Next Generation Artificial Intelligence-Based Learning Platform
for Personalized Cybersecurity and IT Awareness Training:
A Conceptual Study

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Abstract- **The problem in cybersecurity and Information Technology (IT) awareness training is the inadequacy of traditional learning approaches in the field of computer science and cybersecurity education. These methods often struggle to provide personalized and adaptive learning experiences. Therefore, this conceptual study aims to explore the development of a next-generation learning platform for personalized cybersecurity and IT awareness training, focusing on the key aspects of content personalization and adaptive learning environments. The study explores the potential of using advanced technologies to enhance the learning experience and create adaptive environments that meet the individual needs of learners. In detail, we describe what constitutes a next-generation learning platform, the requirements and success factors, a possible architecture and system design, as well as the aspect of gamification and identification of player types for personalizing the learning environments.**

Keywords— Artificial Intelligence; next-generation learning platform; cybersecurit and IT awareness training.

I. INTRODUCTION

In today's rapidly evolving digital landscape, the demand for highly skilled computer scientists and cybersecurity professionals continues to grow. To meet this demand, it is critical to develop advanced learning platforms that effectively equip learners with the knowledge and skills they need. Traditional learning approaches often fall short when it comes to providing the personalized and adaptive learning experiences that are essential to meeting the diverse needs and learning preferences of individual learners. By harnessing the power of technology, there is an opportunity to create learning environments that can dynamically adapt to learners' needs, increase engagement, and maximize learning outcomes. This conceptual study seeks to explore the potential of such next-generation learning platforms and contribute to the advancement of cybersecurity education practices.

The field of computer science and cybersecurity is characterized by its fast-paced nature, requiring professionals to continuously update their knowledge and skills to stay ahead of emerging threats and technologies. Traditional education methods often struggle to keep up with the rapid changes in the field, making it imperative to explore innovative approaches to education and training. This study focuses on the development of next-generation learning platforms that leverage advances in technology, particularly in the areas of content personalization and adaptive learning environments. By tailoring the learning experience to the needs and preferences of individual learners, these platforms have the potential to significantly improve the effectiveness and efficiency of cybersecurity education and training. Through an in-depth review of existing literature, emerging trends, and best practices, this study aims to propose a conceptual framework for the design and implementation of such platforms, paving the way for future research and development in this critical area.

This paper is organized as follows. Section II reviews the specifications of a next-generation artificial intelligence-based learning platform. Section III describes the success factors and requirements for Artificial Intelligence (AI)-based learning. Section IV describes adaptive learning environments and personalization of learning content. Section V discusses a possible architecture and system design of a next-generation AI-based learning platform. Section VI deals with the addition of gamification elements according to predetermined player types. Section VII discusses cybersecurity and IT awareness training and a first version of a customizable learning environment prototype. Section VIII provides a summary and conclusion. Finally, Section IX provides an outlook on the next development steps.

II. SPECIFICATION OF A NEXT GENERATION ARTIFICIAL INTELLIGENCE-BASED LEARNING PLATFORM

Next-generation AI-based learning platforms are educational systems that use artificial intelligence technologies to enhance the learning experience for students. These platforms have several characteristics that set them apart from traditional learning environments. Here are some key features of next-generation AI-based learning platforms:

1. **Personalization of learning content:** AI enables these platforms to tailor learning content to each individual student's needs, abilities, and learning style. By analyzing data, about the student's past performance, preferences, and behavior, the platform can provide personalized recommendations, adaptive exercises, and targeted feedback. This personalized approach helps students learn at their own pace and focus on areas where they need improvement.

2. **Adaptive learning environments:** AI-based learning platforms create adaptive learning environments that dynamically adjust to the student's progress and provide appropriate challenges and support. The platform continuously analyzes the student's performance and adjusts the content, level of difficulty, and instructional strategies accordingly. This adaptivity ensures that each student receives an optimal learning experience, maximizing engagement and comprehension.

3. **Intelligent tutoring systems:** Next-generation learning platforms often include AI-powered intelligent tutoring systems. These systems can provide personalized guidance, answer student questions, and offer explanations tailored to individual needs. They can simulate one-on-one tutoring by understanding the student's strengths and weaknesses, diagnosing misconceptions, and providing targeted interventions to improve understanding.

4. **Data-driven insights:** AI-based learning platforms collect and analyze vast amounts of data about student performance, interactions, and learning patterns. This data can be used to gain insights into student progress, identify areas for improvement, and inform instructional decisions. Educators can use these insights to provide targeted support and interventions, track student progress over time, and make data-driven decisions to improve the learning experience.

