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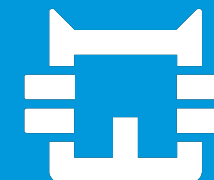
An Assessment Framework for Serious Games Focused on Cybersecurity

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OSCAR
CODING CAMPS

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Introduction (1/2)



- In a rapidly evolving landscape of cyber-risks, **cybersecurity education becomes crucial** at all ages
- Several strategies -- **coding camps**: immersive, hands-on, collaborative
- One effective strategy is to have participants design and develop **serious games** focused on cybersecurity



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Introduction (2/2)



- Lack of specific methods to comprehensively evaluate students' outcomes
 - dual mission of serious games -- educational objectives and entertainment
 - early-stage development of the serious games created during the limited time of a coding camp



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RQ: *How can we evaluate early prototypes of serious games focused on cybersecurity, considering both their serious and game aspects?*



Methodology: the assessment framework



- It evaluates early prototypes of serious games focused on cybersecurity -- a dashboard provides instructors with a comprehensive overview of students' learning outcomes
- Three key components
 - overall quality of the serious game
 - domain representation
 - balance between these two aspects



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Methodology: the assessment framework



Serious game features (Table 1 - extract)

Criteria	Group	Definition	Values / Notes
Learning objective	/	Presence of an educational goal of the serious game	Yes: the learning goals has been defined, even if it may be too broad or not ideal for the target audience. No: otherwise.
Target audience	/	Characteristics of the final users for whom the game was designed	A: age is specified, but skills/expertise are not mentioned. B: both age and skills/expertise are specified. C: neither age nor skills/expertise are specified. D: age is not specified, but skills/expertise are specified.
Storytelling	Game mechanics	Presence of a storyline in the game	Yes: the game is embedded within a meaningful context that conveys a narrative framework, even if the storyline is not explicitly written or detailed. No: otherwise.
Levels		Presence of different levels in the game	Yes: at least 2 levels are defined. No: otherwise.
Points/Score		Presence of a clear progression mechanics in the game	Yes: a scoring system is adopted. It does not need to be complex; however, it should provide players with feedback to understand whether an action is correct or incorrect. No: otherwise.
Characters		Presence of one or more characters having different roles in the game	Yes: one or more characters have been defined; their roles may not be clearly defined in the context of the game. No: otherwise.



