

Habituating Students to IPR Questions During Creative Project Work

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Abstract: Intellectual property rights (IPR) constitute a topic that is unavoidably encountered in digitalizing learning environments but that has received little attention as a separate educational research topic. In a project course context where students ideate and implement open data-themed projects, and hence IPR questions are highly relevant, we have learned that students readily perceive this matter as a side topic and tackle it without much deliberation. To improve students' awareness of IPR questions, we modified our course arrangements. This article analyzes and discusses students' responses to IPR in this setting. We found that students consider IPR a challenge, and we argue that they must be "habituated" to think over this matter. The temporariness, incompleteness, and potential humor of educational projects constrain students' interest in IPR, while the perceived relevance of a project topic increases their interest. Students altogether appreciate that IPR questions are raised and need to be agreed on within teams.

1 INTRODUCTION

The computing profession comprises several aspects that are referred to as professional skills. We focus on intellectual property (IP), which has received fairly little attention as a separate educational research topic. This topic is, in fact, inherently challenging. As noted by Bach et al. (2010), in the classical creative industry intellectual property rights (IPR) have a strategic but controversial role: both individuals and companies prefer strong IPR, whereas creative communities call for weak IPR to allow for flexible recreation (e.g., new music or video games).

The context of our work is project-based learning, which has a century-old documented history (Kilpatrick, 1918). In our field of computer science and software engineering, various project course models were already suggested decades ago (Shaw and Tomayko, 1991). Capstone projects or senior design courses constitute an essential part of many computer science and engineering programs, which is illustrated in taxonomic works (Fincher et al., 2001; Hoffman, 2014). We focus on a bachelor-level project course where students innovate a software product using open resources, open data and open APIs (Application Programming Interfaces). This emphasis on creation based on available resources links with the concept of open innovation proposed by Chesbrough (2003). In a systematic literature review on this con-

cept, IP was mentioned both as one of the main trends and as a popular keyword within the open innovation literature, while student innovation did not receive attention (Hossain et al., 2016). Hence, within the open innovation research paradigm, the student setting with regard to IPR is a novel domain.

In our experience, project-based learning in which students collaborate with industry can make IPR questions a relatively easy topic for students, as often such courses operate using university-made agreement templates requiring not much more than signatures from the students. That is, the topic of intellectual property is raised to ensure the protection of customer rights. When we devised a project-based course based fully on students' own ideation (no customers involved), we noticed that IPR questions constituted a "necessary evil" and that efforts had to be taken to raise students' attention (Isomöttönen and Kärkkäinen, 2016).

In an open, student group innovation context, one needs to manage IPR to prevent any concerns about students not submitting their part of the project work (Abdelkafi, 2011) and in order not to suppress creative work (Kiili et al., 2012). As noted by Fuller et al. (2010), students 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. Hence, the use of open resources in conjunction with

self-made deliverables can create a tension that leads to an overemphasis on one's own achievements. In this article, we study students' responses to IPR in the context of creative group-based project work.

2 IP IN STUDENTS' COURSEWORK

The recommendations and lessons learned relating to IPR issues in capstone projects have been strongly based on protecting the rights of industrial partners (e.g. Gorka et al., 2007). The importance of IPR issues is thus well recognized in project courses with explicit external customers. Under such conditions, intellectual property is negotiated and agreed between the university, individual students, and the customer organization (Isomöttönen and Kärkkäinen, 2008; Pilskašns, 2009; Vanhanen et al., 2012).

Many organizations implement several kinds of customer projects in such a way that students can make a selection and be allocated to the projects based on their opinions about IPR (Goldberg, 2004; Vallino, 2014; Alexander et al., 2014). As exemplified in the study by Vallino (2014), customer collaboration may take a form of an open source project, a project where IP is fully granted to the customer, a project where only particular rights to use the project outcome are granted to the customer (students keeping their IPR), and a project where no rights are granted to external parties. Sometimes IP transfer is organized in such a way that students grant IPR to the university, which then signs them off to the customer (Goldberg, 2004).

IP transfer is often seen as the key factor in being able to recruit companies as project sponsors and customers (Todd and Magleby, 2005; Henson, 2010; Warnick and Todd, 2011). Accordingly, IPR are often straightforwardly transferred to the companies, with other options mentioned in a sense of a backup-plan (Alexander et al., 2014). In a study by Stearns et al. (2003), there was no procedure for managing students who declined to transfer IP; such students simply continued working in the capstone sequence. Generally, IPR questions in customer collaboration are noted to be potentially difficult to manage (Gorka et al., 2007).

