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Hack it with EDUCHIC! Educational hackathons and interdisciplinary challenges—Definitions, principles, and pedagogical guidelines

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Abstract

Whereas hackathons are widespread within and outside academia and have been argued to be a valid pedagogical method for teaching interdisciplinarity, no detailed frameworks or methods are available for conceptualizing and organizing educational hackathons, i.e., hackathons dedicated to best achieving pedagogic objectives. This paper is dedicated to introducing EDUCational Hackathons for learning how to solve Interdisciplinary Challenges (EDUCHIC) through: (1) defining the fundamental principles for framing an activity as an EDUCHIC, integrating principles from pedagogical methods, hackathon organization, and interdisciplinarity processes; (2) describing general properties that EDUCHIC possess as a consequence of the interaction of the fundamental principles; (3) developing operational guidelines for streamlining the practical organization of EDUCHIC, including an exhaustive end-to-end process covering all the steps for organizing EDUCHIC and practical frames for carrying the key decisions to be made in this process; and (4) a demonstration of these guidelines through illustrating their application for organizing a concrete EDUCHIC.

[Corrections made on 7 June 2024, after first online publication: Research Council of Norway Grant/Award Numbers in the Funding information, the formatting of a few in-text citations and 'the paper' to 'this paper' in the example for No. 8 in Table 1 have been corrected, in this version.]

KEYWORDS
education, formal learning, guidelines, hackathon, interdisciplinary, pedagogy

1 | INTRODUCTION

Against the backdrop of the challenges faced by humanity since the beginning of the 21st century, spanning from catastrophic consequences of climate change (Benevolenza & DeRigne, 2019) to the COVID-19 pandemic (Chu et al., 2020) and the ethical dilemmas raised by development of Artificial Intelligence (Belk, 2021), *interdisciplinary action* is hoped to be a solution (Buanes & Jentoft, 2009) to so called 'wicked problems' (Rittel & Webber, 1973): problems that are complex, lack clear boundaries, and attempts to solve them have unforeseen consequences (Lönngren & Van Poeck, 2021; McCune et al., 2021). While *interdisciplinary teaching and learning* (IDR T&L) is seen as a 'key part of the required educational response' (Turner et al., 2022) to address these problems, implementing IDR T&L initiatives in higher education is not an easy task, with difficulties including institutional barriers (Harré et al., 2020), reducing the time available for practical work (Baschung 2016), adaptation to the local context (Ruano-Borbalan 2019), sustaining teacher collaboration (Pharo et al., 2012) or student involvement (Gantogtokh & Quinlan, 2017), and lack of general design frameworks for various educational activities, as most accounts of IDR T&L tend to focus on describing the details of a specific implementation rather than on synthesizing generalized theoretical frameworks and methods for implementing IDR T&L activities (Lindvig & Ulriksen, 2019).

Acknowledging these difficulties, this study aims to offer concrete guidance for practitioners in higher education about the design of an activity that gained increased popularity in the last years—the hackathon. Even though hackathons are widely used in higher education (Warner & Guo, 2017), including in relation with interdisciplinarity (e.g., (Kienzler & Fontanesi, 2017), (Björklund et al., 2019)), their framing and their uses are described as 'just a new way of working rather than an integral part of the education' and 'their use as an integral part of curriculum is immature or at least it has not been properly documented in academic papers' (Porras et al., 2019, p.7756). While there are several detailed guidelines for organizing hackathons in general (for example, (Hacking, 2020; Heller et al., 2023; Nolte et al., 2020; Tauberer, 2014)), to our knowledge, this paper is the first structured endeavour to conceptualize the methodology of hackathons using pedagogical lenses in general and for IDR T&L in particular.

The goal of this paper is to propose concrete definitions, principles, and guidelines for practitioners in higher education to develop *EDUCational Hackathons for learning how to solve Interdisciplinary Challenges* (EDUCHIC; pronounced edu-chic). Thus, we propose a definition of EDUCHIC, and we establish their foundational principles and key properties in relation to pedagogy, processes of interdisciplinarity, and hackathon organization. Building over these, we propose guidelines for designing and implementing EDUCHIC in higher education and we demonstrate an implementation of these guidelines through their application in an example from our own practice, i.e., the AutogrAIde Hackathon, held at Umeå University, Sweden, in January 2022, as a university-wide teaching & learning collaboration between computer science, pedagogy, philosophy, law, and sociology departments, seeking to expose students to interdisciplinary challenges by exploring the topic of Automated Grading in Higher Education.

The rest of this paper is organized as follows: first, we characterize interdisciplinarity (Section 2); second, we describe the types and approaches to hackathons (Section 3); then, drawing on these both, we introduce EDUCHIC and the guidelines for their implementation, together with the example of our implementation (Section 4).

2 | INTERDISCIPLINARITY

Interdisciplinarity is one of the most discussed, but also most misunderstood topics in research and education (Graff, 2016). In order to promote transparency and rigour, we believe that it is important to clarify the use of this concept in this study.

Based on (Tress et al., 2005) and (National Academy of Sciences, of Engineering, and of Medicine, 2005), interdisciplinarity is understood, for the purpose of this study, as *integrating several unrelated academic disciplines or bodies of specialized knowledge in a way that forces them to cross subject boundaries in order to advance fundamental understanding (e.g., create new knowledge, theory) and/or to solve problems whose solutions are beyond the scope of a single discipline or area of practice*. As such, interdisciplinarity is different from other approaches to knowledge creation, such as monodisciplinarity (which involves only one discipline) or multidisciplinarity (which involves several disciplines that work in parallel) (Tress et al., 2005). Moreover, this definition of interdisciplinarity assumes a form of knowledge creation: the interdisciplinary nature of a topic diminishes with the degree of establishment and consolidation of the knowledge of the topic (e.g., the well-established field of biochemistry requires less interdisciplinary framing than crossing chemistry and sociology). Looking at the 'conceptual and cultural distance between the participating research fields' (Huutoniemi et al., 2010, p. 82), interdisciplinarity can be narrow in scope ('participating fields are conceptually close to each other, typically representing the same broad domain of scholarly work'; e.g., biochemistry) or broad ('conceptually diverse fields that cross the boundaries of broad intellectual areas'; e.g., digital humanities).

Interdisciplinary endeavours usually involve a collaborative action undertaken by a group of people, though it can also be performed by a single individual (e.g., persons with T-shaped and KEY-shaped interdisciplinary profiles, who possess both breadth of capability for collaboration across multiple disciplines and depth of disciplinary knowledge in one or several domains (Bridgestock, 2015)). Interdisciplinary activities are carried through an *interdisciplinary process* that facilitates the identification and integration of the needed disciplines. A widely used model from specialized literature on interdisciplinarity, the Integrated Model of the Interdisciplinary Research Process or the 'Broad Model' (Repko & Szostak, 2020), divides the *interdisciplinary process* in the following two phases and 10 steps, which may overlap or be iterated on:

A *Draw on disciplinary insights*:
1. Define the problem or state the research question
2. Justify using an interdisciplinary approach
3. Identify relevant disciplines
4. Conduct literature search
5. Develop adequacy in each relevant disciplines
6. Analyse the problem and evaluate each insight

B *Integrate disciplinary insights*:
7. Identify conflicts between insights and their sources
8. Create common ground between insights
9. Construct a more comprehensive understanding
10. Reflect on, test, and communicate the understanding.

This model reflects a pragmatic, instrumentalist approach to interdisciplinarity, as it draws on all disciplines for insights, whether they are epistemologically distant or close, and it uses all "disciplinary tools" including concepts, theories, methods, assumptions, metaphors, models, processes, narratives, questions, policies, plans, or programs to study a problem (Arvidson, 2015; Repko et al., 2019). To these 10 steps (Spencer & Phillips, 2018) added: greater inclusion of humanities scholarship; space for insights of previously published interdisciplinary work; an expanded sense of the topics worthy of study (as to emphasize the value of areas of study lying outside the purview of the traditional disciplines); use of interdisciplinary sources in the literature search; and explicit critical perspectives over the benefits and limitations of disciplinary approaches. What the model integrates are not disciplines or their perspectives but the insights they generate (Repko et al., 2019).