III. SUCCESS FACTORS AND REQUIREMENTS OF AN AI-BASED LEARNING PLATFORM

We have scientifically identified the key success factors and requirements for an AI-enabled next-generation learning platform for cybersecurity and IT awareness training. These are:

Success Factor (SF) and requirement (Req) #1: High quality and trust in the information and data provided. Content quality at the highest expert level.

SF/Req #2: High user trust in data protection and in the handling of your personal data and information, as well as in the handling of your training and learning services. No blaming/shaming of users, but positive psychology and positive, inner motivational factors.

SF/Req #3: Highest effectiveness/efficiency/quality of didactics and teaching quality (learning gains, learning successes) for users and clients by using an AI-based next-generation learning platform for personalized learning and adaptive learning environments.

SF/Req #4: Relevance, Timeliness, and Timeliness. The content provided on the NG learning platform must be highly relevant to the needs of the user group and must be kept up-to-date on the latest threats, hazards, developments, and trends in cybersecurity and IT awareness on a daily basis.

SF/Req #5: Engaging and Interactive (UX-1). The platform should be engaging and interactive, using a variety of different learning formats and methods to best keep users interested and motivated.

SF/Req #6: Customization and Personalization (UX-2). The platform should be able to customize and personalize the learning experience based on the individual needs and preferences of each user.

SF/Req #7: Usability (UX-3). The platform should be easily accessible and user-friendly, with a user-friendly interface and a range of different learning formats and methods to accommodate different learning styles and player types.

SF/Req #8: Support and Resources: the platform should provide a range of support and resources to enable users to learn effectively, including guidance, gamification elements, feedback, and assessments.

SF/Req #9: Integration with other Systems: The platform should be able to integrate with other systems and tools, such as learning management systems, to provide a seamless learning experience.

IV. ADAPTIVE LEARNING ENVIRONMENTS AND PERSONALIZATION

In the context of adaptive learning environments and personalization of learning content, Artificial Intelligence (AI) can use various methods and techniques to customize the learning process for each individual learner. Below are some possible AI methods:

Adaptive Learning Paths: AI can be used to determine the optimal learning path for each learner based on their individual needs, prior knowledge, and learning styles. By analyzing data, such as learning history, test scores, and feedback, AI can provide personalized recommendations for the order and difficulty of learning content. This ensures that each learner learns at their own level and pace.

Adaptive content delivery: AI can help select and deliver the most relevant learning content for each learner. Based on the learner's interests, proficiency level, and preferred learning style, AI can apply algorithms to select appropriate content from a wide range of learning materials. This can increase learner motivation and engagement by providing them with content that is most relevant and interesting to them.

Automated assessment and feedback: AI techniques, such as machine learning and Natural Language Processing (NLP) can be used to automatically assess learning tasks, tests, or hands-on exercises. AI can analyze learners' responses and generate real-time feedback to identify errors, suggest improvements, and detect comprehension issues. This allows learners to receive immediate feedback and improve their performance.

Sentiment analysis and emotion detection: By analyzing user behavior, interactions, and communications on the platform, AI can use techniques, such as sentiment analysis and emotion recognition to understand the emotional state of learners. This information can be used to provide personalized support, such as targeted resources or activities to reduce frustration or maintain interest.

Chatbots and virtual assistants: AI-powered chatbots or virtual assistants can help learners with questions, problems, or for additional explanation. These systems can use natural language processing to provide human-like interactions and be available to learners 24/7 as needed.

It is important to note that these AI methods are not used in isolation but can be connected and integrated to create a

comprehensive adaptive learning environment that meets learners' individual needs.

V. ARCHITECTURE AND SYTSEM DESIGN OF A NEXT GENERATION AI-BASED LEARNING PLATFORM

The architecture of a next-generation AI-based learning platform can vary depending on specific requirements and design choices. However, here is a high-level overview of the components typically found in such platforms:

Frontend: The frontend is responsible for the user interface and user experience. It provides the interface through which learners, instructors, and administrators interact with the platform. Common technologies used for frontend development include Hypertext Markup Language (HTML), Cascading Style Sheets (CSS), JavaScript, and frameworks, such as React, Angular, or Vue.js. These frameworks provide flexibility, responsiveness, and rich interactive features.