A different approach is found in studies drawing on student creativity. In the context of entrepreneurial capstone, Shartrand and Weilerstein (2011) posit that the entrepreneurial element transfers the usual emphasis on customer and university policies to the student team as to IPR. They stress the importance of educational possibilities to understand and learn fundamentals of IP in a real context and related to self-generated artifacts, as students are then motivated

and encouraged to pursue projects beyond the provided courses—their program offers students opportunities to advance the work initiated during the capstone projects.

Similarly, in the study by Silva et al. (2009), which focused on an entrepreneurial practical course, a major argument to ask students to reflect explicitly on intellectual property was its motivational influence on their creative work. They asked students to review patent registers to help them see how novel their ideas were, and they even encouraged students to file patents. The authors argue that such procedures are educationally valuable, preparing students for their professional future.

Yet another entrepreneurial project course for undergraduate students is presented by Pilskašns (2009). As with our own course arrangements, important content was provided to students in the form of small lectures, with one of the topics dealing with ownership and intellectual property related to project deliverables. The operational model in this case report, however, was based on establishing a student company around a lecture-defined novel software product whose IPR agreements were related to ensuring profitability for an external investor.

Empirical findings on students' perceptions are found in a small survey by Kilamo et al. (2012) who explored students' perceptions of IPR during projects implemented in a hatchery (Demola). In this setting, students and companies can collaborate on student-ideated projects. The authors noticed that students paid little attention to IPR during their projects, which corresponds with our prior experiences. The study by Silvernagel et al. (2009) also highlights challenges, reporting that it is not clear that students or faculty members are willing to openly disclose their project ideas, in particular if they consider their ideas to be of value. On the other hand, the study by Silva et al. (2009) reveals that students consider the topic of IPR to be important. In a post-survey of 42 former students from their course, over 90% of the respondents considered understanding of IPR issues to be crucial or important to solving business problems and taking advantage of entrepreneurial opportunities.

In summary, the role of an external customer, who typically pulls IPR from a student group, could be replaced by the requirement of the group to deeply consider IPR with respect to their own deliverables potentially having business value and/or societal impact. On the other hand, the literature indicates that students regard the topic of IPR as important but may pay little attention to it. Further, individuals collaborating on a shared project may demonstrate reserve when it comes to disclosing their own project ideas.

3 THE PRESENT CONTEXT

We devised a project course where students utilize open resources. The course is a 12-week (5 ECTS credits) challenge where small groups ideate and implement a software product using self-selected technologies. Each student group is coached on a weekly basis by a teacher focusing on group processes and software processes and a senior student providing technical advice. The course begins with a lecture on group and software processes and a briefing on web development with open data examples. Students present their project ideas after three weeks and then continue with the product design and implementation. During the last third of the project, an expert lecture on “immaterial rights in programmers’ work” is provided to facilitate students’ within-team agreements on IPR and their work with existing resources. The projects are finally presented in an open-day event where students demonstrate and let the audience test their products. The audience consists of staff members and other students in the department.

The course is very intensive and utilizes dialog as its main pedagogic tool. The main learning goal is conceptual learning about group work and software processes in realistic conditions enabled by creative open data projects. The course naturally introduces students to a topical theme, use of open resources, as well as reinforcing their technical skills. The course is for third-year students but is also occasionally taken by second-year and fourth-year students. The course arrangements and completed projects are described more thoroughly elsewhere (Isomöttönen and Kärkkäinen, 2015; Isomöttönen and Kärkkäinen, 2016).

When we previously merely guided students to consider IPR within their groups, we noticed that students gave little attention to the topic, cursorily attaching licenses they might know to their project outcomes at the very last minute. In our view, the course lacked professionalism, and students needed to be made more aware of IPR when undertaking creative work in a collaborative setting. To raise students’ awareness, we designed an agreement template to be used by each student group (Isomöttönen and Kärkkäinen, 2016). The agreement is made between each student in the group and the university. The university signature shows students that the university does not use the students’ work outside the agreement and, importantly, makes the IPR questions formal and noticeable to the students.

The agreement is applied in two phases. In the first phase, at the beginning of the project, students sign an agreement text by which they make a com-

mitment to agree on the IPR in their group by the end of the project. Each student in a particular project is then able to trust that IPR are addressed within the group. In the second phase, during the last third of the project, students sign another document, an attachment to the former, where they announce the IPR related to their project outcomes. Usually this means announcing an open license that they have attached to their product. We have noticed that it is natural to make final decisions on the IPR during the last third of the project, as by then the students are able to form a realistic picture of the project outcomes.