Including interdisciplinarity in education is considered to be a future-oriented pedagogy suitable for promoting sustainable development (Sahlberg and Oldroyd 2010), forwarding innovation training (Lemaître 2019), and preparing learners for a digitally transformed working world (Terkowsky et al. 2019). This inclusion can be thought of along four approaches: teaching *interdisciplinary objects of study* (e.g., urban communication (McLellan & Johnson, 2014)); teaching *interdisciplinarity* per se, as a subject (e.g., interdisciplinary inquiry (Burgett et al., 2011)); teaching transferable skills necessary for interdisciplinarity (e.g., collaboration in interdisciplinary teams (Petri, 2010)); and a *combination* of the above (e.g., learn about interdisciplinarity and its processes applied on interdisciplinary objects of study, as in the example provided in this paper, Section 4.3). Besides providing key recommendations for institutions planning to include interdisciplinary modules into the curriculum (see, for example, (Turner et al., 2022)), speciality literature indicates a variety of teaching and learning approaches and methods that are relevant for including interdisciplinarity in education: experiential learning, collaborative learning, case studies, role-playing, gaming, problem-based learning, or field experiences (DeZure, 2010); inquiry-based learning through hackathons (Kienzler & Fontanesi, 2017); teaching wicked problems (McCune et al., 2021).

From the perspective of the design of interdisciplinary educational activities, there are three possible implementation forms (Lindvig & Ulriksen, 2016, 2019): the *'pearls on a string'* form, where, the different disciplinary elements are presented one after the other and the intention is that there is a string running through the entire activity tying the elements together; the *'zipper'* form, where the different disciplinary elements are presented separately, but with an explicit expectation that one actor, usually the students, will be the one tying the different elements together; and the *'snowflake'* form, which is a type of activity that organizes the different disciplinary elements around a common center such as a particular social or scientific problem. [Corrections made on 7 June 2024, after first online publication: ', etc' in the previous sentence has been removed in this version.]

3 | HACKATHONS

A hackathon can be defined as a '*flexible invention development method, in which participants face a specific challenge or a group of challenges within an imposed amount of time*' (Rys, 2021), where 'challenge' means a concrete situation/problem that needs addressing and 'flexible' is meant as allowing for various purposes and not assuming a priori a certain range of attendees, activities, and organizational settings.

Hackathons have increased in popularity since the turn of the century and, while at the beginning hackathons were dedicated to developing technical solutions in the IT sector, their frame has now become much more universal, spreading over a multitude of fields, including solving technical, educational, social, ethical challenges in a wide array of contexts, from corporations to higher education and military institutions (Rys, 2022). For more details on the historical account of the appearance and use of hackathons, see (Rys, 2021). To capture this broad variety of contexts and hackathon designs, a multitude of variables can be considered for framing the various forms, types, and purposes that hackathons can take. Figure 1 gives an overview of some of these variables.[i]

Based on the *organizers of the hackathon* (i.e., the entity that plans and arranges the event with or without the help of an implementation team) (Gama et al., 2022), hackathons can be: *educational* (performed in association with teaching and learning activities, as an initiative of a teacher, as cooperation between academia and industry, or organized by students), *corporate/entrepreneurial* (commonly used by IT companies of all sizes, which integrate these events into their research and development activities), or *civic* (organized by the public sector or by non-governmental organizations; these are focused on more socially-oriented innovation). Regarding this categorization, one has to note that, corporate hackathons are commonly organized with the purpose of creating business

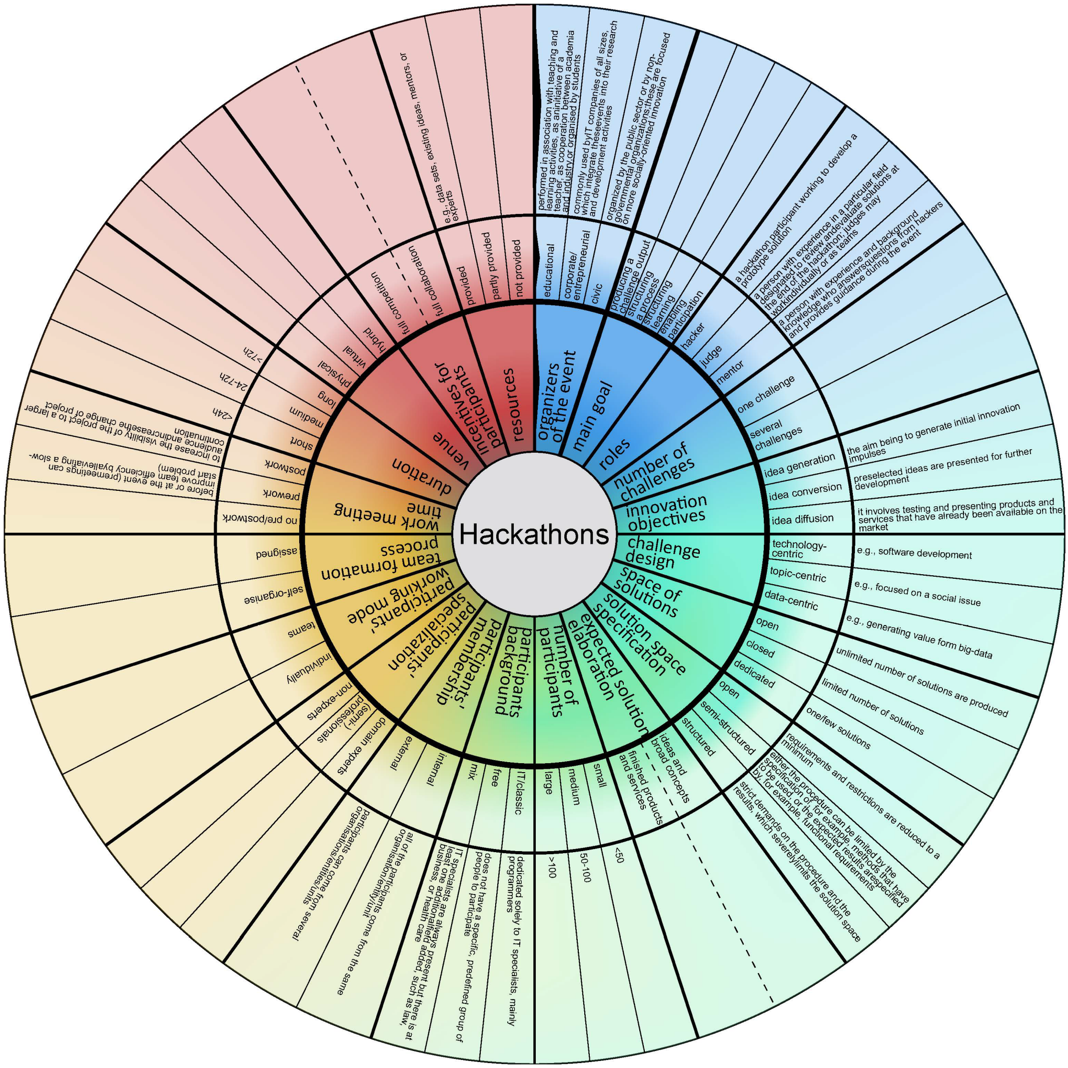

FIGURE 1 Overview of variables to take into consideration when designing a hackathon. The stippled line indicates a continuum between the two values. A larger format of the figure is available for printing at https://github.com/lvanhee/autograide-hackathon-resources.

value (e.g., by creating a space where innovative ideas and prototypes can be created) or organizational value (e.g., by fostering out-of-the-team business-wide collaboration), during which workers are expected to acquire new knowledge and skills (e.g., technical skills, social skills), albeit this learning is a secondary purpose. Any of these three types of hackathons can have as *main goal* (Falk Olesen Jeanette & Halskov, 2020; Kollwitz & Dinter, 2019): *producing a challenge output*, *structuring learning*, *structuring a process*, and/or *enabling participation*.

The hackathon organizers and the challenge organizers (i.e., the ones that have identified or selected the challenge addressed in the hackathon) could, but do not have to be the same entities (Rys, 2021). The persons involved in a hackathon can take various *roles* (Ramatowski et al., 2017), such as *'hacker'* (a hackathon participant working to develop a prototype solution), *'judge'* (a person with experience in a particular field designated to review and evaluate solutions at the end of the hackathon; judges may work individually or as teams), or *'mentor'* (a person with experience and background knowledge who answers questions from hackers and provides guidance during the event).

