HOW TO TEACH PRIVACY: ASSESSMENT OF INNOVATIVE LEARNING APPROACHES FOR UNDERGRADUATE STUDENTS

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ABSTRACT

The demand for privacy specialists is expected to increase, but there is a shortage of them to meet market demands. Certain ICT skills and competencies are required for professionals who develop, manage, and protect data that drive the digital world. The current study explores undergraduate students' attitude about different teaching strategies utilized in a newly developed course Privacy and personal data. A study using the revised Bloom's taxonomy and semantic differential measurement technique found that students were generally satisfied with course design and used teaching strategies. Students preferred the activity evaluation of cookie policies the most, thereby they grant the highest marks in five adjectives: useful, necessary, adequate, motivating, and facilitates the subject's learning outcomes. The most challenging activity for them was the creation of project tasks, while the most interesting was looking for examples of privacy breaches. Complex tasks were considered more challenging, but students showed slightly less motivation in solving them.

KEYWORDS

Privacy, Perception, Methods, Course, Students, Bloom's Taxonomy

1. INTRODUCTION

Demand for individuals with complex privacy expertise is likely to outstrip supply, creating a global need for advanced experts in an already limited pool (PwC, n.d.). The number of cybersecurity job openings worldwide has increased from 1 million in 2013 to 3.5 million by 2021 (Cybersecurity Ventures, 2021) but the gap between demand and supply is expected to persist until at least 2025 (Morgan, 2023).

Since the profession of teaching privacy is still largely undefined, it is useful to research what kind of expertise and skills employers are looking for. The European Cybersecurity Skills Framework (ECSF) defines 12 profiles to develop a common understanding of the roles, competencies, skills, and knowledge for individuals, companies, and training providers (ENISA, 2022). The NIST Privacy Framework (NIST, 2020) outlines privacy practices for organizations, consisting of three components: Core, Profiles, and Implementation Tiers, where each element strengthens privacy risk management by linking organizational roles, responsibilities, and privacy protection actions. Future privacy specialists should comprehend psychology, ethics, and technology-related legal skills in addition to STEM knowledge (PwC, n.d.). Therefore, it is important to mention the E-Competence Framework (HRN EN 16234-1:2019, 2019) which introduces transferable skills that can be applied to any ICT competency. In the age of IoT, AI, and Industry 4.0, transfer skills are required in all ICT-related operations. The fact that two of the seven stated transversal factors are security and privacy demonstrate the significance of this expertise. The Skills Framework for the Information Age (SFIA) provides a list of skills that are most relevant to a variety of professional disciplines, industry topics, and complementary frameworks through several views (SFIA Foundation, n.d.). Information and cyber security is one point of view, which includes skills such as information security, enterprise and business architecture, governance, risk management, audit, information assurance, continuity management, vulnerability assessment, digital forensics, penetration testing, research, and personal data protection.

Given the growing demand for privacy professionals and the sophistication of modern cyber threats, it's imperative to establish robust educational programs that equip future experts with the skills and knowledge needed to combat these challenges. To guarantee that privacy professionals have the essential knowledge and abilities, educational programs must be carefully designed. Student motivation should be a central focus in the learning process to encourage active engagement. Effective educational program design requires careful consideration of teaching strategies and task complexity to foster active learning participation. The purpose of this research is to investigate how students view the learning approaches taken to teach privacy-related subjects. To address this issue, the study research questions were placed:

- Q1: What are students' perceptions of the methods used to teach privacy related topics?
- Q2: Is there a difference in the perception of methods depending on the complexity of the tasks?

2. LEARNING PROCESS

Bloom et al. (1956) proposed a taxonomy of learning objectives which should provide a classification of the goals of education systems. Learning encompasses the cognitive, affective, and psychomotor domains. The cognitive domain comprises learning objectives, which are concerned with the recall or recognition of knowledge, as well as the development of intellectual abilities and skills. The affective domain includes learning objectives that explain changes in interest, attitudes, and values. The third domain focuses on manipulative or motor skills. The original Taxonomy provided definitions for each of the six major categories in the cognitive domain. The categories were Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation. The categories were ordered from simple to complex and from concrete to abstract. Cognitive domain includes activities like remembering and recalling knowledge, thinking, problem solving and creating.