4 THE STUDY

We present a thematic analysis of students’ responses to IPR questions after our attempts to raise students’ awareness of IPR by the agreement practice. The study reflects a step in an action research project where actions taken are put under validation and reflected on. It must be emphasized that validation here signified an aim to describe the phenomenon instead of controlled experimentation. The resultant categories on the students’ reactions to IPR can inform a follow-up quantitative study on the relative importance of the categories.

The data used were the students’ reviews of IP in their personal learning reports prepared in the end of the autumn 2015 course. These reports were received from the whole course population (N=21). The analysis followed data-driven (inductive) content analysis. We began by extracting IP-related extracts from the learning reports. Thereafter, the first author performed a thematic analysis, the outcomes of which were reviewed by the second author for reaching an agreement. Similarities and differences in the data indicated a set of categories. Finally, the resultant categories were arranged into a holistic “display,” as shown in Figure 1; A similar analytic approach is described by many, for instance, by Attride-Stirling (2001), who suggests that themes discovered in the data are developed into “thematic networks.”

Our data concerns only single course instance and yielded a single patterned display. In this connection, it must be stressed that the current study is underpinned by our previous improvement efforts on the same matter (IPR) and context; In improving education as an action research project, continuity in the research process, such that one and the same researchers stay together, is an important validity aspect (Melrose, 2001).

5 STUDENTS' RESPONSES TO IPR

This section reviews the students' responses to IPR questions. The main themes of the thematic analysis are presented in Sections 5.1–5.7 and summarized in Section 5.8.

5.1 Temporariness

Looking at the students' responses to IPR, we noticed that an educational project is readily perceived to be a temporary organization, with this temporariness reducing students' genuine interest in the project outcomes and related IPR issues:

I was not interested in IPR questions during the course, as I had no plans to further develop our product, and the rights to it were then not interesting.

However, the same student continues:

As for the future, it was useful to explore the different licenses and figure out their purpose.

The same contradiction, albeit in a milder form, is illustrated by the below quotation from another student:

Although it may seem a bit useless to consider IPR on the project outcome in the context of a short-term student project such as this, IPR questions play such a big role in the software business that it is good to start pondering them at this point.

These contradictions reveal that the attribute of temporariness “pushes” students' interest away from a matter that they consider will be important in the future.

5.2 Incompleteness

The intensive 12-week course yields useful and illustrative prototypes, although of course many parts of such prototyped products should be refactored in order to become technically sound products. Accordingly, students refer to the incompleteness of their product as a factor affecting the selection of a licence, which, in this case, can simply be very open in nature:

We had no problems in selecting the license within our group, as we knew that the quality of the code was not that good. So we selected a very open license, as the whole thing would have to be implemented afresh if one wanted to make it a really usable [deployable] product. [...] Well it [the code] was not that bad nor unreadable, but reworking it would help in figuring out what we were actually doing.

We should note here that creative product development has been associated with continuous prototyping. Silva et al. (2009), who also implement a course drawing on student creativity, aptly state that “the more you build prototypes, the more you understand the product.” Our experiences align with the need for continuous prototyping, and we must place more emphasis on this feature of software process to the students.

5.3 Humor in Project Topic

Creative topics may turn out to be humorous in nature, which may, however engaging they may be, lead students to develop only a minor interest in IPR. Educationally, as we emphasize conceptual learning about group processes and software processes as the key learning goals, such topics have worked out well, and we have not blocked student creativity in this regard. The quotation below nonetheless illustrates a constrained reaction to IPR with respect to such a project topic:

On my part, licensing questions were hardly at all relevant, as I thought from the beginning that our project was, as you may find in its topic, made up so much with tongue in cheek and a twinkle in the eye that I didn't even want to think about immaterial rights. [...] For me the project was about implementing a jolly idea, for which reason I felt up to doing the project and avoided boredom.

Although we guide students to consider a target group for their projects, the quotation suggests that this must be particularly emphasized for humorous project topics. Students should perceive their project, however humorous, to be relevant outside their own project scope.

5.4 Perceived Relevance

A project topic perceived to be relevant (serviceable, of real value) increases student interest in IPR, a factor counteracting the above constraining factors:

IPR questions did not really emerge in the discussions of the group. In the beginning, we simply thought that if someone earned large amounts of money with the product, the topic would begin to make sense. At the end, the group members, including me, pondered the licensing much more. Especially because we received a pat on the back for our project idea and implementation. We finally selected the AGP license instead of the MIT license.