Considering the *number of challenges*, a hackathon can pose *one challenge* or *several challenges* (Rys, 2021). Depending on their *innovation objectives* being pursued (Kollwitz & Dinter, 2019), hackathons can focus on *idea generation* (the aim being to generate initial innovation impulses), *idea conversion* (preselected ideas are presented for further development), or *idea diffusion* (it involves testing and presenting products and services that have already been available on the market). The *challenge design* can be *technology-centric* (e.g., software development), *topic-centric* (e.g., focused on a social issue), or *data centric* (e.g., generating value form big-data) (Kollwitz & Dinter, 2019). Considering the *space of solutions* that are expected to be delivered to the challenge(s) by the end of each event by the participants (i.e., the persons working to develop a solution) (Rys, 2021), hackathons can be: *open* (unlimited number of solutions are produced), *closed* (limited number of solutions), or *dedicated* (one/few solutions). Usually, these proposed solutions are evaluated against each other, against an ideal solution, or against pre-defined evaluation criteria. By the *degree of specification of the solution space* (Kollwitz & Dinter, 2019), hackathons can be *open* (requirements and restrictions are reduced to a minimum), *semi-structured* (either the procedure can be limited by the specification of, for example, methods that have to be used, or the expected results are specified by, for example, functional requirements), or *structured* (strict demands on the procedure and the results, which severely limits the solution space). The *degree of elaboration of these solutions* can range from *ideas and broad concepts* to *finished products/services* (Kollwitz & Dinter, 2019).

When considering the *number of participants*, hackathons can be *small* (<50), *medium* (50–100), or *large* (>100). Based on the *background of participants* (Rys, 2021), hackathons can be classified as: *IT/classic* (dedicated solely to IT specialists, mainly programmers), *free* (does not have a specific, predefined group of people to participate), or *mix* (IT specialists are always present but there is at least one additional field added, such as law, business, or health care). Based on the *membership of the participants*, hackathons can be *internal* (all of the participants come from the same organization/entity/unit) or *external* (participants can come from several organizations/entities/units). Considering the *degree of specialization of the participants* (Kollwitz & Dinter, 2019), these can be *domain experts*, *(semi-)professionals*, or the *non-experts*. Based on the *working mode of the participants*, they can work *individually* or in *teams*. Considering *team formation process*, participants can *self-organize* or teams can be *assigned* by the hackathon organizers (Pe-Than et al., 2018). Depending on *whether the team meets to work before or after the hackathon*, there can be *no pre/postwork*; *prework* before or at the event (premeetings can improve team efficiency by alleviating a slow-start problem); or *postwork* at the event or after (to increase the visibility of the project by communicating it to a larger audience and increase the chance of project continuation) (Pe-Than et al., 2018).

Based on their *duration* (Kollwitz & Dinter, 2019), hackathons can be *short* (<24 h), *medium* (24–72 h), or *long* (>72 h). Taking into consideration of their *venue* (Kollwitz & Dinter, 2019), hackathons can be *physical*, *virtual*, or *hybrid*. Considering the *incentives offered to the participants* (Kollwitz & Dinter, 2019), hackathons can be placed somewhere on the continuum between *full competition* and *full collaboration*. A last dimension that we mention here is that of *resources* (e.g., datasets, existing ideas, mentors, or experts; Kollwitz & Dinter, 2019), which can be *provided*, *partly provided*, or *not provided*.

Zooming in into educational hackathons, an overview of the learning theories underpinning hackathons as educational activities (ranging from Rousseau's humanist conception of learning to Robinson's creative schools) can be found in (Huerta & Riera i Romaní, 2020), to which (Kienzler & Fontanesi, 2017) added inquiry-based learning and (Wallwey et al., 2022) added problem-based learning. However, analyses of studies reporting such hackathons concluded that most of these 'do not set clear educational learning outcomes but use the hackathon more like a tool to innovate new solutions in which the solution is more important than the learning [involved in] the process of developing the new solution' (Porras et al., 2019, p. 7755) and lack 'formal structure or pedagogy' (Olesen Jeanette & Halskov, 2020, p. 1077).

One has to note that, while in non-educational hackathons, solving the challenge is the (sole) objective of both the hackathon organizers and of the participants, in an educational hackathon, solving the challenge is a means to achieve the intended learning outcomes (ILOs) of the activity. The main purpose of differentiating between the educational hackathon goal (i.e., learning operationalized through ILOs) and the challenge goal (i.e., solving a concrete problem) is for the experience to have more authenticity and, as such, to increase students' motivation.

When it comes to methodologies for implementing hackathons, though there are several comprehensive descriptions of the steps to take and design choices to make when organizing hackathons in general or corporate hackathons (see, for example, (Heller et al., 2023; Nolte et al., 2020; Pe-Than et al., 2018; Rys, 2022; Valencça et al., 2020)), to our knowledge, besides brief descriptions that do not account for pedagogical aspects (e.g., (Yarmohammadian et al., 2021)), there is no available detailed description of how to design and implement an educational hackathon. Our study fills in this gap.

4 | EDUCATIONAL HACKATHONS FOR LEARNING HOW TO SOLVE INTERDISCIPLINARY CHALLENGES: DEFINITION, PRINCIPLES, IMPLEMENTATION PROPERTIES, AND GUIDELINES

In order to enable the elaboration of a conceptual basis for framing EDUCational Hackathons for learning how to solve Interdisciplinary Challenges (EDUCHIC), this section is dedicated to introducing a general *definition* of what such hackathons are; the base *principles* that EDUCHIC are founded on; and, derived from these principles, basic *implementation properties* that such hackathons should possess, followed by clear *implementation guidelines* (that come with examples from our own practice). Crafted with the intention of a general and broad scope in mind, this frame accommodates a diverse range of potential structures that EDUCHIC can take –all while maintaining the attributes necessary to classify it as an educational hackathon for learning how to solve interdisciplinary challenges.

For example, the need for an activity involving an explicit challenge and production of solutions is mandatory, whereas plenum presentation of solutions, while usually implemented in hackathons, is a likely but not necessary constituent of an EDUCHIC.

4.1 | Definition and principles

Based on the definitions provided in Section 2 and Section 3, we define an EDUCational Hackathon for learning how to solve Interdisciplinary Challenges (EDUCHIC) as: *a flexible innovation development method for TEACHING and LEARNING, in which LEARNERS face a specific INTERDISCIPLINARY challenge or a group of challenges within an imposed amount of time, where by 'interdisciplinary challenge' it is meant a concrete situation/problem that needs addressing and whose solution is beyond the scope of a single discipline or area of practice*.

Placed at the intersection of three areas (teaching and learning / pedagogy, hackathons, and interdisciplinarity), an EDUCHIC builds on three core principles, as follows (Figure 2).

4.1.1 | Principle A. An EDUCHIC is a formal learning activity

The participants of the EDUCHIC that have the role of 'hackers' are *learners* engaged in the activity with explicit purpose of *learning* how to solve interdisciplinary challenges. As such, from now on, these hackers will be referred to as learners. An EDUCHIC involves an *educator*, who acts as the hackathon (and, possibly, challenge) organizer and who has as explicit objective the organization of a teaching and learning activity in which the participants learn first and foremost, how to solve interdisciplinary challenges. Thus, the activity is *explicitly designed as teaching and learning* and, as such, first and foremost, *it follows established good pedagogical practices*. At a minimum, these practices include: *defining Intended Learning Outcomes* (ILOs) (formulated using, for example, Bloom's taxonomy (Forehand, 2010)); *following the constructive alignment principle* (which argues for teaching and learning

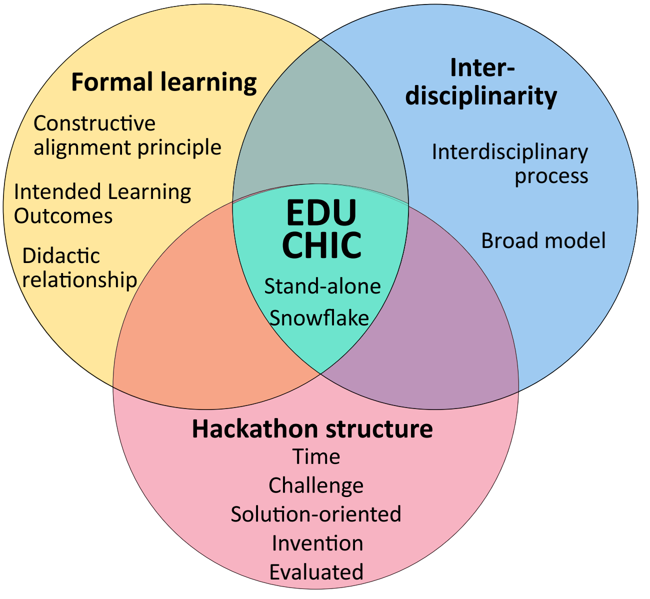

FIGURE 2 EDUCational Hackathon for learning how to solve Interdisciplinary Challenges (EDUCHIC), at the intersection of three areas, with their respective application models: teaching and learning / pedagogy (constructive alignment principle (Biggs & Tang, 2011), intended learning outcomes (Forehand, 2010), didactic relationship (Bjørndal & Lieberg, 1978)), hackathons (Rys, 2021, 2022), interdisciplinarity (Repko & Szostak, 2020; Tress et al., 2005) and at their intersection, snowflake (Lindvig & Ulriksen, 2016, 2019), standalone (Chadha, 2006).

activities, content, and assessment methods to be aligned with the ILOs defined for a specific instructional unit (Biggs & Tang, 2011)); and *using the Didactic Relation(ship) Model* (that describes interrelated elements in a teaching & learning situation, e.g., goals, learner-related preconditions, content, activities, context, and evaluation (Bjørndal & Lieberg, 1978)).