Anderson and Krathwohl (2001) proposed revision of Bloom's cognitive domain (they proposed Bloom's Revised Taxonomy). Six categories were kept, although with some significant modifications. In order to better align with their usage in the objectives, three categories underwent renaming, two were rearranged in terms of order, and the titles of the remaining categories were converted to verbs. The original Knowledge category's verb aspect was retained, but it was renamed Remember. The second of the original categories, comprehending, was renamed Understanding. The terms Application, Analysis, and Evaluation were kept, but they were expressed as Apply, Analyze, and Evaluate in their verb forms. Synthesis was renamed Create and swapped positions with Evaluation.

In addition to adding action words to increase usability, Bloom's Revised Taxonomy also included a cognitive and knowledge matrix that listed four levels of knowledge or products that could be processed (Krathwohl, 2002):

- Factual: the basic concepts that students need to understand in order to solve problems or get familiar with a subject.
- Conceptual: The connections between the fundamental components of a bigger structure that allow them to work as a unit.
- Procedures: How to accomplish purposes, how to undertake research, and rules for applying skills, algorithms, techniques, and methods.
- Metacognitive: Awareness and understanding of one's own cognition in addition to generic cognition information.

Cognitive complexity provides a significant viewpoint on task complexity (Urgo et al., 2019). The cognitive complexity of a task is determined by the type (and diversity) of mental activity necessary to perform it.

Learning is a comprehensive model that defines the learning process thru five aspects/dimensions (Marzano and Pickering, 2011): (1) attitudes and perception, (2) acquire and integrate knowledge, (3) extend and refine knowledge, (4) use knowledge meaningfully, and (5) habits and mind. All learning occurs in the context of learners' attitudes and perceptions (Dimension 1), as well as the application (or lack thereof) of positive habits (Dimension 5). Students with unfavorable attitudes towards learning are less likely to learn well. Positive attitudes and beliefs lead to easier and more effective learning. Positive attitudes and habits of mind lead to more effective thinking in Dimensions 2 and 3, which include acquiring and integrating knowledge, extending and refining knowledge, and using knowledge meaningfully (Dimension 4).

2.1 Teaching Strategies

Teaching and learning have evolved over time as a consequence of the emergence of new forms of delivery, such as blended and hybrid learning, as well as innovative pedagogical approaches such as project-based learning (Guo et al., 2020), problem-based learning (Savery, 2006), work-based learning (Rienties et al. 2023), inquiry-based learning and utilizing artificial intelligence in education (Feng and Law, 2021). Since the student is the main focus of curriculum development and teaching in a modern learning approach, educators have a major responsibility to include appropriate teaching and learning strategies and meaningfully use technology to help students achieve learning outcomes. With the widespread use of computers and digital technologies, online information seeking is becoming more incorporated into students' learning experiences (Mao et al. 2022). Table 1 introduces teaching strategies according to Bloom's revised taxonomy (Anderson and Krathwohl, 2001).

Table 1. Teaching strategies according to Bloom's revised taxonomy (Anderson and Krathwohl, 2001)

	LOWER ORDER THINKING			HIGHER ORDER THINKING		
Bloom's taxonomy	Knowing or remembering	Comprehending or understanding	Applying	Analyzing	Synthesizing or evaluating	Creating
Teaching strategies	Examples, illustrations, visuals, lecture, video	Discussion, questions, review, test, reports, exercises	Demonstration, practice, presentations, projects, role play, micro-teach	Problem solving, case studies, critical incidents, discussion, questioning, test	Projects, problem solving, case studies, plan development, constructing, simulations	Simulations, critiques, complex case study, design or development, product generation, producing

Online information searching provides diverse knowledge, but it also increases cognitive strain due to the enormous amount of information available online. People search for information to help their learning and to suit their information demands, either by adding new knowledge or restructuring current knowledge (Wu et al., 2018). Consequently, these searches help them produce better learning outcomes, such as assignments, presentations, and discussions (Chen et al., 2022), however, it must be noted that learning is a crucial result of search (Urgo and Arguello, 2022). The phrase "search as learning" (SAL) emphasizes the learning part of exploratory search with the purpose of understanding, which may lead to knowledge growth (von Hoyer et al., 2022). With SAL activities, learners spend time in an open, constantly evolving digital information environment through which they must effectively navigate in order to learn without or with minimal instruction. Unlike some other kinds of searches (Roy et al., 2020), those searches are usually iterative and necessitate the user to scan, read, and process a big number of documents. However, prior study (Froyd and Simpson, 2018; Kyndt et al., 2011) on the student-centered learning strategy was not always positive, emphasizing that such learning is only effective if it is properly approached. To be effective Smith et al. (2022) argue that a search-centric learning system must model four key components: individual students (searcher factors), the educational domain (topic factors), academic assignments (task factors), and progress toward learning goals (the end-to-end system's objective function).

