorporating enhancements that enriched the learner experience. Key highlights of this period included the revamping of the courses and the seamless integration of the CyberRange, both of which contributed to the program's ability to deliver a more robust and cohesive online learning experience.

The revamping of the courses introduced dozens of new video pills, refined resources, and a thorough correction of errors, significantly improving the theoretical and practical components. This comprehensive update addressed previous challenges and ensured a higher-quality educational offering. The integration of the KYPO CyberRange exercises into the Virtual Learning Environment (VLE) eliminated barriers to accessing hands-on components, providing learners with direct, uninterrupted access to practical exercises—a critical improvement that enhanced engagement and applicability.

The demographics of learners showcased a diverse, international audience, reflecting the program's wide-reaching appeal and relevance across various regions and professional fields. The inclusion of beta testing and feedback loops ensured that issues identified in earlier phases were addressed, leading to substantial improvements in functionality, user-friendliness, and platform stability.

In conclusion, the second delivery period of REWIRE courses demonstrated the program's ability to evolve, addressing earlier challenges while delivering an enriched learning experience. The integration of the CyberRange and the revamping of course content stand out as transformative milestones that significantly enhanced the program's educational impact. The report underscores the program's success in meeting its objectives, blending theoretical rigor with practical application, and leaving a lasting impact on a diverse learner base. The results affirm REWIRE's contribution to advancing cybersecurity education in a dynamic and accessible virtual environment.

LIST OF ABBREVIATIONS AND ACRONYMS

Abbreviation	Explanation/ Definition
LMS	Learning Management System
VLE	Virtual Learning Environment
VOOC	Vocational Open Online Courses
CTI	Cyber Threat Intelligence
PENTESTER	Penetration Tester
CIR	Cyber Incident Responder
KYPO	Know Your Platform Online (KYPO Cyber Range)
ISMS	Information Security Management System
ISO	International Organization for Standardization
SANS	SysAdmin, Audit, Network, Security Institute
NIST	National Institute of Standards and Technology
ICT	Information and Communication Technology

List of abbreviations and acronyms

LIST OF FIGURES