The specification of EDUCHIC being a formal learning activity is important, as some of the previous literature has referred to hackathons organized within educational institutions (e.g., college hackathons, university-sponsored hackathons) as informal learning (e.g., (Nandi & Mandernach, 2016; Warner & Guo, 2017)). However, according to the glossary developed by the European Centre for the Development of Vocational Training (CEDEFOP, 2014):

- *Formal learning* 'occurs in an organised and structured environment (such as in an education or training institution or on the job) and is explicitly designated as learning (in terms of objectives, time or resources). Formal learning is intentional from the learner's point of view.'
- *Non-formal learning* 'is embedded in planned activities not explicitly designated as learning (in terms of learning objectives, learning time or learning support), but which contain an important learning element. Non-formal learning is intentional from the learner's point of view.'
- *Informal learning* results 'from daily activities related to work, family or leisure. It is not organised or structured in terms of objectives, time or learning support. Informal learning is in most cases unintentional from the learner's perspective.'

Thus, according to these definitions, an EDUCHIC always has to be categorized as *formal learning*, i.e., an intentional learning activity from the learner's point of view, which is explicitly organized and structured as learning by the educator. As a formal education activity, the main objective of an EDUCHIC is first and foremost that the participants (i.e., learners) achieve the ILOs, with the production of solutions to the hackathon challenge as secondary focus, unless this is specifically included in the ILOs.

4.1.2 | Principle B. An EDUCHIC complies with the characteristic structure of a hackathon

Hackathons do not per se imply interdisciplinarity. However, since their main purpose is to bring people together to work on a challenge in a specifically structured way, we consider the hackathon as especially suitable for learning how to solve interdisciplinary challenges: it is *flexible* enough to allow devising activities that guide participants through a specific process and it places the participants in a *time-bound* environment that maintains them in a state of *active*, *single-focused* engagement to produce an *inventive*, *demonstrable* solution to a *specific* challenge. As such, it is different from other participatory activities, e.g., group discussions. Thus, an EDUCHIC always:

1. Defines a challenge to be undertaken by learners.
2. Is time-bound, and a clear time limit should be set, almost necessarily with a sense of urgency requiring immediate and exclusive engagement with the challenge.
3. Is solution-oriented, and learners should primarily act towards proposing a concrete, demonstrable solution to the challenge (as such, only the visible/functional/finalized part of the solution is accounted for, and, for example, only brainstorming about possible solutions is not enough).
4. Requires learners to be inventive, thus, coming up with new, creative ideas and not only rely on pre-existing solutions.
5. Evaluates the proposed solutions in accordance to clear criteria, by the end of the event.

4.1.3 | Principle C. An EDUCHIC is aligned with the phases and steps of an interdisciplinary process

Since the solution of an interdisciplinary challenge is beyond the scope of a single discipline or area of practice, we believe that solving interdisciplinary challenges, as a process, can be enabled by following the interdisciplinary research process. Thus, the activities designed for the participants to carry on during the EDUCHIC have to follow the steps of such a process. As described in Section 2, the 'Broad Model' (Repko & Szostak, 2020) provides such a process, which is divided in two phases and 10 steps; this model can be used for devising the specific activities to be carried out by the educators and the learners during an EDUCHIC event. Explicitly following such a process opens the black box of 'doing interdisciplinarity' and makes the teaching & learning process more straightforward, and, thus, more efficient and effective. This model has been used in higher education for training STEM (science, technology, engineering, and math) doctoral researchers to deal with moral dilemmas (Rashid, 2020) or to work collaboratively (Rashid & Lim, 2020) and more general in doctoral level training (Rashid, 2021), with positive feedback from students.

4.2 | Implementation properties

A set of implementation properties can be described for an EDUCHIC as a consequence of the integration of the pedagogic, organizational, and interdisciplinary principles described above.

- As a teaching and learning method, EDUCHIC facilitates the learning of interdisciplinarity-related transferable skills as an *explicit topic*, *independently from learning in other disciplines*. This approach mirrors the *bolting-on (or stand-alone)* model from (Chadha, 2006).[ii] Since the hackathon forces participants to work with a concrete and applied matter, the issue of students failing to grasp the academic or practical relevance of such an approach, which is sometimes associated to this model, is avoided. When following this model, an EDUCHIC should include (without being restricted to) within its ILOs specific items referring to interdisciplinarity as a topic in itself (e.g., describe the main steps in an interdisciplinary process) that is not dependent to specific disciplines (e.g., computer sciences).
- From the perspective of the design of interdisciplinary educational activities, an EDUCHIC takes *the 'snowflake form'* (Lindvig & Ulriksen, 2016, 2019), which, as described in Section 2, is a type of activity that organizes the different disciplinary elements around a common center such as a particular social or scientific problem that is included in the challenge.
- *The space of desired solutions for the challenge must involve an integrated combination of multiple disciplines*. For example, an eco-friendly cost-effective car engine based on the integration of mechanical, economic, and ecological concerns is such a solution. Solutions involving less integration or even a mere juxtaposition of disciplines should be ruled out or down-graded (no matter how elaborated they are). For example, proposing a more oil-efficient engine that would not consider economic factors such as car price should be a low-quality solution. Making a more oil-efficient engine and crossed with an economic and ecological impact assessment would be a passable outcome. Making an engine that is optimized for minimal ecological impact and economic cost would be a high-quality outcome.
- EDUCHIC learners are required to produce *new* intellectual material (knowledge, theories, data, models, etc.), new being defined here as *expectedly not known by the learner* (e.g., finding on-line an already conceptualized solution or only searching for existing intellectual material that might bridge the disciplines, but not conceptualize the bridging itself, is not a viable strategy).
- EDUCHIC includes an *assessment activity that should cover the mastery of the learners in following the interdisciplinary process and solving interdisciplinary challenges (as formulated in the ILOs)*. This assessment can rely on the quality of the solution proposed by the learners and on the strategies used by the learners. As such, the assessment should scrutinize the solution and the process on which this solution has been established. For example, a solution that produces a moderately eco-friendly car engine that sought to optimize for and developed a model for a mechanical–ecological–economical compromise should be evaluated as better than a solution that produces an oil-optimal engine following pure mechanical theories, no matter how ecologically friendly and economically viable is the engine. [Corrections made on 6 June 2024, after first online publication: In the previous sentence, 'who sought to' has been corrected to 'that sought to', in this version.] Likewise, strategies followed by the students for producing this solution should be accounted for as well. For example, positive evaluations should be given to solutions whose proposers reasonably engaged with all relevant disciplines (even if they failed to be conclusive in the solution).

One has to note that the prospect for learning how to solve interdisciplinary challenges is dependent on the background of the learner (e.g., the hackathon may fail to provide the learner with opportunities to grow interdisciplinary skills if the learner has already been exposed to that specific interdisciplinary challenge). *The characteristics of the students (i.e., learners-the participants), the challenge, the proposed solutions, the evaluation of these solutions, and the assessment of achieving the ILOs should therefore be carefully aligned as to enable and validate the occurrence of such learning*. Learners should be exposed to challenges of a different nature than of those they have received dedicated training as an object of study. The aim of an EDUCHIC is to provide participants with adaptive, flexible thinking skills, i.e., being able of solving *new problems*, rather than becoming better at solving formerly studied problems (e.g., more efficiently, more accurately).