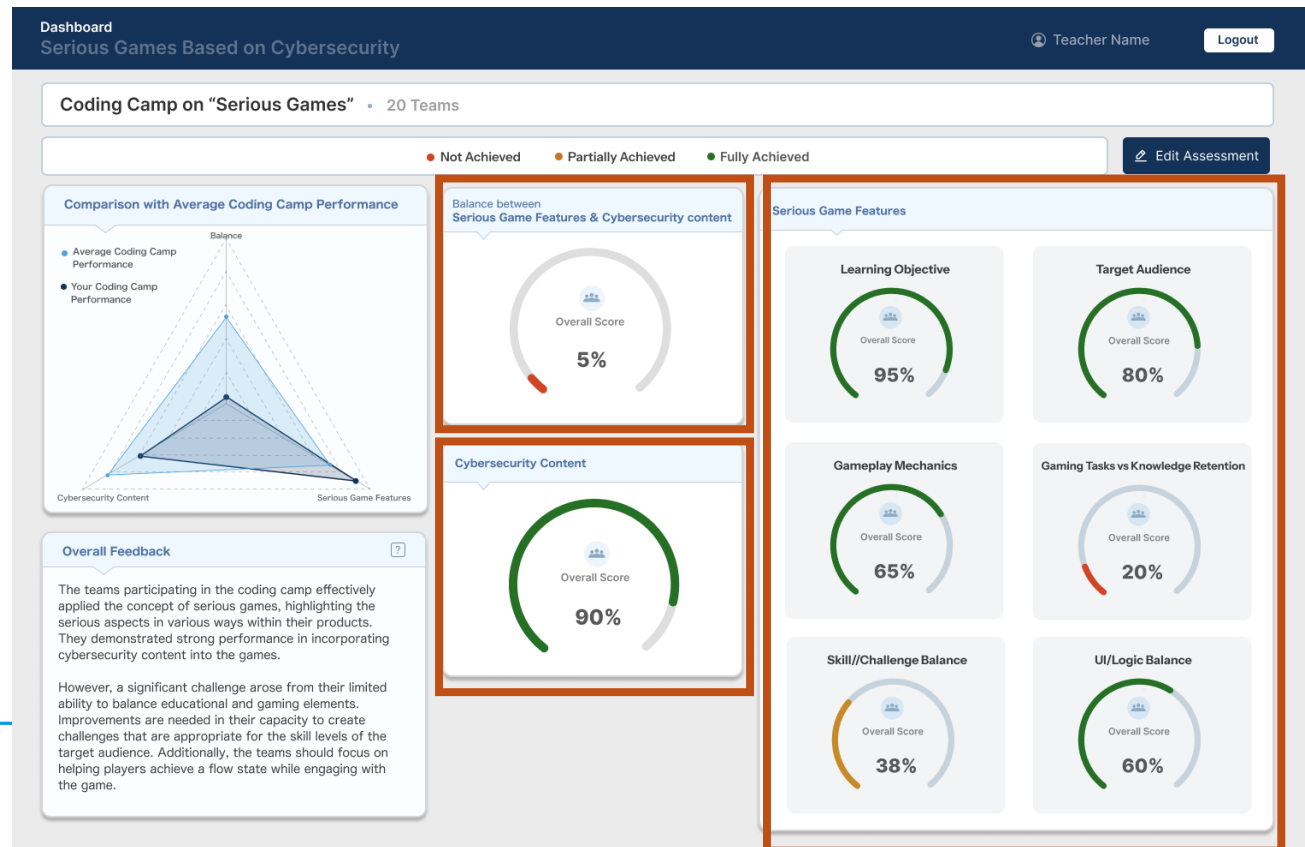
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Methodology: the dashboard



Three sections, one for each component of the assessment framework



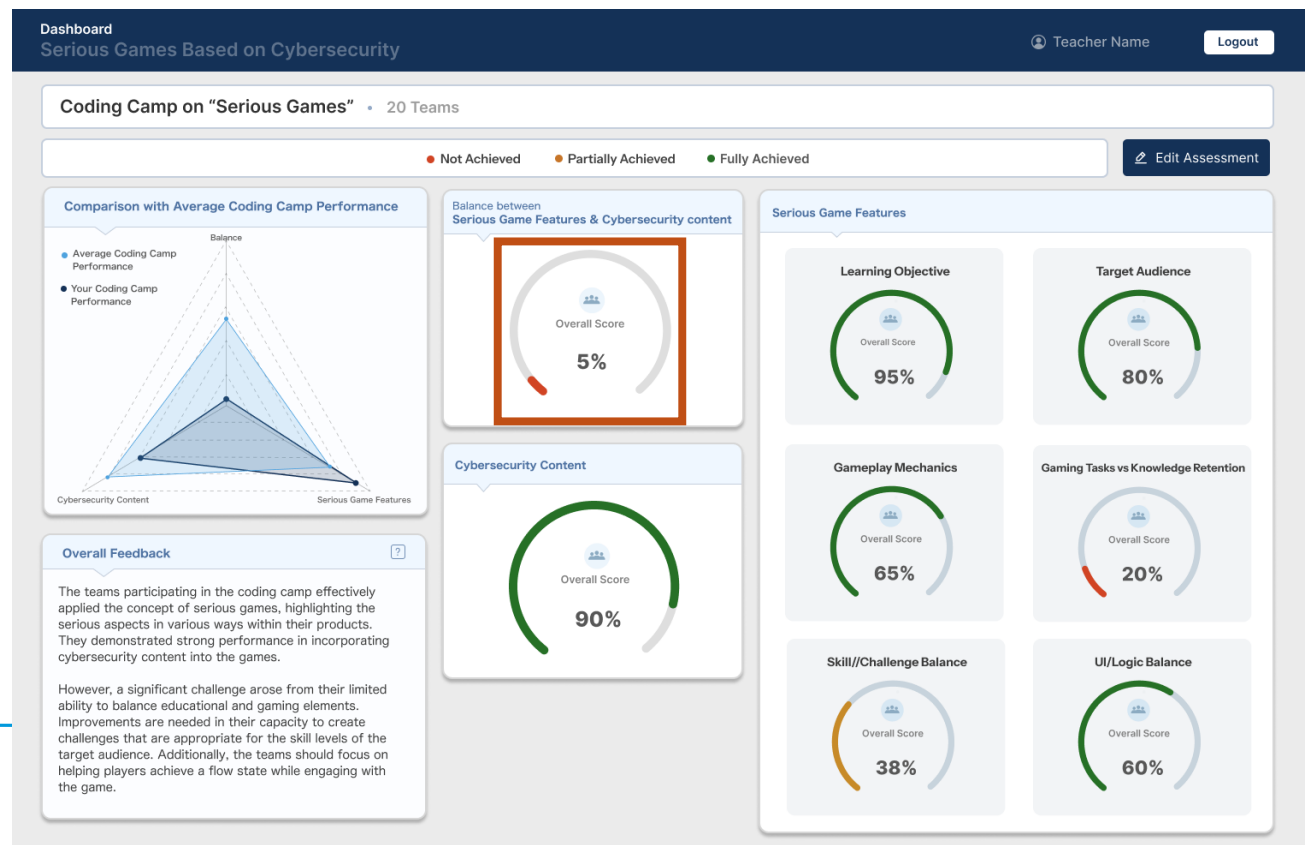
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Methodology: the dashboard