Backend: The backend handles the server-side logic, data management, and integration with external services. It typically consists of several components, including:

- Web Server: A web server, such as Apache or Nginx, handles Hypertext Transfer Protocol (HTTP) requests and serves web pages and resources.
- Application Server: The application server manages the core functionality of the learning platform, including user management, content delivery, and data processing. Popular choices for backend frameworks and languages include Django (Python), Ruby on Rails (Ruby), or Node.js (JavaScript).
- Database: A database system is used to store and manage user data, learning content, assessment results, and other relevant information. Common options include MySQL, PostgreSQL, or MongoDB.
- APIs and Integrations: APIs facilitate communication and integration with external services, such as authentication providers, Learning Management Systems (LMS), content repositories, or analytics platforms.

Artificial Intelligence (AI) Components: The AI capabilities in the learning platform can be implemented using various algorithms and techniques. Some commonly used AI algorithms and technologies in this context include:

- Machine Learning: Supervised and unsupervised machine learning algorithms can be used for tasks, such as learner profiling, content recommendation, and performance prediction.
- Natural Language Processing: NLP techniques enable language understanding, sentiment analysis, chatbots, and automated feedback systems.
- Deep Learning: Deep learning algorithms, particularly neural networks, can be applied to tasks, such as speech recognition, image recognition, or natural language understanding.
- Recommender Systems: Collaborative filtering and content-based recommendation algorithms can be utilized to suggest relevant learning resources based on learners' preferences, behavior, and past interactions.
- Data Analytics: Data analysis techniques, including statistical analysis, clustering, and visualization, can be employed to gain insights from the large amounts of data generated by learners' interactions and performance.

Regarding **open-source tools**, here are some popular options:
- Frontend: HTML, CSS, JavaScript, React, Angular, Vue.js
- Backend: Django (Python), Ruby on Rails (Ruby), Node.js (JavaScript)
- Database: MySQL, PostgreSQL, MongoDB
- AI Libraries/Frameworks: TensorFlow, PyTorch, scikit-learn, NLTK (Natural Language Toolkit), spaCy, Apache Mahout.

These are just a few examples, and the choice of tools and technologies may depend on factors, such as the specific requirements of the learning platform, the development team's expertise, and scalability considerations. Remember that this is just a high-level overview, and the actual architecture and tool choices may vary depending on the specific needs and goals of the learning platform being developed.

The system design of a Learning Management System (LMS) for **university courses in computer science** must consider the specific needs of students, instructors, and administrators. Here is a suggested architecture and system design for such an LMS:

User roles and access levels:
- Students: Access course materials, submit assignments, participate in discussions, view grades.
- Instructors: Create and manage courses, upload content, grade assignments, interact with students.
- Administrators: Manage system settings, user accounts, course enrollment, and general system administration.

Frontend:
- User Interface (UI): Develop an intuitive and user-friendly UI for easy navigation and seamless interaction with the LMS. Ensure responsive design for cross-device accessibility.
- Course Dashboard: Provide a centralized dashboard where students and instructors can access their respective courses, announcements, and notifications.
- Course Content: Display course materials, lecture slides, videos, code samples, and additional resources in an organized manner.
- Discussion forums: Enable students and instructors to engage in online discussions, ask questions, and share insights.
- Assignment submission: Provide an interface for students to submit assignments, view due dates, and receive feedback.
- Grading and Feedback: Allow instructors to grade assignments, provide comments, and share feedback with students.
- Progress Tracking: Include features to track student progress, completion of course modules, and overall performance.

Backend:

- User Management: Implement user authentication, registration, and profile management functionality.
- Course Management: Develop features for instructors to create, manage, and organize course content, modules, and assessments.
- Data storage: Set up a database system to store user profiles, course data, assignments, grades, and other relevant information.
- Content delivery: Efficiently deliver multimedia course content, such as videos and code samples, while ensuring scalability and performance.
- Collaboration tools: Implement features for collaborative project work, such as group creation, shared documents, and version control.
- Notifications: Enable automated notifications of important updates, deadlines, and announcements.
- Analytics and reporting: Incorporate data analytics to generate reports on student performance, course engagement, and learning outcomes.

Integration:

- External Tools and Services: Integrate with external tools, such as plagiarism detection systems, virtual lab environments, and online coding platforms.
- Learning Standards: Support integration with learning standards, such as Sharable Content Object Reference Model (SCOM) to import and export course content.

Security and privacy:

- Implement strong user authentication and data encryption mechanisms.
- Ensure role-based access control and privacy compliance.
- Regularly update and patch software to address security vulnerabilities.