4.3 | Implementation guidelines

This section provides a set of guidelines designed to support the implementation of an EDUCHIC. These guidelines are not describing a strict process to follow, and adjustments are to be made for fitting each specific situation.

The guidelines were developed by integrating the hackathon structure (based on (Heller et al., 2023; Nolte et al., 2020; Valença et al. 2020; Yarmohammadian et al., 2021)) with the interdisciplinary research process (the 'Broad Model') (see Section 2), and the six interdependent elements of the *Didactic Relation(ship) Model* (that describes interrelated elements in a T&L situation, i.e., goals, learner-related preconditions, content, activities, context, evaluation) (Bjørndal & Lieberg, 1978), with practical experience when implementing such activities, i.e., the AutoGrAIde Hackathon, UmeåUniversity, Sweden 19 January 2022. [Corrections made on 6 June 2024, after first online publication: In the previous sentence, 'e.g.' has been corrected to 'i.e.', in this version.] The development process started with mapping all the activities of our implemented hackathon within the general hackathon structure, followed by a mapping of all the steps of the 'Broad Model' within these activities. Afterwards, we went through all the items of the Didactic Relation(ship) Model and added detailed descriptions on how we addressed that specific item in our implementation.

Following the timeline of a hackathon, the guidelines for EDUCHIC divide activities in *three main phases*: pre-hackathon, during hackathon, and post-hackathon. While during the implementation of the hackathon, these phases unfold in sequence, during the design of the activity the steps within each phase might overlap and might be taken in loops. The steps of the guidelines are summarized in Figure 3 and detailed upon in Table 1, together with the implementation example of the AutoGrAIde Hackathon (Figure 4), which was an EDUCHIC organized by the first four authors at Umeå University, as a collaboration between computer science, pedagogy, philosophy, law, and sociology departments, on the topic of Automated Grading in Higher Education. The activity was funded by Rådet för Artificiell Intelligens of Umeå University, through the project AutoGrAIde "A Student-Driven Interdisciplinary Hackathon on Whether and How to Automate Grading & Assessment" (project number 570002260), coordinated by the first author. This hackathon was developed as a tool for facilitating dialogue around the topic of the use of AI in education (which is of current critical interest (Tuomi et al. (2022)) as to broaden the spectrum of methods available for responsible AI teaching & learning, for which the presence of disciplinary silos has been identified (Javed et al. 2022). As to implement the responsible AI component within the AutoGrAIde Hackathon, the GEDAI method (Growing Ethical Designers of Artificial Intelligence) was applied (Vanhée & Borit, 2022), thus ensuring a streamlined integration of responsible AI concerns within the activity. Following recently proposed guidelines for interdisciplinary education (see (Rashid, 2021)), the organisers of the AutoGrAIde Hackathon: selected a topic sufficiently complex to warrant an interdisciplinary approach (i.e., the use of automated grading in higher education); selected a definition of interdisciplinarity and framework that will promote interdisciplinary learning (i.e., the definition Section 3); selected an active learning strategy to make learning more meaningful (i.e., the hackathon); reviewed the effectiveness of the approach (i.e., through debriefing); and shared findings with research community (i.e., this article).

Though the AutogrAIde Hackathon has been designed and implemented first and foremost as an educational activity within the frame of IDR T&L, it also served secondary goals, such as: enable the students to express their opinion about a matter relevant for their life in higher education; provide the university and the wider community with opinions regarding to technology in education that students can formulate when provided time, structure, and resources; connect teachers across various departments at the university, increasing, as such, the potential for interdisciplinary activities in research and education. The feedback received from the students encourages us to continue using such methods, e.g.," The opportunity to talk to students and professors from different fields was life-changing!" (Computing Science);" Very rewarding! Helps you to think out of the box." (Philosophy);" Very satisfactory! Learned a lot, not only from other disciplines but also from my own." (Cognitive Science);" The environment was very inspiring, and it makes you want to work more. I can't think of a bad aspect. This activity has been a very good exercise and a very good experience." (Informatics).

FIGURE 3 The main steps of the three phases of EDUCHIC: EDUCational Hackathon for learning how to solve Interdisciplinary Challenges.

TABLE 1 Guidelines for implementing an EDUCational hackathon for learning how to solve Interdisciplinary Challenges (EDUCHIC). The example is based on the implementation of the AutogrAIde Hackathon.

No.	Step	Example: AutoGrAIde Hackathon
Pre-hackathon		
1	Define explicitly the main learning approach based on which the hackathon is chosen as a teaching and learning activity (e.g., Inquiry-Based Learning, Problem-Based Learning, Authentic Learning)	For the AutoGrAIde Hackathon, these approaches to learning were relevant: Authentic Learning; Experiential Learning. Socio-cultural learning
2	Familiarize with the principles and properties of the Educational Hackathon for Learning How to Solve Interdisciplinary Challenges (EDUCHIC) (this paper, Section 4.1 and Section 4.2)	The organizers of the AutoGrAIde Hackathon are co-authors of EDUCHIC
3	Define Intended Learning Outcomes (ILOs) of the session so that the students learn how to perform all the steps of the interdisciplinary research process (Repko & Szostak, 2020) and solve an interdisciplinary challenge.	The intended learning outcomes for the AutoGrAIde Hackathon included: • Connect disciplinary knowledge through establishing connections between the learner's primary discipline and concepts of grading, Artificial Intelligence (AI), and AI for grading. • Imagine AI applications for grading through envisioning and proposing plausible applications of AI for grading within the learner's field of expertise. • Co-create through collaboration with individuals from diverse disciplinary backgrounds to jointly develop the envisioned AI applications for grading. • Appraise the feasibility of the proposed AI applications from the perspective of the learner's own discipline. • Integrate perspectives through merging the feasibility assessment with those provided by other disciplines to gain a holistic understanding. • Represent disciplinary standpoints through presenting and advocating for the viewpoints of the learner's primary discipline in discussions and evaluations. • Revise an existing proposal, considering the constraints and insights raised by other disciplinary viewpoints. • Engage in collaborative problem-solving and idea development within a semi-competitive context, fostering teamwork and innovation

(Continues)

TABLE 1 (Continued)

No.	Step	Example: AutoGrAIde Hackathon
4	Define assessment activity (e.g., reflection note, multiple choice questionnaire) and assessment criteria for demonstrating the achievement of the ILOs	The assessment activities of the AutoGrAIde Hackathon were composed as follows: 1. Pre-test at the start of the hackathon: This test will include open questions, such as how learners connect their discipline with AI, grading, and AI for grading, along with open comments. Additionally, Likert scale items will gauge learners' self-assessed competence in AI, grading, AI for grading, and interdisciplinary teamwork. 2. Post-test during solution presentation and evaluation: After learners present their solutions and while judges evaluate these solutions, participants will undergo a post-test. Similar to the pre-test, this post-test will comprise open questions and Likert scale items to assess changes in learners' understanding and competence. 3. Oral debriefing after evaluation of solutions: Following the communication of solution evaluations, an oral debriefing session will be conducted. This session aims to gather further insights into the learning outcomes achieved during the hackathon. Participants will share their reflections and experiences. In addition, the following assessment criteria were defined: 4. Comparative analysis of responses: The assessment will involve comparing the richnessand completeness of answers provided in response to open questions. Additionally, changes in self-assessed competence scores between pre- and post-tests will be analysed, indicating the evolution of participants' understanding. 5. Coherence comparison between discussions: An assessment criterion involves comparing the coherence and depth of discussions among learners at the start of the hackathon and during the debriefing session. This comparison helps gauge how effectively participants incorporated feedback and insights into their understanding.
5	Define the EDUCHIC challenge. Explanations about this step can be found in the main text (page 23)	The challenge set by the AutoGrAIde Hackathon consisted of two interleaved parts: 1) propose concrete solutions answering the question of how can AI systems be deployed for automating grading and assessment and 2) evaluate and adapt the proposal by integrating the five disciplines organizing the hackathon (computer science, law, philosophy, sociology, and pedagogy). This challenge was organized as to foster the generation of ideas, is topic-centric, and it focuses on a social-issue and broad concepts. The organizing team considered this to be an ideal challenge, as almost all student can say something about it and most students urge to do it; most of the students have a strong practical and often emotional connection to grading (thus creating a strong basis for sustained motivation as well as feeling secure about having a relevant opinion to share about grading); likewise, most students have a general idea of AI, sufficient enough to have something reasonably accurate to say about it