One gauge for each criterion -- percentage of teams that received a positive assessment for the criterion

- >60%: green
- <30%: red
- Otherwise: yellow



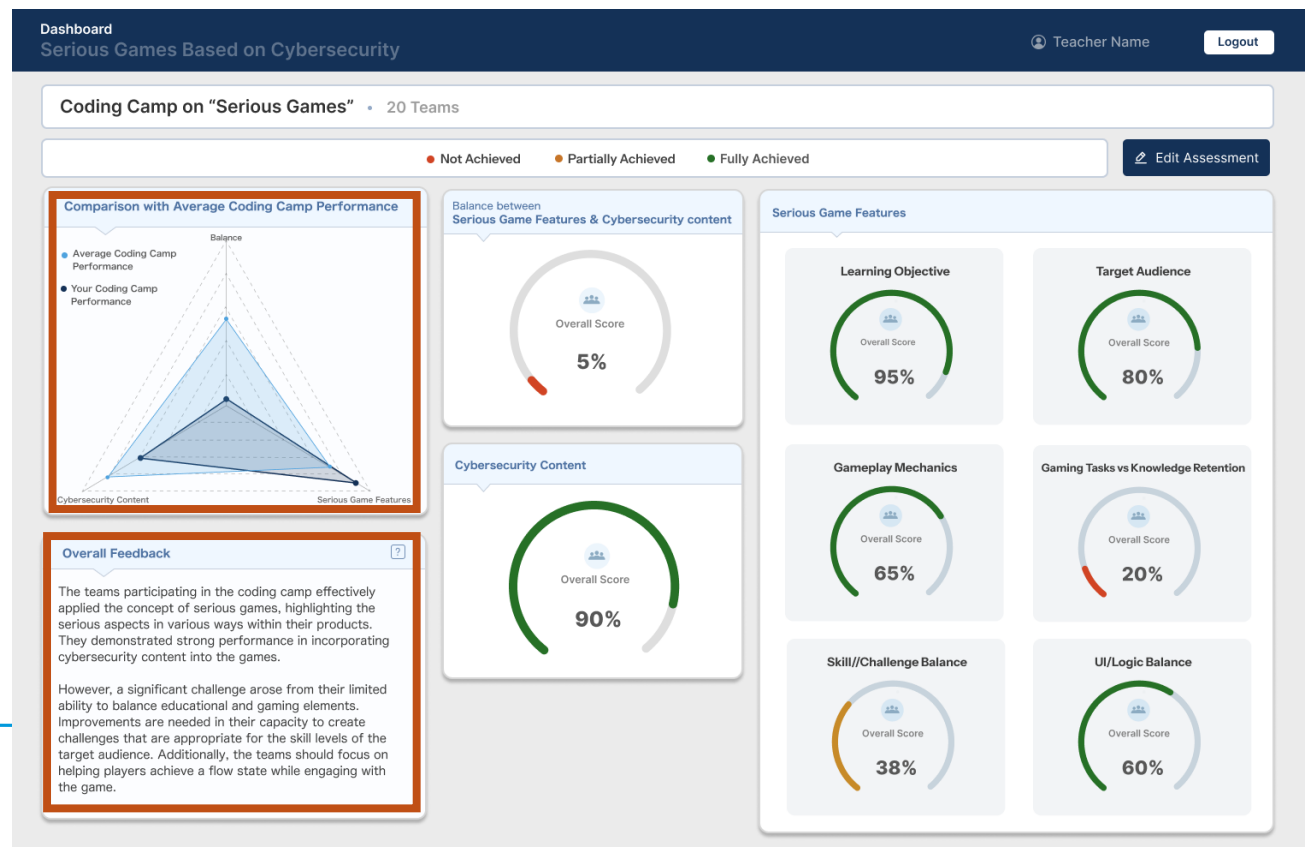
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Methodology: the dashboard



