

Project as a Learning Method in Expert Development

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Abstract. In this paper we suggest that a project should be used as a learning method and not only as a way of organising student work. Different orientations on learning are presented as well and the transformative development of processes is suggested to be combinable with project learning.

The results of a survey of polytechnic teachers are presented. The obstacles against the use of project work are mostly combined with heavy workload, requirements on high quality demands for students and teachers and the unpredictability of projects. The advantages of projects are good learning results, student motivation and co-operative learning for real-life.

The use of projects requires changes in the curriculum and the organisation. Co-operation with working life also sets new requirements on learning environments.

Key words: project learning, expertise, co-operation.

1. Project as a Method of Organising Work

A project is the most common method in organising software development. However, since years and still today most projects end with disappointment: product goals were not achieved, much more time and money was spent than estimated in the beginning and users were not satisfied with the product released.

Project work is primarily seen as a method of organising work and the use of resources. It is also an efficient way of carrying out software development. During a project learning takes place on the product being developed, the development process and methods and also on project work itself.

However, the role of project work as a learning method and the time spent in learning is underestimated. In project plans we seldom consider time needed for learning in human resources or timetables.

A project can be defined as follows: a project is a temporary endeavour undertaken to create a unique product or service (A Guide, 1996). A project should thus have defined goals and resources; one part of the product of a project should be learning results.

2. Education and Learning

We can divide education in several forms. Formal education is temporally and gradually proceeding, hierarchically organized and based on different degrees. Formal education is thus school teaching on different levels. Unformal education is the action organized for education and learning which takes place outside formal school education, e.g., education at workplaces. Informal learning occurs in an experience-based way outside classrooms and organised learning situations. Learners' high self-control and previously defined goals are typical for informal learning. Spontaneous learning (everyday learning, tacit knowledge) takes place without previously defined goals and is produced as a by-product of other actions.

Traditional methods of teaching define education, learning and teaching necessarily combined with each other and produced by lessons, laboratory and classroom work. We may ask, however, how much more effective it is to learn, e.g., programming through the examples and mistakes of other learners, as spontaneous learning in real life situations or as learning at the workplace compared to learning during lessons.

We can thus define learning here as relatively constant, experience-based changes in the knowledge, skills and abilities of a person and hence in his/her actions.

We can see in learning different meta-orientations (Poikela, 1998):

1. Transmission: Learning is knowledge transfer and its goal is to produce a previously defined action. Teaching is organised on different sciences. Learning is universal and objective and the role of a teacher is crucial.
2. Transaction: Learning is knowledge construction in social interaction. Learning can be organised cross-scientifically. Knowledge is subjective and based on personal experience. Methods of teaching can be co-operative but the teacher is responsible for contents and goals.
3. Transformation: Learning is development and expansion of processes and contents. Learning is always in connection with other learners and learning environments. Learning and knowledge are intertwined with individual meanings.

In this paper we define learning as a transformational process where students and teachers should be equal learners. However, if we want students to be life-long learners and efficient co-operators, the teachers must first be life-long learners and co-operators (Fullan, 1993). In co-operative and transformative learning the setting of shared goals is not adequate, learners and guides must be conscious of the goals which must be mutually accepted. Also the interactions used for the goals must be negotiable (Dillenbourg, 1999).

3. Expert Development

In expertise and expert development the importance of tacit knowledge is emphasized. Tacit knowledge is based on experience and learning, which has been evolved in similar situations. Using tacit knowledge can also be problematic in a changed environment because it can cause incorrect actions.

If we want to develop tacit knowledge, e.g., through problem-based learning we must use real-life situations. Abstract prototypes can even conclude to erroneous actions in real-life situations (Sternberg, 1999).

4. Project as a Learning Method in Computer Science

Eteläpelto and Tourunen (1999) did a research on computer science students at Jyväskylä University, Finland. They propose that project learning in real-life situations is a very efficient way of learning methods and strategic skills of software development but it does not expand, at least immediately, students' contextual understanding on the work organisations and background of the client. Specially at the beginning of the project the students' orientation was deeply expert-centered and did not develop into client- or user-centered thinking until in the later phases of the project. In software development the students, however, used prototypes, which emphasize individual aspects of the product and client-orientation.

Real-life projects can thus produce high-quality method knowledge, which constitutes a base for broader expertise. However, technical problems and the implementation of the product are usually the most interesting questions for the students, not the contextual or organisational problems.

Learning in real-life projects is also a good and valued way to establish the identity of an expert among computer science students.

5. Opinions on Project Work among Computer Science Teachers

We made a combined e-mail/spreadsheet survey in spring 1999 on computer science teachers at Finnish polytechnics. We received 76 replies from teachers representing mostly the fields of technology and business and administration. In Table 1 we present the work experience as a teacher at a polytechnic and other work experience.