Scalability and Performance:

- Design the system with scalability in mind to accommodate growing numbers of users and courses.
- Use caching mechanisms, load balancing, and efficient database design to ensure optimal performance.

It is important to note that the proposed architecture and system design are high-level guidelines. Actual implementation may require further analysis, considering factors, such as specific institutional requirements, technical constraints, and integration with existing systems. Collaboration with stakeholders, faculty, and students throughout the design and development process can provide valuable insights to effectively tailor the LMS to their needs.

VI. GAMIFICATION AND 6 PLAYER TYPES

With the advent of gamification - the use of game elements in non-game contexts - the HEXAD model was developed by Marczewski [4]. The HEXAD model distinguishes six different types of gamers [4]:

Intrinsically Motivated Types: 4

Relatedness (Socialisers): Socialisers are motivated by relationships. They want to interact with others and create social connections.

Autonomy (Free Spirits): Free Spirits are motivated by autonomy and self-expression. They want to create and explore.

Mastery (Achievers): Achievers are motivated by excellence. They are out to learn new things and improve themselves. They seek challenges that they can overcome.

Purpose (Philanthropists): Philanthropists are motivated by purpose and meaning. This group is altruistic and wants to give to others and enrich the lives of others in some way without expecting a reward.

Extrinsically Motivated Types: 1

Players: Players are motivated by rewards. They do what is what they are asked to do, in order to collect rewards from a system. system. They are only in it for themselves.

Change-Oriented Types: 1

Disruptors: Disruptors are motivated by change. In general, they want to disrupt systems, either directly or with the other users to force positive or negative change. or negative changes.

The determination of HEXAD Gamification User Types is based on the use of a specially developed questionnaire, the HEXAD Gamification User Types Questionnaire [4]. This questionnaire was developed by Marczewski and his colleagues and is an important part of the HEXAD framework.

The HEXAD User Types Survey consists of a series of questions that address the specific characteristics and motivations of the six HEXAD player types. The questions are designed to be answered on a five-point Likert scale ranging from "strongly agree" to "strongly disagree."

The responses to these questions are then analyzed quantitatively to determine which HEXAD gamification user type a user is likely to be.

The work "The Gamification User Types HEXAD Scale" by Tondello et al. is an important addition to HEXAD theory and has contributed to the development and validation of the HEXAD User Types Survey [5]. The study strengthens the theoretical basis of the HEXAD model and provides empirical evidence of its validity. To validate the HEXAD User Types Scale, Tondello and his team conducted several studies [5]. The scale serves as a measurement tool to identify and quantify the six user types. The authors were able to show that their research results confirmed the existence of the six player types and demonstrated the effectiveness of the questionnaire in measuring them. The size of the questionnaire could be reduced from 30 to 24 questions, with comparable accuracy of the results.

In addition, the work provides valuable insight into the relationships between the different player types. For example, the results show that Philanthropists and Achievers often exhibit positive correlations, suggesting that users who are identified as one of these gamer types are also likely to exhibit characteristics of the other.

This is consistent with Marczewski's observations that people cannot be reduced to simple individual player types and exhibit these characteristics to varying degrees [4].

In April 2023, HEXAD-12, a shortened version of the original HEXAD-Scale questionnaire, was released [7].

HEXAD-12 addresses the challenges posed by the extensive 24-question questionnaire of the original scale, such as high dropout rates and participant fatigue. By reducing it to 12 questions, HEXAD-12 provides a more efficient and compact tool for assessing user types in gamification, particularly suited for limited interaction modalities, such as on mobile devices. Despite its brevity, HEXAD-12 retains a reliability and validity comparable to or better than the original HEXAD scale.

Importantly, a user's player type is not static. Marczewski emphasizes that users change between different player types depending on context, environment, and over time [4]. Therefore, determining user type should be viewed as a continuous process that requires regular iterations of the HEXAD User Types Survey requires.

An important finding is the practical applicability of the HEXAD Player types for the design of gamification applications. Through the player types of a user, designers can better understand what motivates their better understand what motivates their users, and create appropriate, individually tailored experiences. By knowing the dominant player type player type of a user, gamified features can be better tailored to individual needs and preferences better, leading to increased user engagement [6].