Radar chart: coding camp compared to the average of other coding camps

Overall feedback: strengths and areas for improvement



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Methodology: validation



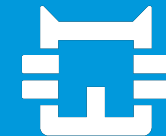
- We assessed 20 serious games through expert reviews using assessment framework and dashboard
- Three experts in serious game development reached a consensus
- Coding camp: 20 hours, 85 high school students, 28 teams, goal: creating a serious game focused on cybersecurity



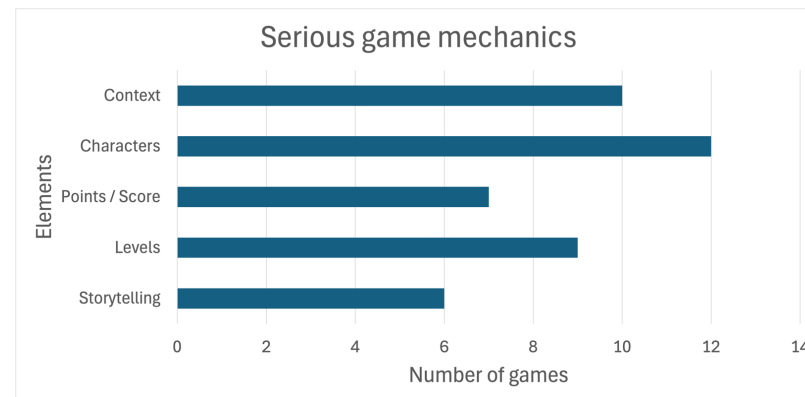
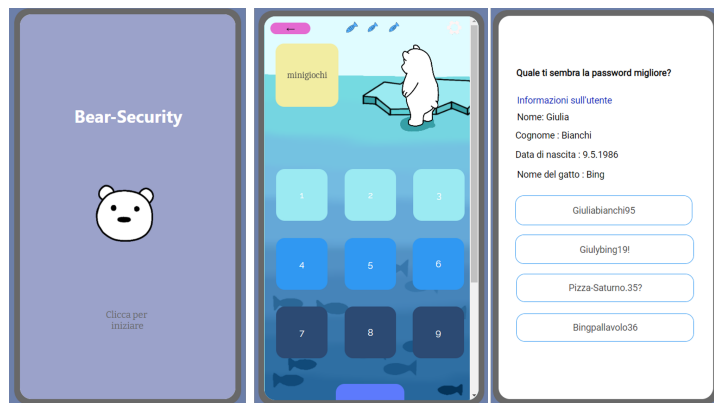
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Findings