3. METHODOLOGY

The current study explores undergraduate students' perception about privacy teaching strategies utilized in a newly developed course. To find out how students taking the course Privacy and Personal Data felt about teaching strategies, a survey was given to them. Table 2 shows a description of the tasks completed during the laboratory exercises. Teaching strategies are assigned to each activity according to Bloom's revised taxonomy (Anderson and Krathwohl, 2001).

Table 2. Description of laboratory exercise activities and teaching strategies

Activity	Task description	**Teaching strategies**
Job description of a privacy expert	List the job titles, education, required skills and knowledge, demand and average salary for privacy experts.	**Search for examples**
Examples of privacy breach	Examine 5 examples of privacy breach at a specific company, focusing on the type of data taken, the amount stolen, and the damage done.	**Review examples**
Identification and categorization of personal data	Choose three services used through websites, mobile apps/platforms, and direct contact, and define the types of personal data processed and the category (ordinary or special) they belong.	**Problem solving**
Analysis of privacy policies	Analyze three privacy policies and assess whether or not are they well-made, according to the „Guide - How to create a privacy policy“.	**Problem solving, review**
Privacy certification programs	Describe information about privacy certification programs for individuals, organizations and process.	**Review**
Thinking about punishments	Choose three laws of the Republic of Croatia that deal with any domain (health, education, etc.) and extract from each law the provisions related to the protection of personal data.	**Problem solving, review**
Request for exercising the rights	Assess the rationale behind the application of the two given requests for data access and right exercise (laws used), and give your opinion.	**Problem solving, critiques**
Organizational/technical protection measures	Recommendation of appropriate protection measure.	**Problem solving**
Correct/incorrect cookie policy examples	Evaluation of cookie policy.	**Problem solving**
Consent or approval	Comparation of various types of consent.	**Problem solving, critiques**
Project task	Design the campaign for raising privacy awareness.	**Design/development**

3.1 Data Collection and Data Analysis

A survey was conducted among 45 out of 50 students enrolled in the course Privacy and personal data during their third year of undergraduate studies. The survey included 20 questions grouped into four sections: (1) lecture organization, (2) laboratory exercise structure, (3) project assignment, and (4) student recommendations for improvement. The survey was available in Croatian and took approximately 10 minutes to complete. The research aimed to gather feedback on teaching strategies, the effectiveness of student knowledge assessment methods, and potential improvements in course content and teaching methods.

In order to determine respondents' attitudes regarding used teaching strategies, the semantic differential measurement technique was employed. The semantic differential scale is a rating scale that measures people's reactions towards a specific concept using contrasting adjectives at each end. It measures the perceived gap between opposite concepts to provide better insight into the attitudes of the respondents about the certain topic (Heise, 1970).

Students were asked to use a five-point scale to rate each activity used as a knowledge assessment method with respect to the following seven categories with contrasting adjectives:

- Useless | Useful,
- Unnecessary | Necessary,
- Inappropriate | Appropriate,
- Unchallenging | Challenging,
- Demotivating | Motivating,
- Boring | Interesting,
- Not Facilitating the subject's learning outcomes | Facilitates the subject's learning outcomes.

For example, on a created semantic differential scale, a student scoring one on a five-point scale for the category „Useless | Useful“ indicates that he finds these activities strongly useless, whereas a rating of five indicates that he/she finds them strongly useful, and so on. Based on the survey data, a semantic differential analysis was made for the laboratory exercises' activities. The aim was to see if there is a significant difference between the activities performed in the exercises.

4. RESULTS

Figure 1 displays the results of the semantic differential measurement technique based on averaged evaluation score of contrasting adjectives for teaching strategies applied in laboratory exercises.