TABLE 1 (Continued)

No.	Step	Example: AutoGrAIde Hackathon
6	Define criteria for evaluation of the solutions proposed by the learners. Explanations about this step can be found in the main text (page 23).	The solutions were to be evaluated both by an expert panel and by peers (i.e., other learners present in the activity). As a process, criteria for the expert panel were as follows: (1) if the solution is overall sound (is the solution addressing an actual application of AI for grading?) (2) if the solution is sound along each involved discipline (e.g., is the solution pedagogically, legally, ethically, socially, and technically viable and/or feasible?); (3) if the in-group appraisal of the solution is sound along each of the involved disciplines (e.g., did the learners recognize all key pedagogic, legal, ethical, social, and technical ramifications of the solution)? The evaluators, each being expert of one discipline, would first evaluate collectively criterion 1 and then individually criterion 2 and criterion 3 and fuse them as a preference order over the proposed solutions. The preference orders were then to be fused as to evaluate the most suited solution. The peer-evaluation would be based on a vote from the learners, who could elect their most favoured solutions proposed by another group
7	Define the aspects of the EDUCHIC. First define the general aspects (e.g., online hackathon) and then the specifics (e.g., use Zoom). See this paper, Section 3	*Organizers of the hackathon*: organized by teachers in higher education, thus educational hackathon. The organizing team also implemented the activity. Catering and room logistics were offered by third parties. *Main goal*: structuring learning. ILOs focused on developing knowledge and competence on interdisciplinarity (create and assess interdisciplinary solutions, collaborate in interdisciplinary teamwork) and on the issues and challenges regarding AI, grading, and AI from the pre-existing disciplinary frames of the learner – basic knowledge of the key issues tied to AI and grading from the learner's discipline standpoint, and basic understanding AI for grading, from the learner's discipline standpoint, e.g., a lawyer would seek knowledge of the legal issues tied by AI, by grading, and derive the legal issues tied to AI for grading) as well as an interdisciplinary object of study; additionally, as a secondary focus, citizen skills (engage in a democratic debate, act as a representative of a discipline). *Secondary goals*: acquiring insights on learners' discourses and narratives in regards to current and future possibilities and practices of AI, grading, and AI for grading elaborated in an interdisciplinary context as well as insights on acceptability of possible solutions for AI for grading

(Continues)

TABLE 1 (Continued)

No.	Step	Example: AutoGrAIde Hackathon
		Number of challenges: 1. *Innovation objectives*: Idea generation. *Challenge design*: Topic centric, albeit technology-centric proposals were accepted. *Space of solutions*: Open. *Degree of specification of the solution space*: Semi-structured (the solution space must feature a proposal, an assessment along all involved disciplines, and an interdisciplinary assessment). *Degree of specification of the solutions*: Ideas and broad concepts that still must be a concrete proposal and concrete assessments (not just a broad discussion around the topic of AI for grading). *Number of participants*: Small, albeit the design is scalable to medium. *Background of the participants*: Mix. *Membership of the participants*: Mostly internal participants (learners from the university) with some external participants (e.g., professionals in grading at pre-university level). *Degree of specialization of the participants*: Most of the participants were semi-professionals (discipline-specialized learners, mostly students). *Working mode of the participants*: Teams. *Team formation process*: Assigned. *When the team meets to work*: no pre/postwork, the whole activity was meant to occur on site as a standalone event with minimal demands from the participants outside of the activity. *Duration*: Short. *Venue*: Hybrid. *Incentives offered to the participants*: In-team collaboration, between-team (friendly) competition. *Resources*: Provided (curated contents on AI, grading, and AI for grading for all involved disciplines; mentors for all involved disciplines)
8	Select the team to implement the hackathon phase (this team takes care of all the practical aspects of implementing the event from an organizational point of view, e.g., prepares the room, sends emails, and prints materials)	The implementation team was the same as the organization team. It included academic staff recruited by the project[iii] (associate professors and professors, most of them being part of this paper's co-author team), one for each key discipline involved by the project (computer science, informatics, law, pedagogy, and philosophy)
9	Prepare learning material/resources (e.g., content, texts, charts, and links). For every discipline, make sure learners have access to material/resources that helps them connect the discipline, to interdisciplinarity, and the challenge. Possibly prepare references to pre-existing interdisciplinary pathways as learners will have to rely on and prepare materials ahead (to be delivered on demand, as it is to be found by learners)	Materials were created for students to relate their primary discipline to the topic at hand (e.g., for law learners, related regulations and legal frameworks about grading, about AI, and about AI for grading). These resources are available on the GitHub account of the first author[iv]
10	Prepare instructions for the learners to use during the hackathon phase	Slides and paper instructions were created for the learners (documented ibid)

TABLE 1 (Continued)

No.	Step	Example: AutoGrAIde Hackathon
11	Prepare physical and technical infrastructure (e.g., logistics—Flipchart paper, tables, software)	A local complex was acquired for the day,[v] featuring a plenary setup allowing to make presentations to the whole audience, as well as well-connected semi-isolated areas, suited for up to 10 small groups of 3–10 learners to work together in a quiet and cosy environment while still being easily reachable by organizers, mentors, and other learnersbbbWork materials (pens, paper, large sheets of paper, post-its, tape, and boards) were provided to the groups at the start of every session. Dedicated boards were provided for results to be displayed up to the end of the daybbbRefreshments (tea, coffee, and water) and food (lunch, pastries, and fruits) were provided, with free access throughout the day for all the participants
12	Double check that the constructive alignment principle is followed (Biggs & Tang, 2011)	The compliance to the constructive alignment principle was analysed
13	Advertise for the hackathon (includes possibly recruiting other learners than own students).	The hackathon was advertised through several methods: messages on the university mailing lists, printed posters pinned on public boards of student associations across the university, direct invitations. In addition, two press releases were made as to attract the general public and a public webpage was created.
14	Assess the learners through a pre-test, examining their initial disciplinary background, level of interdisciplinary expertise and knowledge, motivation, interests, and their alignment with the ILOs	This step was performed right after at the opening of the hackathon. The learners were given the questionnaire (on paper and Microsoft Forms, respectively)
15	Invite mentors and judges (disciplinary and interdisciplinary experts). This selection is based on the results of the pre-test	Members of the organizing team took the roles of mentors and judges
16	Prepare the mentors and judges	A preliminary meeting was organized for introducing the purpose and organization of the hackathon. All the mentors were tasked for delivering the curated materials on AI, grading, and AI for grading

(Continues)

TABLE 1 (Continued)

No.	Step	Example: AutoGrAIde Hackathon
17	Recalibrate all previous decisions based on the constructive alignment principle, accounting for the results from the pre-test and availability of mentors and judges	The compliance to the constructive alignment principle was analysed. Minor adjustments were made in regards to the organizers who could respond positively to our invitation; learner profiles at an aggregated level: Over/under-representation of disciplines, differences in terms of academic, interdisciplinary, and hackathon experience and in terms of activity sector (e.g., learners, professionals). These adjustments included revising the set of involved disciplines, extending the pool of organizers, refining strategies for allocating groups as to ensure that disciplines and levels of experience are best spread, providing means for learners to acquire dedicated support on the discipline they miss (tokens allowing teams who would be deprived from a discipline to 'hire' a mentor as part of their group for a limited amount of time who would play the role of an in-group disciplinary expert)
18	Present the hackathon (structure, challenge, etc.) to the learners (e.g., by email)	An overall presentation of the hackathon was provided in the various invitation media as well as through the form used for participants to register to the hackathon.bbbA mail was sent a week before the event to the registered participants in which the pedagogical and logistical organization was reminded and further specified (e.g., general structure of the hackathon, activities to be carried, and time and location of the event)
Hackathon		
19	Open the hackathon (hold opening ceremony) and introduce the challenge	The first 40 min were dedicated to allow participants to reach the room, meet each other, fill in a complementary pre-test form, and be presented the event (purpose, structure, organizers).
20	Explain general key concepts about solving interdisciplinary challenges and customize these to the challenge (frame the interdisciplinary context of the challenge, explain the importance of the various disciplines, provide some basic explanation on how these have to be integrated)	Integrated in the previous point