The teams effectively applied the concept of serious game



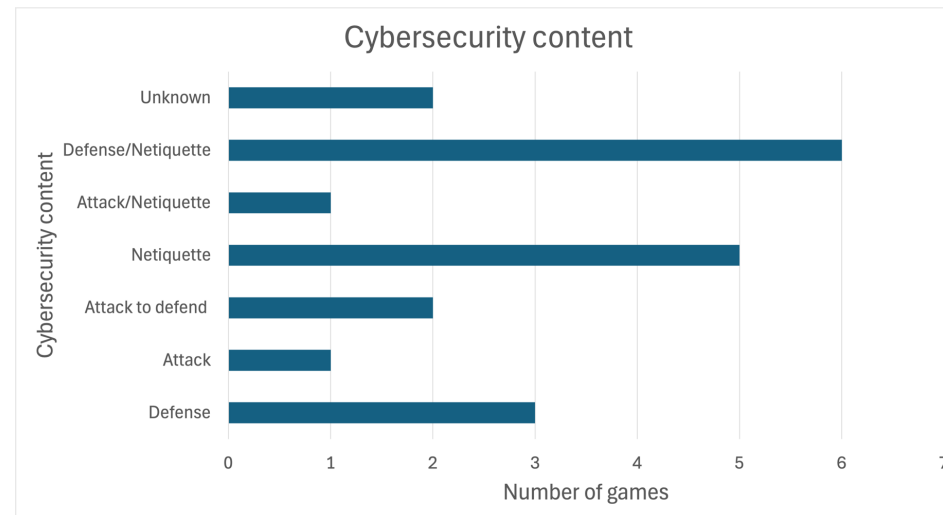
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Findings



They incorporated cybersecurity content into the games



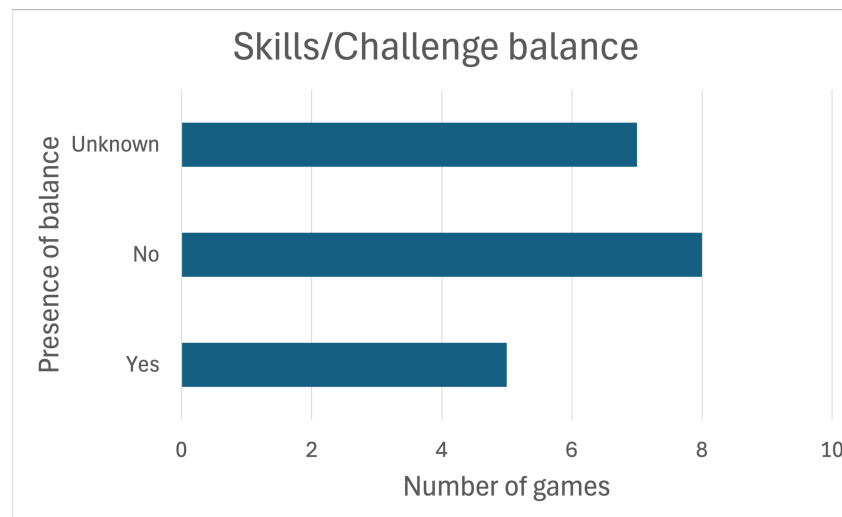
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Findings



Limited balance between educational and gaming elements



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Discussion



- The results show the **potential of the framework and its dashboard** in supporting instructors in verifying whether the predefined educational objectives were successfully met
 - The proposed framework acknowledges the **early-stage** nature of the serious games produced during coding camps
 - It evaluates participants' progress based on **three key components**: the overall quality of the serious game, cybersecurity content, and balance between these two aspects.
 - The dashboard gives instructors **a comprehensive overview** of the coding camp's outcomes



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Discussion



- Framework and dashboard can be utilized beyond the context of coding camps
 - situations involving similar time constraints and the need to create early prototypes
- They could be enhanced to assess serious games across a broader range of fields beyond just cybersecurity



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Limitations



- Expert bias: the experts conducting the reviews were also the authors and were closely involved with the project
 - To mitigate this bias, the three experts independently evaluated all the games and compared their findings
 - Importance of involving external experts in future evaluations
- Items in the framework are based on current literature in the field
 - Further validation is needed -- gathering feedback from instructors



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Future work



- Development of a **platform** that integrates assessment framework and dashboard
- Allow value inputs, in addition to the Yes/No options, in the assessment grid (excellent, good, poor, very poor)
- Evaluate serious games across a broader range of fields beyond cybersecurity



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Thank you!



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