Project-Based Learning Emphasizing Open Resources and Student Ideation: How to Raise Student Awareness of IPR?

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Abstract. This article examines a project-based course that is based on the use of open resources, where students ideate and implement Open Data applications in small groups during an intensive 12-week period. The course emphasizes students' abilities to innovate and necessitates the adoption of technologies that are typically new to the students. The course is offered at the bachelor's level after highly structured first university courses, which means that the students face a great challenge with regards to adopting self-directed and self-regulated way of working. The main research focus of the article is on how to emphasize Intellectual Property Rights (IPRs) as a learning objective. In the project education literature, IPRs are typically discussed in conjunction with courses where students collaborate with external customers. We argue that the present Open Data context together with creative group work also require a proper emphasis on IPR questions. A project agreement template and educational activities are designed and proposed to be used in student-ideated projects to properly raise student awareness of IPRs.

Keywords: Project-based learning · Open resources · Open data · Innovation ability · Creativity · Intellectual property

1 Introduction

'Project method' has existed in education for almost (or at least) a century, as indicated by Kilpatrick's [36] early report. Project courses in the field of computer science and software engineering have also been implemented for decades [49], with a high number of reports published over the decades. Within these fields, various project course models have emerged and are summarized in taxonomic reports by Shaw and Tomayko [44], Fincher et al. [19], Clear et al. [11], and Burge and Gannood [7]. As reflected in these reports, an educator can choose from a number of course attributes when designing a project course. Generally, project education reflects the educational thinking that 'function drives the form' [19], i.e., the educational goals for a project can be reached by selecting applicable course attributes.

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Recent course conceptualizations include teamwork in multicultural [42] and multidisciplinary [8,25] settings. Accordingly, it should be fairly plausible to state that project education reflects changes in the modern working life environment. The present article describes and reviews a bachelor-level project course where *students innovate* a software product using 'Open Data and open APIs (Application Programming Interfaces)', which are on the increase among societal interfaces. This course theme was initially regarded as topical and, therefore, potentially interesting to students, while making projects realistic and hence educationally relevant at the bachelor's level. Innovation ability is a skill that many agree is important for present-day and future graduate students [18,56,57].

The authors' previous *CSEDU2015* article [31] described the course concept and several challenges observed in running the course after two course iterations. These challenges require careful planning to be followed by informed action-taking during the next instance of the course. The present article extends upon the previous article by addressing one of the challenges described in detail, that is, how to emphasize IPR as a learning objective during the course.

IPR questions during project courses are typically acknowledged and formally managed in projects where students collaborate with customers (industry) (e.g. [51]). The customer interface is typically managed through agreements or contracts between individual students, customers, and the university (e.g. [53]). In the present article, we propose project agreements to be used also in the setting where external customers are not used but rather students themselves ideate the products. We design a project agreement template and educational activities needed to raise IPR as a learning objective.

Section 2 reviews the theme of 'openness' while Sect. 3 makes remarks on how IPRs show in project course reports. The course concept is outlined in Sect. 4, while Sect. 5 describes the IPR challenge faced by teacher and students in detail. The challenge is then addressed in Sect. 6, where actions needed to emphasize IPRs as a learning topic are designed. This section reflects planning for subsequent action-taking in the authors' action research project that aims to address the challenges identified during preliminary course iterations. Concluding remarks are stated in Sect. 7.

2 Being 'Open' in the Digital Era

When a resource is open, it is available for others to use. It is freely accessible, usable, modifiable, and redistributable as-is or as a derived work. Similarly, an open activity or process can be followed and affected by others during its execution. However, when the attribute of openness is attached to different things, we end up with multifaceted and varying conceptualizations, such as open data, open source software, open service, open innovation, open education, open information society, open government, open science and research, etc. (see, e.g., [32]). To be known as open, a resource or outcome of a process is typically attached with an open license. For a piece of software, this can mean complete freedom, even to close the derivative works, as with the permissive MIT license.

Another well-known alternative is to enforce the derivative works to be similarly available as the original source code, as with the copyleft GPL licenses (see [50] and references therein).

Open *data* is accessible and usable for further processing and refinement. According to [16]: 'Open data is the concept that defines the publication of government or private company data without copyright restrictions. The data should be formatted so that citizens can reuse it at their discretion to create new, innovative services or applications.' However, the overall rights for even a raw data resource should be governed by a content license, such as one from the creative commons family[1]. Moreover, open (and sometimes big) data is often not enough, but one should be able to turn it into interesting patterns, models, and visualizations [23] that provide answers to some specific questions of true value [24]. In the Finnish national context, the development of the open data movement has been summarized by [33].