VII. CYBERSECURITY AND IT AWARENESS TRAINING

Cybersecurity and IT awareness [Definition]: IT and cybersecurity awareness mean problem awareness and secure behavior. In everyday dealings with IT systems, awareness is an elementary security measure. First, this means creating an awareness of the problem of cyber security attacks and threats. Building on this, it is possible to achieve a change in behavior toward secure digital use. Security awareness measures are successful if they empower the target groups and motivate individuals to improve their cyber security. It is important to develop awareness at eye level and in a practical manner [1].

As a first step towards a next-generation learning platform, we have implemented an IT Awareness Learning Platform with an AI chatbot as a demonstrator and prototype:

An AI-based learning chatbot is an intelligent, speech- or text-based dialog system that allows chatting with an artificial intelligence. Such an AI-based learning chatbot is to be used and tested for the first time as part of an IT awareness training for the basic sensitization of employees.

The AI chatbot delivers the most relevant IT awareness content to the learner in a simple and sometimes even playful dialog. The AI chatbot breaks down the knowledge into small "bites" and delivers them to the user one at a time.

The IT awareness learning platform with AI chatbots delivers expert knowledge on IT awareness and cybersecurity to specific target groups: Low-threshold, "in small bites", "for in between".

The user controls the AI learning chatbot through his questions, choices and selections.

The following topics are already included in the current IT Awareness Learning Platform with AI Chatbots and optimized for recognition rates above 75%:

TABLE I. SUBJECT MATERIALS

Malware	Phishing	Secure handling on the web	Good and secure passwords
Social engineering	Data protection on the web	Blackmail Trojan	Computer viruses
Spying on data	Botnets and DDoS attacks	Cyber and computer crime	Voice assistants
Hacking - my online bank data on the web	Industrial and commercial espionage	Cyberbullying and cyberstalking	Fake stores, fraud, subscription traps
Skimming	ICT criminal law	Sexting on the web	Catfishing

AI-based IT awareness training begins with a user self-assessment, placement and player type test based on the knowledge level of the individual participant. This takes into account the user's strengths and weaknesses, as well as their individual player type, and ensures that the training is tailored to the individual.

According to the player's type, the user is then offered suitable gamification elements so that the user receives a personalized offer. Thus, a first version of a customizable learning environment was prototypically realized for a cybersecurity and IT awareness training.

VIII. CONCLUSION

Individualized learning paths: In IT awareness and cybersecurity training, learners come from diverse backgrounds and have varying levels of technical knowledge. Our next-generation learning platform can personalize learning content based on each learner's existing skills and knowledge. This ensures that beginners receive basic concepts while advanced learners are exposed to more sophisticated cybersecurity topics, resulting in optimized learning outcomes.

Adaptive learning environment: Cybersecurity threats are constantly evolving, making adaptability a critical skill. Our learning platform uses adaptive learning environments that dynamically adjust the difficulty and complexity of content as learners progress. This approach ensures that cybersecurity professionals stay up-to-date on the latest threats and defense strategies, reducing the risk of cyber incidents.

Data-driven learning insights: The next generation learning platform generates rich data analytics and insights into learner progress and performance. In IT awareness and cybersecurity training, these analytics provide valuable information about learners' strengths and weaknesses, enabling trainers to effectively personalize their support and interventions, resulting in better skills development.

Gamified Learning Experience: Cybersecurity training can be complex and technical, which can disengage some learners. By incorporating gamification elements, such as points, badges, and leaderboards, our platform makes the learning process engaging and fun. Gamification encourages

learners to stay motivated, track their progress, and strive for continuous improvement.

Flexibility and distance learning: In the fast-paced world of IT and cybersecurity, professionals may have limited time for training. Our platform offers flexible learning options that allow learners to access training materials anytime, anywhere, and at their own pace. This flexibility accommodates busy schedules and remote work arrangements, making it convenient for cybersecurity professionals to continually improve their skills.

In summary, a next-generation learning platform is uniquely suited for IT awareness and cybersecurity training due to its personalized content delivery, adaptive learning environment, and data-driven insights.

IX. OUTLOOK

In the future, other valuable additions to the Next Generation Learning Platform should include the following features:

The learning platform should include realistic threat simulations that allow students to engage in simulated cyberattacks in a safe environment. This hands-on experience strengthens their ability to effectively identify and respond to security threats, preparing them for real-world situations.

Certification and Recognition: In the IT and cybersecurity industry, certifications carry significant value and can enhance career opportunities. Our learning platform prepares learners for industry-standard certifications, giving them the knowledge and skills, they need to gain professional recognition and excel in their cybersecurity careers.

ACKNOWLEDGMENT

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