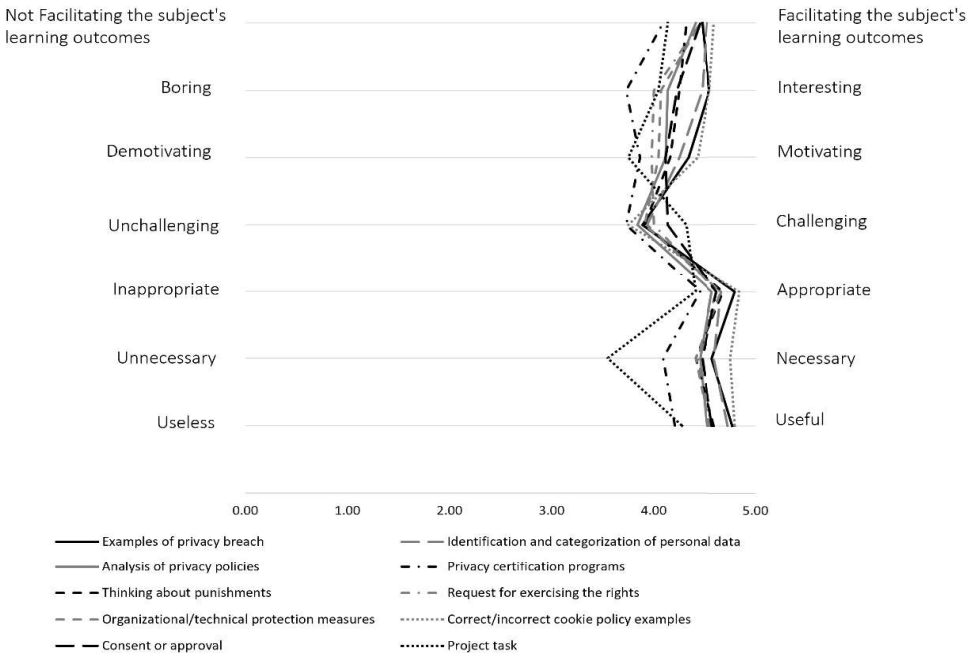

Figure 1. Results of semantic differential measurement technique for laboratory exercise activities

It can be seen that the curves are shifted to the right, with average grades ranging between 3.5 and 4.8 for observed attributes. This indicates very high ratings for the laboratory exercise activities that were carried out, showing that students were generally satisfied with the structure of laboratory exercises. The point that pops up is related to the “Project task” activity which the students thought was somewhat less necessary and useful for the successful acquisition of knowledge and skills in the subject, but on the other hand student marked this strategy as the most challenging.

Mostly all the activities were rated with very high grades, only a slight shift towards a lower rating can be seen in the aspect of challengingness of the tasks. It is interesting to notice that the students preferred the activity „Correct/incorrect cookie policy examples“ the most, thereby achieving the highest marks in five adjectives: useful (M=4.80), necessary (M=4.75), adequate (M=4.84), motivating (M=4.43), and facilitates the subject's learning outcomes (M=4.59). The most challenging activity for them was the creation of project tasks (M=4.32), while the most interesting (M=4.55) was looking for examples of privacy breaches.

The activity that received the lowest marks according to the criteria of useful (M=4.20), interesting (M=3.73) and facilitating the learning outcomes of the subject (M=4.09) is related to the task of searching information about privacy certification programs. The students rated the creation of the project assignment as less necessary (M=3.55) and adequate (M=4.41) for achieving the learning goals, and as it was an activity at the end of the semester, it was rated somewhat less motivating (M=3.75). The least challenging (M=3.66) activity for them was searching for a job description of a privacy expert.

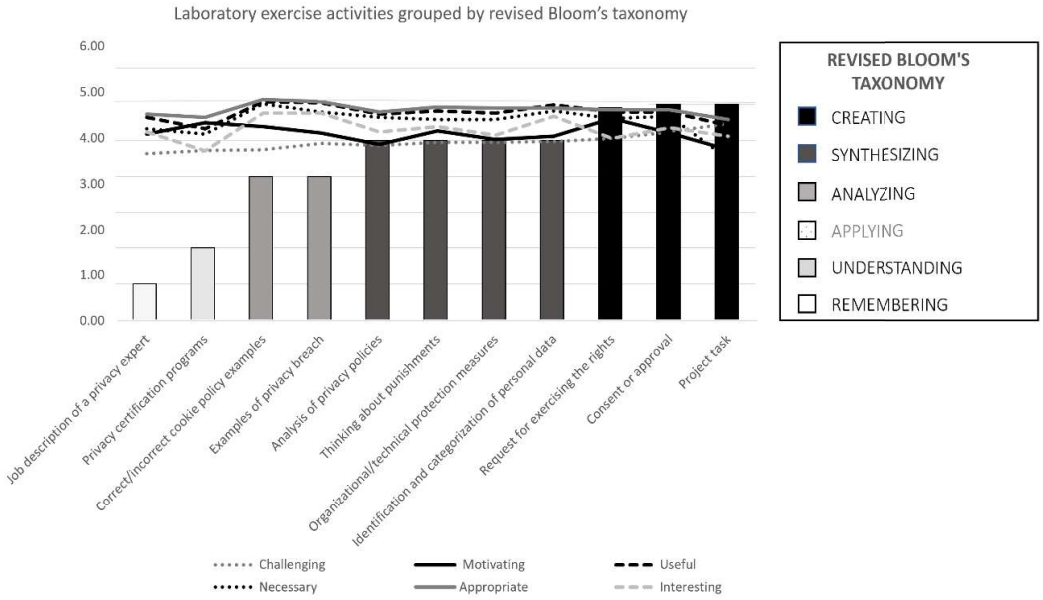

Figure 2. Results of semantic differential measurement technique with activities grouped by revised Bloom's taxonomy