Recently, many tools and methods for utilizing open data have been proposed: visual exploration of open data [41], a flexible environment for Web data integration [9], a domain-specific language (DSL) for open data visualizations over the Web [40], and a high level library to help developers build safe mashups over APIs in HTML5 [48], to mention a few. Open data can also be utilized in existing or novel games, as suggested by [20]. Concerning the Semantic Web tools, the integrated knowledge base of open data is referred to as the Linked Open Data (LOD) (see [3] and articles therein). Arguably, such massive data sources increase complexity of applications but also their potential benefits.

Activities to create, publish, and utilize open data are becoming more and more popular. In many cases, availability of open data can be linked to an open innovation process fostering collaboration between private companies (especially in the creative industry), governmental or public actors, citizens, and academia (scholars and students), once again to create new products and services through purposive inflows and outflows of existing or newly created knowledge (e.g., [12,27]). The existence of a local co-creative platform can be an important precondition for publishing some existing data, even if to reach the actual innovative outcomes requires continuous efforts and allocation of time from all the participants.

It should be noted that to be able to be innovative may require a basic understanding of the actual term innovation, which, for undergraduate students, could be challenging [18]. Similarly, as argued by [13], scientific inquiries related to open innovation reveal a lack of clarity regarding the term's meaning, especially in the business context. However, the paradigm of open innovation has been proposed by [10], with the encouragement of knowledge inflow and outflow to ensure that tasks are completed efficiently and effectively. He sees open innovation as the key to developing novel products and services in the modern business world. He proposes six principles to achieve open innovation, two of which are relevant here: (1) work with smart people inside and outside the company (university

[1] https://creativecommons.org/licenses/.

students of CS should qualify), and (2) a firm (or a student team) does not have to originate the research (or data and software) to profit from it.

The innovation process and outcome can be closed or open. For instance, an open source software component can come from a private software company taking part in the open source development. Similarly, the user-centric design process of, for example, texture for a new curtain model, might end up as a new product sold under a (closed) trademark. As educators in the digital era, we should inform students about making the outcomes of their Open Data/API projects open [27]. So far, the main focus of the course studied in this article has been inbound open innovation, i.e., utilization of existing open resources to produce an own software deliverable.

3 IPR in Project-Based Courses

Allocation of IPR is formally managed in project courses where students collaborate with customers, with many papers reporting similar arrangements. The basic argument on these courses is that it would be difficult to devise relevant customer-ideated projects, and hence to collaborate with real customers, if IPRs are not granted to customers, as is illustrated by the survey data by Warnick and Todd [54]. The typical arrangement is that students grant IPRs to the customer; this occurs through written agreements or contracts [2,26,30,51–53]. Due to university contracting polices, this may in practice be managed so that students grant IPRs to the university who then signs it off to the customer (e.g. [22]).

Many courses allow students to select whether to work in a customer project that requires the transfer of IPR to the customer or in a customer project which do not necessitate an IPR transfer [2,30,51–53]. The experiences reported by scholars indicate that students are typically willing to transfer the IPRs and that only few students object or select other options (e.g. [26,52]). However, it seems that the position of students who object is not always addressed. For instance, Stearns et al. [46] note that they had no process defined for those who objected (and did not sign to) the transfer of IPR and that these students 'just continued' in the capstone sequence.

The characteristics of the customer, university polices, and stance taken by educators may also affect how the customer interface and the IPRs therein are realized. A quite common scenario is that customers who are granted IPR are also charged for the projects, the payment being directed to the university and spent on the costs arising from running the course—which applies to the real customer projects at the authors' department [30]. A panel paper [55] reports on an arrangement where a customer who is required to actively attend the project does not pay but is granted IPRs. Leidig and Lange [38] in turn note that, while IPR is granted to their course customers, the university should prepare for after-project technical support due to collaborating with non-profit organizations, regardless that such customers initially agree on resource limitations. Doepker [15] reports on the arrangement where customers are granted IPR, but the university shares in the potential profits emerging from the projects.

The present interest in IPR concerns student projects that are based on the students' own ideation without a customer stakeholder. Interestingly, a 'call for' tackling IPR in such contexts is acknowledged, but no explicit solutions on how this should be done were found in the literature through non-systematic searches. In a study describing an open innovation contest, Abdelkafu [1] reports on how students may not be willing to submit their work due to being concerned about IPR. In a game development course that exemplifies creative pedagogy, Kiili et al. [35] also identify the presence of IPR issues, and mention the need to tackle them.