The quotation illustrates how students' thinking concerning IPR develops during projects, as they begin to gradually picture the characteristics of the end product. This observation matches our use of the two-phased agreement practice. Moreover, the quotation also illustrates how the student group considered several licensing options when the project was perceived to be relevant (not only the very concise and open MIT license). As an interesting aside, the theme of perceived relevance has emerged in the context of educational projects with external customers as a factor affecting students' opinions concerning potential financial compensation for their coursework (Heikkinen and Isomöttönen, 2015).

5.5 Uncertainty with a New and Difficult Topic

When students use a wide range of available resources in their projects, uncertainty emerges:

The licensing thing was totally new to me. [...] We had to be very careful with how to use Instagram and Twitter. The terms and conditions were difficult texts to read. We had to, for instance, change our site appearance because Twitter and Instagram required particular appearances and functionalities.

The uncertainty also relates to agreements within teams:

Frankly, I am not sure if the licensing of our work followed all the regulations. We spent time on exploring the matter but we certainly are not lawyers.

In a similar tone, another student states:

I have not needed to think over programming-related immaterial rights before, in particular when work is done in a group and existing code is utilized. [...] The large number of available licenses complicates the selection, as many include only small adjustments compared to the others. For this reason, we have not reached a consensus in our group yet, at the time I am writing this report.

5.6 Eye-opening toward Professionalism

A positive learning outcome is reflected in the transitions from initially considering IPR as a useless topic to seeing it as a necessary topic in professional practice:

Although the IPR questions were really alien to me at first and I regarded the whole topic as

useless, it was, after all, good that they were raised. When programming code is created, it is good to talk through who have the rights to that code. [...] Now, being a bit more aware of these things, I've been pondering questions related to immaterial and other rights as regards programming and other functions of companies.

Another quotation reveals that students value being awoken to the topic in order to avoid being accidentally negligent:

IPR questions were fairly strange to me in the context of computer science. I heard interesting and important examples of how you should act depending on the situation [your aims] during the lecture. You easily ignore these topics but after hearing of them, I certainly do not leave anything [IP related] unmarked in any decent projects.

It should be noted that even in cases where we observed a clear constraining factor, we find students anticipating that IPR will be generally an important topic; see the latter two quotations in Section 5.1. The student we quoted in Section 5.3 also concludes in this manner:

I suppose I need to start thinking of these questions [IPR] in the future.

Furthermore, we interpret the instances when students kept on posing questions after the briefing lecture as indications of eye-opening:

After the license lecture, I was still unclear about what open source code you can use and how it should be marked in your own code if you use it. It would be nice to receive further clarification on how you can use open code and what conventions are involved.

Students' comments also reveal that they have considered different options within their groups—a desired learning outcome:

Our group selected GNU GPL 2.0 as the license, as we thought that it would be easier to move from a stricter license to a more open one, if we [later] wanted to do so. It is more difficult to tighten up an open one.

5.7 Within-team Fairness

Students value that IPR is raised as their group situation becomes clarified from the perspective of ownership:

I experienced the considerations on the rights as useful because each group member produced a considerable amount of code into the final version and the work took a lot of time from each of us. Each of us could further develop the software, for what reason it is good that things [IPR] have been agreed on.

This quote highlights the experience of fairness within a group, which is reinforced through making an agreement on immaterial rights.

5.8 Summary Pattern

The course seems to “expose” students to the topic of IPR instead of “integrating” previously learned items, as is the case with many other skills involved in the course. Students’ comments reveal that the topic of IPR was previously strange to them and that this exposure to the topic initiated their knowledge and interest. Our interpretation is that this eye-opening experience counteracted the frustrations caused by their uncertainties about a novel and difficult topic. The constraining factors related to the temporariness and incompleteness of educational projects. These factors were nevertheless counteracted when the students noticed that they had ideated and implemented a useful, serviceable project. Finally, as course providers, we regard the “within-team fairness” outcome as a professional condition that we sought to introduce through the agreement practice described in Section 3. Figure 1 conceptualizes results into pull and push factors. For instance, issues such as temporariness “push” students’ interest away from the matter, while a project topic perceived to be relevant “pulls” their interest back. Students’ responses may also vary within teams: one team member may consider fairness in terms of rights to reuse the code (“pull”), whereas another one straightforwardly shows lowered interest in IP due to the temporary and humorous nature of the project (“push”).