Result presented in Figure 2 demonstrate that there was no difference of perception of activities regarding to complexity of utilized teaching strategy (by revised Bloom's taxonomy), although the perception of activity challenge is slightly raising with complicity of teaching strategy (project task is the most challenging). Also, it can be concluded that student's motivation is constantly high regardless of teaching strategy complexity.

5. DISCUSSION AND CONCLUSION

In today's digital world, where personal data has become a valuable asset, the problem of privacy is becoming increasingly important. Privacy has an unbreakable connection with our safety and well-being. By protecting our privacy, we can create a more secure and fair society. Protecting personal data safeguards us against identity theft, fraud, and other cybercrimes that can have fatal consequences. To properly address these difficulties, it is critical to understand how privacy is learned and efficiently promoted among individuals.

Teaching privacy is crucial in today's technology-driven world for protecting students' personal information, promoting safe online behavior, preparing them for the workplace, encouraging critical thinking, and empowering them (Sharma, 2022). Course design should focus on teaching strategies that foster students' critical reflection on the covered topics, keeping in mind that the quality of student learning is influenced by a complex interplay of factors, including student and teacher attributes, the educational setting, and educational regulations (Sánchez-Cabrero et al., 2021).

The degree to which a student perceives a task to be difficult influences how they will approach it. In terms of self-regulated learning, students' perceptions of task complexity can either motivate them to use existing knowledge to solve the problem or discourage them from trying (Winne, 2018; Mangos and Steele-Johnson, 2001). Our research shows that there was no variation in perception of activities based on the complexity of the used teaching strategy, although the impression of activity challenge increased slightly with teaching strategy complicity. The mentioned conclusions can be related to earlier studies which implicate that task difficulty increases when a student perceives the task as unfamiliar (Garcia-Ponce et al., 2022) or too complex to solve (Nawaz et al., 2020). Another crucial component is students' prior knowledge, as students with stronger self-regulated learning skills are better at recognizing and solving complicated problems (Koivuniemi et al., 2017). Awwad (2019) demonstrated that students are capable of categorizing more challenging tasks as more difficult.

In terms of future privacy education, privacy challenges brought by rapidly evolving technologies cannot be addressed by traditional methods alone; novel approaches must be used (Anastopoulo and Gressette, 2010). Our research can be related with Sharma (2022) proposition that most effective ways to teach students digital privacy are: (1) interactive workshops, (2) online resources that can be accessed any time, (3) role-playing exercises to practice privacy techniques, (4) guest speakers to share real-world knowledge, and (5) collaborative learning to develop recommendations for privacy protection. Indeed, our study demonstrated that promoting student discussion and employing engaging resources and content had a major impact on students' willingness to learn. Our course design which includes teaching strategies like search for examples, review examples, critiques, problem solving and design/development is perceived by students as good model to learn privacy.

We have a lack of people capable of creating organizational methods to secure users' privacy and collected information where most personnel in charge lack the requisite expertise. The practical implications of our study suggest that effective teaching approaches can be achieved by creating engaging and interesting tasks while balancing different complexity levels. Teaching and learning are dynamic processes that require ongoing adaptation to new possibilities and difficulties therefore our study can present model that can be used in teaching complex domain like privacy which must include also other domains like technology, legal rules, and safeguarding specific user rights. Our research can significantly contribute to the improvement of higher education in this field. The results can be used to adapt curricula, develop new teaching materials and methods, and better understand the learning process. To effectively promote privacy education, it is essential to consider the social, cultural, and technological contexts in which young people learn. Future research should focus on developing effective teaching strategies and assessing the long-term impact of privacy education programs.

This study is limited by the relatively small sample size and its homogeneity (students from one faculty). While the results showed interesting trends, caution should be exercised when generalizing the findings to a larger population. Future research should include a larger and more representative sample to confirm the results of this study, also it would be interesting to compare the results of the perception of students from different faculties.

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