We argue that granting IPR to the customer in real customer projects provides, in a sense, an educationally straightforward solution, as students do not need to consider how much each individual actually contributed—IPR is granted to the customer anyway. In student-ideated projects, IPR questions may occupy students' minds more due to the presence of attributes such as creativity. Accordingly, Bach et al. [4] describe the open innovation setting as being dispersed when compared to traditional IPR protections that are more focused in nature.

To emphasize the educational need for addressing IPR issues in the course based on openness, it should be noted that students tend to feel ownership over their work even when they work as 'executors' [45]. Further, as noted by Fuller et al. [21], students as well as software developers may be willing to rashly use software regardless of licensing violations, but be much more strict when considering ownership of their own programming contributions. For our purposes, we would reformulate this remark such that the use of available open resources with own deliverables can create tension when own achievements are overemphasized, resulting in licensing violations.

We also briefly observed literature outside project-based courses. A framework and an implementation of a local open innovation project platform named "Demola" was described in [34]. A mutually beneficial and agreeable IPR model was nominated as one success factor for such projects by multidisciplinary MSc level student teams that produced new products and proof-of-concepts together with companies. The Demola IPR agreement protects the rights of the original authors, giving partner companies full utilization rights but, surprisingly, 'Software licenses from the open source perspective are not addressed in the IPR agreement' (p. 299). Moreover, the paper reports on a small survey on IPR issues, which was issued to project groups and replied to by nine people; the responses indicated that only little care was being given to such matters in the actual projects. This was concluded to be a significant risk, indicating a slight knowledge gap (IPR in principle and in practice) as well.

Based on the outcomes of an European ITEA2-project, eight core practices for software innovation in software companies were suggested in [43]. In addition to being able to stimulate innovation, harvest and valuate ideas, support expertise (etc.), a software company innovation practice referred to as "the Art of Openness" was depicted. Interestingly, the paper mentioned that the utilization of open source software is in many cases not even recognized at the CEO level in companies, whereas the actual development confronts it frequently. The suggestion made

was to define an openness strategy at each relevant level of operation: product, process, organization, and business model.

Altogether, we find it pedagogically appealing to be able to integrate IPR issues in the project course in two senses: first, to face the issue when searching and innovating with available open resources and, second, to deal with the issue in the applied sense when agreeing on the rights of the team deliverables.

4 The Course

This section summarizes the relevant attributes in the implementation of the course. The presentation reflects the current state of the course design, while IPR related actions are reflected on and re-designed in Sects. 5 and 6.

4.1 Workload, Learning Objectives and Facilities

The project course spans 12 weeks and students are rewarded with 5 ECTS credits. The course is intensive and challenging; the software product prototypes illustrating at least a proof of concept are ideated and implemented in the given time frame through newly formed groups.

The initial learning objectives were to introduce and conceptualize group processes and software process issues to the students through realistic project work at the bachelor level. After two course iterations, these objectives were complemented with the ones emerging from the innovation-based course concept; that is, prompting self-directed study processes among the students and improving student self-efficacy. Related to the possibility of improving self-efficacy, ideating and producing software from scratch sets a technical learning goal for the students. These latter kinds of learning objectives were the main focus of the author's *CSEDU 2015* article [31]. The present article focusing on how to address IPR during the course emphasizes IPR as an important learning objective.

Each group is provided with a lockable work room equipped with personal computers for each student to support students' realistic and autonomous work. The course thus differs from studio-based learning environments where students' work is guided through fixed practice sessions (see, e.g. [47]). The faculty's PC support is available to the students, and they are granted local administrative rights to install and configure software independently. Typically, programming code is managed in a version control system, and each student pulling from the remote repository can run the needed server applications in the local computer (localhost). The intended group size is four students, though, due to course population, a few groups have also comprised 3 or 5 students.

4.2 Teaching Resources

The course is taught by two supervisors. A departmental teacher (the first author) supports students with group work issues and software process issues,

while a senior student works as a technical supervisor. The senior student recruitment is based on a strong personal interest in the course topic (creative software development based on the open theme).

Absorbing the overall architectural idea of how to work with APIs and integrate data and software components into new products is important for the students. It is this competence that the technical supervisor of the course needs to possess. Many API releases are supported with an open source wrapper code. Then, what remains as a task of the programmer, in order to receive the data needed, is studying, integrating, and potentially modifying the wrapper. Similarly, parsing various data formats used in open data and API context, such as JSON, is often an effortless task, while open source components also tend to exist for parsing less popular data formats such as PC-Axis. In light of these examples, students are to be informed of the *conventions* and existing *technological possibilities* of small-scale open source (web) development. The technical supervisor, attending all the per group supervision sessions, importantly facilitates the students' technology adoption process.