6 DISCUSSION

This paper has reported on students’ responses to IPR during creative collaborative work. Based on our observations concerning the initial orientations in the course, the push factors (e.g., temporariness) that constrain students’ interest in IPR may be rooted in a broad educational challenge: how students perceive being in formal education. The third-year project students have principally attended big introductory classes after their schooling background. Their perceptions of themselves as potentially self-directed ac-

tive agents may be constrained, and their orientations reflect a mode of being where they expect course providers to instruct them in what to do and where they principally work for credits. We have accordingly overheard and witnessed in the end-of-course learning reports students being overwhelmed by the very open course assignment and the active role required, which we illustrate with a quotation below:

The only thing addressed during the course, in which I did not really develop myself, was ideating. Our group had severe difficulties with ideating, which can be seen in the outcome. We could not come up with a good idea and a topic everyone was interested in. Many courses do not at all require student ideation, which is a bit negative [unfortunate] thing. We have learned to work on predefined topics or problems, which is likely to cause passivity and makes ideating painful. You do not learn to ideate just like that but, encouraged by this course, I started to think over this matter more closely and will work on the matter somehow in the future.

We have fortunately observed transformations (as in the quotation above), which the first author has reported earlier (Isomöttönen, 2014) and which also emerged in relation to IPR questions (see Section 5.6). Re-observing such transformations suggests a useful hidden curriculum for early curriculum project-based courses, one which reinforces a perception of formal education as a meaningful activity. Generally, project work emphasizing complicated problems of open nature has been argued to be suitable for late curricula, as by then students have developed needed levels of self direction (Perrenet et al., 2000).

While the challenges observed may be rooted in the features of the education system, we believe that remedial actions can be taken. Our results suggest that these actions should focus on increasing the perceived relevance of projects. One action is to further support the students’ creative processes at the beginning of the course in order to avoid unrefined and rashly decided project topics. We could announce the first two weeks of the course as a specific phase dedicated *only* to ideation. Another action relates to the previously discussed concern that educational projects without an explicit customer may turn out “flat” in the end (Isomöttönen and Kärkkäinen, 2015), as students notice that their efforts are not deployed in real use. We could introduce more publicity into students’ coursework by building a portal where students can deploy their prototypes together with links to source code in public repositories (e.g., GitHub). This would make the possibility of reuse not only the-

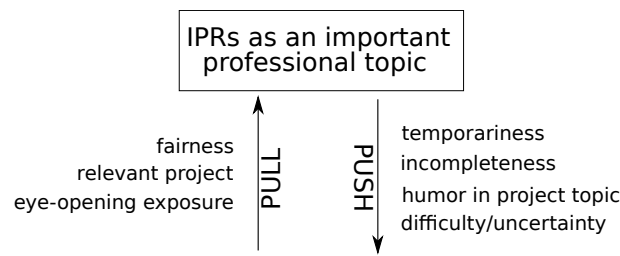


Figure 1: Results summarized as pull and push factors.

oretical but unlikely and likely. This action could be accompanied with an expert lecture on entrepreneurship provided by a carefully selected, inspiring entrepreneur alumnus.

An important educational question is also how strictly students can and should be guided regarding IPR. We have learned that interpreting data licenses and terms and conditions is challenging for teachers as well. From this perspective, we argue that students must be “habituated” to the matter and advised that addressing it is likely to “remain a challenge that must be tackled as part of professional practice.” We thus consider students’ increasing questioning induced by the course to be a desired learning outcome (Section 5.6). That is, students become gradually more prepared to encounter IPR questions.

In ACM/IEEE CS curriculum (2013), it is recommended that professional practice should be taught through a standalone course, while with a note that a mere standalone course does not introduce the topics in a context. Our observations indicate that even when issues are raised within a context, students must see the relevance to be interested. We conclude that encountering IPR questions within contexts and throughout the curriculum, as part of courses where they are needed and relevant, is educationally beneficial.

Finally, we notice that the students’ responses to IPR in terms of fairness in group situations (Section 5.7) align with our goal of teaching group work by conceptualizing and communicating “justice in group work” to the students (Isomöttönen, 2014). Thus, by increasing attention to IPR we feel that we have better incorporated a key educational attribute (justice) into the course.

7 CONCLUSION

We conclude with two main points. First, to attract students’ interest in IPR during creative project work, they should perceive their projects as relevant. This requirement relates to the problem of a “lack of con-

tinuation” in student-ideated projects, an issue supported by the literature (Pilskalns, 2009) and that we can confirm. We wish to note that affording students with opportunities to continue their self-ideated projects may be difficult in computing curricula that do not otherwise emphasize entrepreneurship. The requirement of relevance also signifies support for students’ creative processes at the beginning of the innovation projects in order to guide students to select topics they both perceive and can argue to be serviceable. Second, due to student inexperience, we stress that educators must take responsibility for raising IPR questions through sound procedures in order to make learning environments professional spaces that are able to support fairness in collaborative work. A follow-up study should also continue to address variation in students’ responses to IPR within teams and how group phenomena such as the effects of majority affect IP decisions.

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