TABLE 1 (Continued)

No.	Step	Example: AutoGrAIde Hackathon
21	Organize learners in the disciplinary groups identified in the previous step and give each group the task to perform a literature review relating the topic(s) of the challenge to the discipline of the group. Prioritize making groups based on the discipline of the students. If the disciplines required by the challenge are not covered by the students, the hackathon can be adapted by asking students to role-play the other disciplines, in which case, the teacher has to have adapted material for non-experts	Students undertook the literature review in disciplinary groups and developed a map of all key aspects at play (e.g., connect: AI and the respective discipline; grading and the respective discipline; AI & grading and the respective discipline) (see Figure 3 for an example of such a map). Learning materials provided curated resources for streamlining this review
22	Provide mentoring from a disciplinary perspective	Teachers from each discipline were supporting groups studying AI for grading in regards to their discipline as well as for structuring the exchanges
23	Organize learners in interdisciplinary groups covering all the necessary disciplines identified above. Give each group the task to provide solution(s) to the interdisciplinary challenge and to provide both a disciplinary and interdisciplinary appraisal of this solution(s). Suggested process: students propose a quick first solution; they assess this solution from the perspective of the discipline they represent (the disciplinary groups formed earlier); they cross their assessment with each other and integrate assessments; they optimize the originally proposed solution either by making a small increment or strong modifications if big contradictions were identified	Learners were reorganized in interdisciplinary groups, following the criteria described above. They were tasked to agree on a proposal of how AI can (or cannot) be used for grading that would be acceptable and feasible along all disciplines and to develop an assessment of this proposal along all involved disciplines. They were tasked to write down this proposal on the center of a flipchart and then to note down their assessment around this text

(Continues)

TABLE 1 (Continued)

No.	Step	Example: AutoGrAIde Hackathon
24	Provide mentoring from interdisciplinarity / interdisciplinary challenge solving perspective	Mentors were actively engaged with groups for monitoring their activities and offering support for best achieving interdisciplinary discussions, based on scientific evidence
25	Organize presentations of solutions and reflections on the interdisciplinary process (e.g., in plenum, report)	In a plenum session, learners presented their proposed solutions to each other. There was available time for questions and answers
26	Assess learners' learning (perform post-test): Items related to ILOs	A questionnaire very similar to the pre-test was given to the learners for assessing their progression in regards to achieving the ILOs. A particular focus was provided on a cross-comparison of the open questions with the pre-test as a less subjective assessment of the evolution of the learners' level of mastery
27	Evaluate proposed solutions and announce results. This step can be performed by judges and/or by peers. When by judges, evaluation criteria are given (one criterion is to have each discipline assigned to a judge and the solution to be judged by such a disciplinary judge, in order to incentivize the students to include all the relevant disciplines)	The evaluation by peers and experts followed the procedure and criteria described in Step 6
28	(Optional) Have the groups investigate each other's solutions and the insight provided by these, or explore how all/some solutions can be integrated in a bigger whole	Due to time constraints, this step was not performed
29	Close the hackathon (hold closing ceremony)	Closing slides, in which learners and organizers were thanked for their participation as well as for general information in regards to future steps of the day and of the project were shown. Small rewards (food and flowers, as well as diplomas) were offered to the two teams that were ranked first in the evaluations of the panel and of the peers. Participation certificates were delivered for learners who asked for one. Interested learners were invited for interviews by the project communication team

TABLE 1 (Continued)

No.	Step	Example: AutoGrAIde Hackathon
Post-Hackathon		
30	Debrief the hackathon activity with the learners (for a starter in debriefing, see (Gardner, 2013))	Participants were invited to discuss with each other about their experiences and their solutions (e.g., what frame they consider for their own solutions, for the solution of others) while organizers would sort the room back in its original state. Organizers engaged with the learners as to observe qualitative differences in regards to their knowledge and competence
31	Collect feedback about the organization of the activity from judges, mentors, implementation team, and learners	Feedback collection was performed during the post-test questionnaire (in Step 27)
32	Perform analysis of data collected during the pretest, assessment of solutions, post-test, debriefing, feedback	A first analysis was carried a week after the hackathon by the main organizer as to assess the overall success of the activity and digitalize the information. A complementary assessment activity was organized with the organizing group a month after the event
33	Plan how to integrate EDUCHIC solutions in follow-up activities (e.g., from this hackathon to the next one; from this hackathon to external impact (science, etc.); from this hackathon to another educational activity; from this hackathon to a, for example, start-up)	The organizing team met after the event and discussed possible approaches to integrating this hackathon in other activities at the university
34	Document activity and disseminate it (e.g., internal report, academic article, teacher's course evaluation report)	Press releases were issued[vi]; the initiative and narratives developed by the learners were presented at an expert panel discussion on digital imaginaries in education.[vii] The structure and results of the hackathon were presented within national and international workshops on hackathons and AI ethics pedagogy. The activity was also documented with reports and internal and public presentations carried for the funding agency. Scientific articles were planned (including the current one)
35	Revise the activity based on the results of data analysis and iterate	The key points of success of improvement were identified and organizational and structural elements were streamlined as to be re-used and scaled up for the TAIGAthon,[viii] which was a three-days long series of hackathons on the topic of AI for social good that were run in October 2022. Moreover, actions for integrating such hackathons within formal training structures at Umeå University, Sweden and UiT The Arctic University of Norway are ongoing

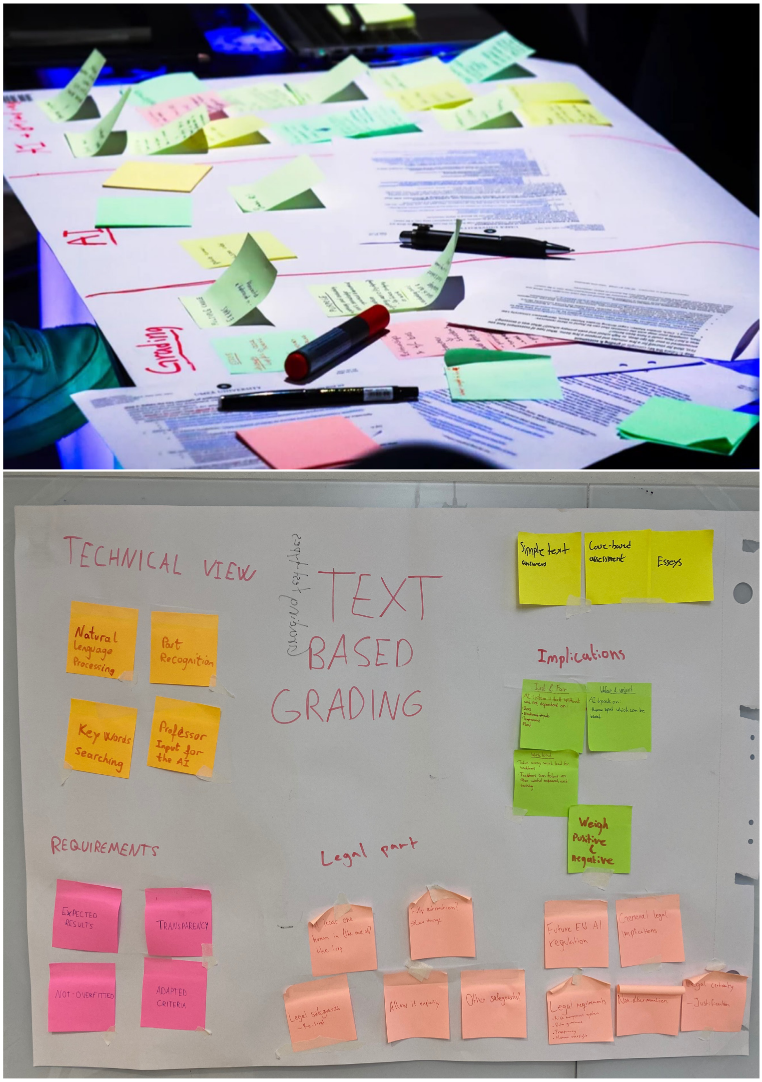

FIGURE 4 Moments of the AutogrAIde Hackathon. Upper picture: the disciplinary activity in the making (home discipline and its connection to grading concerns, home discipline and its connection to Artificial Intelligence (AI) concerns, home discipline and its connection to AI & grading concerns). Lower picture: the outcome of the interdisciplinary activity—a proposal on text-based grading solutions, crossing concerns from pedagogy (types of text-based grading and their complexities), computer-science (what can system sense and fail to sense and decide or fail to decide on, key techniques, key technical issues of these techniques), work environment (how such a system would alter student and teachers interactions, workload), law (present and future regulations, right for justification), philosophy (ethical concerns, fairness, bias, transparency), and sociology (discrimination, human oversight).