The aim is to develop a course climate where the personnel reflect strong interests in their specific expertise areas, to inspire students to develop professional interest in the course topics. In our experience, the course has been manageable for two persons with up to 7–8 groups and a maximum of four students in each.

4.3 Joint Course Events

The course structure is displayed in Fig. 1. The top line describes events concerning all the students. The course begins with a start-up meeting during which the course idea, course events, and documentation are explained to the students. This meeting also provides students an introduction to Open Data and APIs, by giving examples of the related applications found on the Web and a comprehensive list of open resources. Both national and international (EU) open data and API links are listed, and known services with API releases, such as Spotify, Twitter, Bibsonomy, and Trello, are noted. To enable students to picture about the scope of their project, exemplary resources are discussed through speculative examples ("Trello could be complemented with a component that first exports users' work hours markings and then imports a sum of them with visualization"). Students are also guided to independently seek other fresh data releases based on their own interests. They are also told that HTML scraping could be needed to receive data within the interesting topic. Students are grouped by the teacher at the start-up meeting. Because the course pedagogically focuses on group work issues, the aim is to group student who have not worked together previously. This way each group's dynamic has a fresh and equal start.

The next shared event is the project lecture where group work concepts, including norms, statuses, roles [6], and justice in group work [29], are discussed. The topic of software processes is also included. Here, discipline in the software development is carefully explained and linked to project safety. A particular emphasis is also given to iterative software process, which has been found to fit

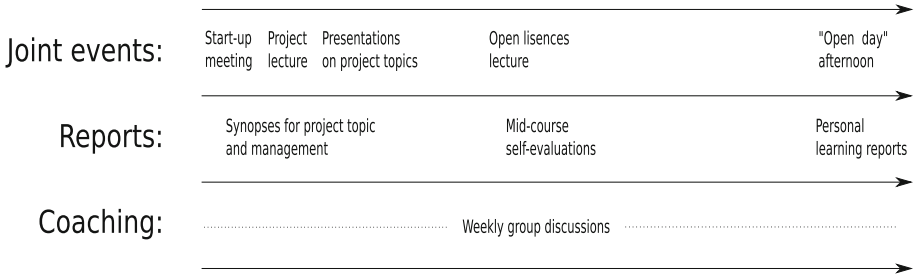

Fig. 1. Course events and tasks during 12-week creative software development effort.

realistic student projects [28]. On the third week, a shared session is arranged where the groups describe the project topics they have ideated. This session is intended to reinforce the innovation theme across groups and share considerations on the use of data resources and the designs of software products. Near mid-course, an expert lecture on open source software licenses is provided to increase student awareness on the licensing issues and enable them to agree on the licensing of the group products.

At the end of the course, groups present their software products during an 'open day' for the department's personnel and other students. In place of traditional presentations, students present in their project rooms and allow the audience to try the software products and discuss design and implementation. This way of presenting fosters dialog among the attendees.

4.4 Minimal but Important Documentation

The mid-line in Fig. 1 describes the documentation required during the course, which is minimal. At the beginning of the course, student groups prepare short synopses for 1) what they have agreed as their project topic and 2) how they are going to manage their work. These are intended to help the students be aware and take responsibility. In the synopsis on the project topic, student groups provide an abstract for the topic but also address the important feasibility questions below:

- further ideas and visions,
- target group (utility aspect),
- licenses and terms of conditions of the intended data usage,
- data formats,
- technical environment (programming languages, platforms, libraries, etc.),
- licensing of the product (under what open source license the product is released), and
- boundaries of the project, i.e., what parts of the ideated project are most relevant and to be achieved during the project.

These questions are reviewed in per group supervision sessions. A potential gray zone in data usage is thus avoided since the students are guided to find out and

comment on the conditions of their data usage. Should there be any open questions, these will be naturally raised since the synopsis questions are reviewed. Because student work is by default owned by the students, they naturally decide on the licensing of the products. In the synopsis, groups make an initial agreement on an open source license for their product. The licensing question is later supported by an expert lecture (see Fig. 1), after which the students are prepared to make an informed decision, taking into account the licenses of the used components. In the course based on the students' own ideation, the university does not require any transfer of rights. It must be noted here that the present article refines the educational actions needed for properly emphasizing IPR during the course; see Sects. 5 and 6. For instance, we will raise IPR already at the time of course registration and use per group IPR agreements.

Given the emphasis on the students' own product ideation, the projects are based on the students' proposals with no initial inclusion/exclusion criteria on APIs, data, or application type. For instance, the product can be a web service or a game, as well as a desktop application, and we have also suggested the use of Arduinos and Raspberry Pis in the context of open resources. Students must nevertheless consider a target group, which implies that the projects become realistic as compared to programming exercises with no user interest. The open theme enables small-scale products starting from ones making single data source utilizable through data manipulation and visualization (cf. small tools for data journalism), while often the ideated products are larger. For this reason, student groups prioritize and define boundaries for what they aim to achieve during the project (see synopsis items above). We want to prompt students to be creative, while the synopsis document and weekly supervision discussions help groups set their goals realistically during the project.

At mid-course, self-evaluations on group work and software process are conducted, each student completing a survey form. The teacher inspects the evaluations and raises their main points during a group discussion session; the group situation revealed by the evaluations is openly discussed. When the projects are complete, each student prepares a personal learning report, reflecting on group work and software process issues in light of both lectured theory and conceptualizations that emerged during the project. The teacher gives a written response to each learning report to enhance student learning.

The inclusion of very little documentation means that all tasks are substance tasks that advance the actual ideation and software product development. This makes it almost impossible for students to limit their involvement to completing some secondary tasks; potential 'passenger' roles become visible and can be raised as group issues. For project management, the students use VCSs (with no exceptions, this has been Git) and project management software, such as Trello. It should be noted that limited documentation does not indicate low teacher workload, as sensitive group discussions (Sect. 4.5) are very challenging for supervisors and require preparation and continuous reflection.

4.5 Emphasis on Dialog Through Group Discussions

The bottom line in Fig. 1 illustrates that teaching this course means coaching through group discussions. Thus, a discussion session attended by the course teacher, the technical supervisor, and the student group, is arranged each week for all the groups. The group situation, software process, and various issues in product ideation and implementation are discussed in these sessions. Informal discussions were considered suitable for the creativity-based course, and are a tool to introduce theory in the presence of authentic practical work; emergent problems are contemplated in terms of theory. During a particular session, the written self-evaluations provide the basis of discussion, which aims to guarantee that all the students are heard through personal writings during the project.

In this short course, the main learning objectives are introduced at the beginning through lectures and are then intensively addressed in the group discussion sessions throughout the course in the context of actual individual projects. The main pedagogic principle is based on the realist epistemology [5,39]. Thus, it is based on an assumption that there are important objectifications that can explain to the students their project successes and challenges, and that these objectifications must be raised during the project to foster conceptual understandings among the students. It is important to note that the innovation-based open-themed projects have provided a good forum to introduce truly authentic project work where group issues, for instance, emerge naturally and can be conceptualized to the students realistically. Taking group work as the example case, the pedagogy of the course was described in detail in another study [29]. The solution to the question of how to emphasize IPR issues during to course (in Sect. 6) follows the same pedagogic principle: the process of agreeing on IPR in the open-themed course context is 'conceptualized' to the students (see Fig. 2).

4.6 Pass/Fail Grading

Considering the sensitive issues (e.g., justice in group work) discussed during the course and the aim to promote the students' innovation ability, grading is pass/fail. Without competitive or external pressure of numeric grading, students are prompted to overcome their difficulties in adopting self-directed, creative, learning processes and to fully focus on conceptualizations that explain their group experiences. Positive experiences with a project-based course without numeric grading have been reported by Daniels et al. [14]. Promoting student interest in course content instead of 'just passing the course' is also in line with the Klug's [37] work. He linked (numeric) grading with a degree system that does not necessarily match with the learner's personal intellectual development.

In our course, students track their work hours. However, passing the course is not based on quantitative inspection of student work hours or amount of programming code. These attributes approximate student role in the group, but they do not explain the effect of group situation on the student's possibility to participate. The passing is based on active participation, which is fairly easy for the teacher to interpret with the selected course arrangements: the frequent

meetings between the supervisors and groups and the related discussions on group processes. During these discussional sessions, reasons for low participation are objectively addressed in terms of group work processes, following that the students themselves become aware if their difficulties result from group work or if they are truly not participating in the course. In the first case, various solutions for improving the group situation are sought for. For instance, by improving intra-group communication the division of work could be improved to match the skill levels of group members.