Defining the EDUCHICH challenge, Step 5 in Table 1, is one of the most critical points in EDUCHIC. A good challenge for such a hackathon should be *easy to learn*, *hard to master*, as *mastery is to be achieved through (inter) disciplinary trade-offs*. This challenge should be large enough for multiple people to work on it. It should be decomposable, with each of its components involving at least two disciplines that are in partial tension and require to find trade-offs. These components should be dependent on each other and modifying one should impact another.

The challenge should pose an iterable, 'hill-climbing' type of problem: a first solution is easy to find and this can be slowly refined over the time of the event. The teacher has to make sure that the learners do not master the challenge on beforehand, as in such case the exercise becomes a mere application of an already mastered corpus of knowledge and skills, void of the possibility for developing further skills to solve interdisciplinary challenges. The challenge should allow for multiple comparable solutions. The solution space consists of compromises along multiple disciplines, rather than compromises along one discipline, and no requirement to pass hard conceptual thresholds (interdisciplinarity is already a hard conceptual threshold). If the challenge is designed in a team of teachers, then the four stages for developing interdisciplinary challenges for hackathons described in (Wallwey et al., 2022) could be used.

When defining criteria for evaluation of the solutions proposed by the learners, Step 6 in Table 1, we recommend that these solutions should be comparable according to evaluation criteria that allow the identification of the most suitable solution; thus, some criteria have to enable a situation in which not all solutions are equally good. These criteria have to ensure that the integration of all or most of the involved disciplines is manifested in the final product (thus, disciplines are represented, are carefully accounted for, and are connected in a meaningful way), as well as *in the means of producing* this final product, in other words, to ensure that the learners have followed the steps of the interdisciplinary process. Asking learners to write short individual reflections is the most accurate (as to avoid free riding and possibly use as part of course work or course assessment), but group reflections can be good enough given the limited timeframe.

When guiding (and assessing) the learners in appraising their proposed solution, one has to be careful not to fall into ineffective relativism ('it depends [without saying on what and to which extent]'; 'it is complicated [but no criteria]').

A final note is that an EDUCHIC can be organized as a stand-alone activity or it can be included within a specific course. For example, the course can offer a first training phase, which is followed by the hackathon, and end with a consolidation of the solution identified in the hackathon.

5 | DISCUSSION, LIMITATIONS, AND CONCLUSION

This paper introduces a conceptual framework as well as three key principles for developing EDUCational Hackathons for learning how to solve Interdisciplinary Challenges (EDUCHIC), as well as the practical properties and a concrete 35-step guideline for implementing EDUCHIC in practice, from planning to implementation. The *main strength* of EDUCHIC lies in being explicit about the terminology it employs, about the underlying principles that it builds on, and about the detailed steps that one can follow when organizing such an activity. Our approach fulfils key dimensions of interdisciplinary pedagogy as identified in speciality literature. Following (Yang, 2009), EDUCHIC is *built on the outcome-based model of teaching/curriculum design* (as it explicitly includes the use of ILOs) and the *principle of constructive alignment* (also explicitly included), along with *innovative teaching and assessment strategies/methods* (the hackathon itself being such a method). Following (Manathunga et al., 2006), EDUCHIC provides learning experiences that are *relational* (by creating explicit spaces for interdisciplinary dialogue), *mediated* (by engaging in interdisciplinary interaction with others and with the texts and tools of a number of disciplines), *transformative* (by synthesizing disciplinary knowledge in order to produce original, creative ideas), and *situated* (by creating personal, interpersonal, and communal intellectual contexts conducive to interdisciplinary exchange). EDUCHIC provides a space in which the learners can *move beyond disciplinary cultural relativism to interdisciplinary synthesis*. It explicitly includes steps in which the learners *work on their epistemological understandings of their original discipline and how this knowledge relates to and sometimes conflicts with that of other disciplines*. Moreover, it provides in an explicit manner a space in which learners can *'wrestle' with multiple disciplinary perspectives*, thus facilitating the enhancement of their higher order thinking and metacognitive skills.

Taking a critical stance, we also see the *limitations* of our approach, which come from the limitations of the hackathons/group work and interdisciplinary education themselves. Here we enumerate some of these. Learners might lose the focus on learning and concentrate mainly on the process or on the product (creating theirs or critiquing the one of the other groups). In group work, some learners are always cast in similar roles (e.g., girls in computer science doing the reporting); some learners are more vocal than others, with the ideas of the latter ending up not being discussed. It may be difficult to recruit and coordinate the right staff/mentors/judges, with the necessary skills and understanding of interdisciplinarity. Implementation of EDUCHIC is costly in pedagogical resources (big enough room, one full day, multiple experts, preparation). The right challenge may be hard to find (must fit the students, the teachers; must be interdisciplinary enough for some good learning to be possible). It might be difficult to scale EDUCHIC up to very large groups. The integration of the solutions in follow-up activities remains to be explored. Hackathons in general require access to considerable resources (both in terms of human capacity and logistics), as they need extensive preliminary preparation and initiation of potential users.

Furthermore, beyond learner experience, this paper contributes to the body of science about hackathons as a pedagogical method (Porras et al., 2019) by providing a conceptual and organizational frame for hackathons to be structured as a learning activity driven by and supporting the attainment of ILOs that can be systematically documented in academic papers. As such, it adds to the studies that provide models of educational practice (e.g., Könings et al. (2017)). Providing meaningful IDR T&L opportunities in higher education is not a trivial task. Developing and sharing clear and concise guidelines with the community of practitioners interested in such endeavours contribute to the collaborative expansion of the toolbox available to both teachers and self-directed learners.

As wicked problems are often composed of complex and interconnected factors, they typically involve trade-offs for which domain competencies are required in order to effectively assess the properties of these factors, but where interdisciplinarity is key for striking an adequate balance in the trade-off. EDUCHIC activities could be used to prevent learners from developing 'siloed' understandings of the world and society by promoting reflection and awareness of the interconnectedness that many societal, technical or other problems may exhibit. Through such broadened perspectives, and the familiarity with interdisciplinary collaboration or dialogue that EDUCHIC may foster, it is also plausible that students in their future careers will become more likely to seek out interdisciplinary collaborations, which would be a welcome development.

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DATA AVAILABILITY STATEMENT

Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

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ENDNOTES

[i] One has to note that these are not all the possible variables that can be considered. We have included here those that the speciality literature found to be particularly salient when reporting implementation of hackathons. We believe that, from a practitioner's point of view, gathering these together in one single place provides valuable help for designers of hackathons.

[ii] The other two models described by (Chadha, 2006) are *embedding*, when no direct reference is made to developing transferable skills as the emphasis is on promoting the development of technical 'know-how' within a specific discipline, and *integrating*, when skills are developed and taught explicitly within the core discipline and the same amount of emphasis is placed on the development of transferable skills as technical abilities.

[iii] See the members on the project description page https://www.umu.se/en/research/projects/autograide---automated-grading-of-ai/ .

[iv] https://github.com/lvanhee/autograide-hackathon-resources

[v] https://www.umu.se/en/humlab/

[vi] https://www.umu.se/nyheter/bor-och-kan-vi-betygsatta-studenter-med-ai-verktyg_11192032/https://www.umu.se/en/news/can-and-should-ai-systems-set-student-grades-_11192032/https://it-pedagogen.se/bor-och-kan-vi-betygsatta-studenter-med-ai-verktyg/https://www.umu.se/en/news/ai-in-future-grading-yes-or-no_11330482/https://www.umu.se/nyheter/ai-i-framtidens-betygsattning-ja-eller-nej_11330482/https://digitalimpactnorth.se/ai-i-framtidens-betygsattning-ja-eller-nej/

[vii] https://www.digitalfutures.kth.se/event/digital-futures-for-education-ai-imaginaries-in-education-hitting-the-target-but-missing-the-point/

[viii] https://www.umu.se/ai-for-good-inauguration-conference-of-taiga-centre-for-transdisciplinary-ai-umea-university-26-28-oktober/ai-for-good-invigning-taiga-program/

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