On the basis of the exposition above, 'failing' and 'dropping out' can be said to mean same thing in this course. Accordingly, two dropped out students of the course agreed to drop out for low participation which was due to reasons external to the course. It should also be noted that group difficulties do not directly mean dropping out; rather, through active participation the difficulties undergone can be reflected on for the sake of conceptual learning.

5 The Intellectual Property Challenge

This section describes the IPR-related challenges that we have identified in running this course.

5.1 Lack of Systematic Expert Support

At the beginning of the course, when exploring various resources for their work (data, APIs), students encounter a 'jungle of terms of conditions (TOCs)'. This particularly occurs when a student group uses data sources that are 'semi-open' in nature, with some specific and often ambiguous clauses stating the conditions of use. The intention is to act legally. Unclear situations have been currently resolved with the teacher requesting expert comments from department personnel who are known to possess the required expertise. Alternatively, where students have scraped web content, the teacher has guided groups to contact the service providers to request permissions for using the data, which has been a successful procedure. The groups have either received permissions or an answer that has helped them to revise their project goals. Altogether, the IP issues in relation to the utilization of resources have introduced a great challenge, a kind of a delay element from the teaching perspective, as the interpretation of TOCs and various small clauses can require juridic expertise.

5.2 Lack of Support for Informed Decisions

Another important IPR-related challenge concerns the outcomes of group effort. We described in Sect. 4 that students have been asked to initially agree on open licensing at the beginning of the course and decide on the license by the end of the course. We have noticed that students tend to only cursorily comment on the question at the beginning of the project ("we will use some form of open licensing"), as they are only ideating their project. Further, the teachers' impression

is that students also make fairly hasty selections at the end of the course, without in-depth, intra-group discussions, and hence there is an educational need to increase dialog on IPR to both allow and foster more informed student involvement. We notice that we have not systematically communicated IPR and 'IPR in connection to openness' to the students, which would most likely explain our experience of IPR as a 'sidetrack' during the course.

5.3 Lack of Proper Release

The IPR challenge during the course is also related to the question of how to release or 'exhibit' project results. An unfavorable pattern can emerge when students overcome their group work and self-direction challenges and show abilities to ideate and implement a product, only to see the completed project as 'just a course assignment' without big-picture relevance. This perspective can leave the course without the purposive outflow of newly created products [27]. Different from our master's level customer project, there is no final release of project deliverables to any customer stakeholder. In addition, in the context of the local CS curriculum, there is no larger business study component underpinning the course that would inspire students to continue with their projects as the course ends. Thus, we need to consider how students should release their results. In our thinking, a meaningful release would increase the perceived relevance of educational discussion and decisions on IPR.

6 Actions for Emphasizing IPR as a Learning Objective

The activities presented below address the challenges described in the previous section. The overall educational purpose is to emphasize to the students that IPR must be raised, discussed, agreed on, and decided on. The agreement template, which is referred to in the text below, was translated from Finnish to English and is provided in Appendix A. The proposed template is tentative and has been briefly commented upon by the Legal Counsel of the University of Jyväskylä. The precise form of the proposed kind of agreement naturally depends on the national legislation (e.g. the general rights for student work outcomes) and on the university level regulations (e.g. who can sign such agreements).

6.1 Before the Course

In a course registration form, we ask if a student is willing to agree on IPR within a group during the course. The student is given the following information on the registration form:

> *Intellectual property emerges on products ideated and implemented in groups during the course. For this reason, it is appropriate that group members agree on how to license project results and thus on after-project use of the results. For this reason, an agreement will be signed during*

the project, which ensures that group members are willing to make an agreement and will select the way of licensing of the results. An example of this procedure is that group members attach open licenses to their project results. The university makes a request that the project results can be used for presentation and education research purposes. Intellectual property rights are not transferred in any way to the university.

We thus inform students at the time of registration that there is a natural need for agreeing on IPR within groups and that the university does not make any claims on IPR. Those students who are not willing to agree on IPR can be advised to take an individual programming project, which is one of the alternatives for a practical 5-credit course in our bachelor offerings. The request by the university is the possibility to use projects for presentation and research purposes, which is a common policy in the department's project courses and relates to the basic tasks of research and societal interaction realized by Finnish universities.

6.2 During the Course

The groups will be provided with a 'consultation hour' from the university jurist or a departmental person with similar expertise to facilitate the interpretation of complex license and TOC texts when ideating with data resources. The project course is one alternative for the mandatory practical study component in the students' bachelor studies, and the responsibility for answering juridic questions that arise during the course naturally rests on the course provider. Having an explicit course arrangement for this purpose would make the start of the course more fluent and underline IPR issues as an important learning objective. Another option would be to guide the students to strictly limit their project ideation to resources whose conditions are phrased without any ambiguities. However, in our view, this latter option would limit how the course concept can foster student innovation ability. Moreover, the use of various data resources and APIs increases both the students' and the supervisors' useful knowledge on intellectual property rights and licenses. For this reason we recommend that the course supervisors also attend the expert consultation hours suggested here.

To be able to emphasize IPR as an important objective, we will use written agreements. During the starting lectures, a project agreement template is reviewed and given to students to be prepared for their particular project. This guarantees that all course students are informed about the agreement's contents. During the first week, the agreement of each group is signed by each student of the group and the university stakeholder. However, as is noted in the agreement template, each student group attaches an appendix describing their selected licensing procedure till the end of the course. Thus, we want student groups to be able to start working from an unambiguous (signed) position where IPR is being addressed, while allowing the selection of actual licensing to take place at the end of the course, when the students can picture about their project outcome and have attended the mid-course expert lecture on open licenses.

When the agreement template is reviewed in the presence of students, a remark is made that students can select regarding their willingness to granting the research and presentation permissions, and that the agreement text is revised accordingly. The template default text informs students on the research to which the requested permission relates, meaning that an attempt is made to follow the national research ethics guidelines.

To increase student awareness of IPR and to allow for informed decision-making, we will also raise IPR as a lectured topic during the starting lectures. Students will be informed of intellectual property in the context of openness using the model in Fig. 2, which is inspired by the discussion on IPR and open creativity by Bach et al. [4]. These authors note the importance of interaction between 'as many entities as possible' in creative processes in contrast to the mere reliance on talented individuals. In line with this remark, we want to illustrate to the students that they act not only as individuals but as a group, which is likely to provide a useful ground for ideation: a project idea initiated by a particular student may go through refinements, additions, and even transformation to new ideas within a group. A student group and the interactions between its members are illustrated in the center of Fig. 2.

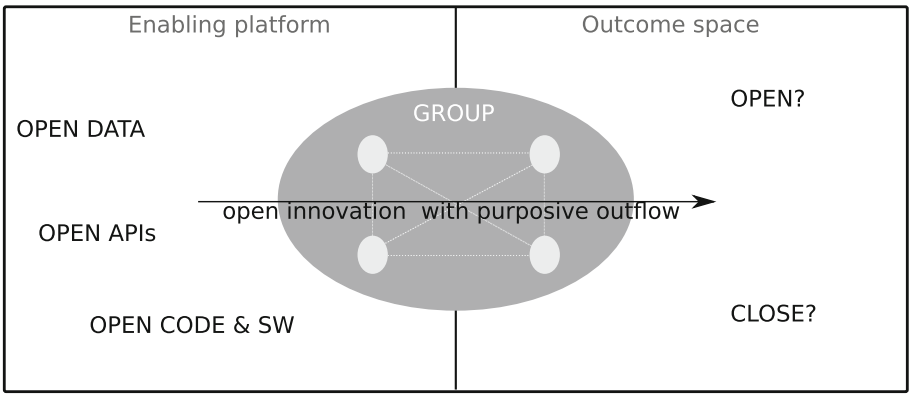

Fig. 2. The open-themed course setting conceptualized for informed IPR agreements within groups.

Another perspective stressed by Bach et al. is that innovations that find their way to commercialization require 'underground' creative communities. The authors note the dilemma between acts to restrict access to creative works and being open to fuel the functioning of creative communities. In this connection, we want students to be aware of the 'communities' involved. The left-hand side in Fig. 2 illustrates that students build open data applications upon open data and open API releases and various open programming code fragments and software components, while also upon the efforts underlying the publication of such resources. Thus, students are provided with an enabling, pre-existing, platform,

which is important to be aware of when making decisions on the licensing of project results. As displayed in Fig. 2, we also illustrate the presence of the open innovation process, which emphasizes a purposive outflow and openness of the outcomes. As the university does not make claims on student work, we provide students with the information on openness in a neutral way. It is possible that particular groups consider their project idea suitable for another (closed) way of publication, for which reason we also provide students with information on local area hatcheries and innovation hubs. Accordingly, it is possible that the licensing information attached to the contract is a purely student-specified clause, and even that 'each group member can utilize the project results as they wish'. The minimal educational goal is that IPR were raised, discussed, agreed on, and decided on, and hence acknowledged as an unavoidable topic in goal-oriented creative group effort.

On the question of how to release project results, we establish a showcasing site with links to GitHub or other platforms used by students for their product development. Such a site can then be connected with a local open data community, meaning that student work would become 'involved'. The students are also informed of and encouraged to attend open data contests in Finland (see [17]). The important educational question is how to deal with differences in the maturity of the products, i.e., how students perceive these differences if the products are made publicly available. Here, our plan is to ask student groups to prepare a digital presentation of the project to be included in the showcasing site at the end of the course. Students are hence able to set the form and the level of detail in their presentation.

7 Concluding Remarks

This article described a course concept that builds on student innovation ability, including attributes such as creativity and co-creation. The course is based on the students' use of open data and API releases. The main goal of the article was the designing of activities for emphasizing IPR as a learning objective. In the literature, IPR have typically been addressed in project courses where students work with customers, while in the settings drawing on students' own ideation IPR has received less attention. In this light, the present article can also contribute to other creativity-based education such as game development. The article reflects action research planning activity, which will be followed by action-taking and evaluation.

The educational actions designed stress that students are informed early on that they will make IPR-related agreements during the course and that all agreement template clauses must be reviewed in the presence of the students. Students should also be informed of licensing options and the idea of open innovation before deciding on how to deal with IPR. Further, we also stress that we will provide all information to the students in a neutral way, as the university is not making any IPR claims on the students' work.

Our subsequent action-taking will be evaluated from the perspectives of whether the designed activities raised students' awareness of and interest in

IPR, how students reacted to the activities proposed, and to what extent students, who are objectively informed about IPR and given the full freedom to decide on how to license their results, will adhere to 'openness'. Moreover, it is interesting to study how much students' views on IPR decisions differ within groups.

A Project Agreement Template

Responsibility for potential mistakes rests on the users of the template. The template is open to modification. We have marked with italics obvious replaceable points. For instance, the need for and formulation of the research permission request depends on the students' opinion on granting the permissions.

A.1 Stakeholders and Purpose of the Agreement

This student project agreement (the "Agreement") concerns the study module *TIEA207 Introductory Project in Computing and Technology* (the "Study Module"). The Agreement is made between the *University of Jyväskylä/Department of Mathematical Information Technology* (the "University") and the individual students who participate in the Study Module as an assigned group ("the Group"), implementing a project according to the Study Module syllabus and requirements ("Project"). This Agreement governs the rights to use and redistribute the material that is created by the Project.
The Group consists of the following students: *student names here.*

A.2 Definitions

In this Agreement, unless the context otherwise requires:

"Learning Assignment" refers to a task that must be done to pass the Study Module but whose outcome is not part of the main product of the Project, which is to ideate and implement a software system (including its source code) by the Group. Written Learning Assignments consist of, but are not necessarily limited to, ideating documents and presentation materials, Project management documents, time allocation reports, and personal writing assignments like self-evaluations and learning diaries.
"Product" refers to that software system or service (including the source code) and the immaterial rights therein, which the Group has created in the Project.
"License" defines the rights to use, copy, redistribute, or modify the Product created by the Group in the Project.
"Deliverables" refers to both the Learning Assignments and the Product.

A.3 Rights to Deliverables

Immaterial rights of the Product belong to the students of the Group who have created the Product. Members of the Group hereby agree that they will attach the License to the Product before the Project completion, which is the date of *the final Project presentations in the Study Module*. The choice of the License will be documented and signed by all the members of the Group (see Appendix) and attached to the Deliverables, which as a whole must be delivered to the University for archiving purposes by the Group to finish the Study Module. If a student stops the Project prematurely, the rest of the Group can use such student's Deliverables to continue and finish the Project and to agree on the License, after the student who has quit has been heard.

The University can use the Deliverables in teaching and education research as follows: The research is conducted by the course teacher Ville Isomöttönen and his research colleagues, for example Tommi Kärkkäinen, and concerns project-based learning and its components such as group dynamics and software process in creative work. The research results and the development of teaching activities will be made in such a way that an individual student is anonymized. The research materials will be kept in a locked storage and the results are published in education research forums.

The students themselves decide whether they want their names to be attached to the Project presentation material that is placed on the University's website by the end of the Study Module.
This Agreement does not contain any obligations for compensation.

A.4 Signatures

Signatures of each student and Dean of the Faculty here.

Agreement Appendix

Example 1: Group places the Product under MIT-license.
Example 2: All members of the Group can use the Product as they wish.
(students' signatures)

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