Table 1
Teachers' work experience

Years of experience	As a teacher	Other work experience
0-5	19	36
6-10	22	18
11-15	20	10
16-20	7	7
21-	8	5
Total	76	

Table 2
Goals of project work

Most important goal of project work is	
Students learn the principles of project work	65
Students get acquainted with real-life situations at workplace	58
Students learn information acquisition on their own	52
Students have the possibility of learning group-work and co-operation	51
Students have the possibility of working with experts	39
Students must reflect their work	38
Project work is an effective way of organising exercises	24
Students learn to work like experts	20
'Can be used if nothing better is found'	3
Projects should not be used in teaching	3
Other goals	5

The computer science teachers at polytechnics thus had quite a good experience as a teacher but a fairly short experience on other kind of work environments.

The teachers mentioned as the most important goals in using project work as a learning method the following: adopting the principles of project work, getting used to real-life situations and learning information acquisition on one's own initiative (Table 2). Project work is thus defined as a method of 'learning-by-doing'. Every other of the teachers mentioned the reflection on one's actions as an important feature of project work.

In our survey we also had open questions on the reasons of using/not using projects in teaching. The reasons for using projects can be classified as follows:

1. A project is the convention of working life in organising software development: "Today we use project work in all fields."
2. Project work emphasises and increases sociality, responsibility and motivation: "Projects teach many pedagogical and social norms and conventions." "Students learn how to really work together."
3. A project is an efficient learning method: "Learning results are good." "Students learn to handle with greater units of knowledge."
4. A project is an effective method in saving teacher's resources: "Most of our contact hours have gone with cuts in resources."

Reasons for not using projects can in most answers be associated with the high expectations of both teachers and students:

1. Projects are difficult and require a lot of work of both teachers and students: "They are a good way of learning but they are laborious, difficult to understand and take responsibility for."
2. Using project work requires time and experience: "Too short courses, in project work more than comprehensive skills are needed."
3. Control and evaluation of learning, especially by single persons, is difficult in projects: "My most important goal in teaching is to give more knowledge to eve-

ry student. In project teaching you can't control the learning results of a single student."

We also asked which were the most important difficulties in project work. These answers are associated with the same difficulties mentioned with previous answers in 'not using projects'. However, most of the problems mentioned were related to extensive anticipation and the unpredictability of projects:

1. The instruction of project work is difficult: "As a teacher you should have an answer to every question." "Real guidance is difficult when students have done something on their own. Project work always requires deepening and broadening at the same time."
2. Lack of good real-life project topics is constant: "There are no real-life cases." "How to find enough project topics which can be carried out with students in limited time during the courses?"
3. Projects need more time and more work: "More resources are needed, specially time." "A teacher's workload is much bigger."
4. Passive students can destroy the whole project: "Motivation of students." "Heterogeneous student groups." "Passive students wait for a miracle to happen without any need to work."
5. Project work needs integration with other subjects: "Co-ordination is a big problem." "We should have co-operative projects but the old course-based curriculum is a big obstacle."
6. Teachers don't trust on their own capability: "When your own leadership abilities are inadequate..."

Answers to the open question "What are the advantages of project work?" were mostly associated with the pleasure of 'really working together':

1. Students achieve good results in project work: "Good results keep on trying." "Better learning results." "When you see that some of the students really exceed all expectations." "You get the finest results and you can achieve the goals in many different ways."
2. Students' motivation and 'joy of working': "Real learning and real enthusiasm." "You see real co-operation and results and enthusiasm." "You really see them developing."
3. In projects you learn how to work in real-life: "Working-life touch." "You really work like a project manager." "Real situations."
4. In projects a teacher can get feedback from and contacts to working-life: "New contacts to working life." "A good link to the world outside the polytechnic."
5. In projects a teacher can learn as much as the students: "Learning: students and teacher." "If there were more projects, you could always learn new things." "In projects you learn more about the students than in mass lectures."
6. A project can be a good way of breaking away from the old routines: "Away from the old classroom lessons!" "Different projects keep the mind active." "Different interaction between students and the teacher."

6. Conclusions

Teaching and learning at universities and polytechnics is looking for new ways. Co-operation with working life and continuing changes in technology set new requirements on both teachers and students but also on the organisations giving higher education.

Project work and project-based learning could be a solution to the problems especially in computer science. However, in project work where students, experts from companies and teachers are working together, we are faced with organisational, knowledge-based as well as attitude-based problems.

Learning in projects requires changes in the curriculum and in learning environments. Projects should combine different subjects, expertise on several levels and fields and enhance cognitive as well as social learning.

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Projektai kaip mokymo metodas lavinant specialistą

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Šiame straipsnyje projektinį darbą siūloma taikyti kaip mokymo metodą, o ne tik kaip būdą moksleivio veiklai organizuoti. Straipsnyje aprašomi keli mokymo būdai, taip pat patariama, kaip tradicinį mokymą derinti su projektiniu mokymu.

Pateikiami Kuopio (Suomija) politechnikumo mokytojų apžvalgos rezultatai. Kliūtys projektiniam darbui daugiausia susijusios su dideliu darbo krūviu, aukštos kokybės reikalavimu moksleiviams ir mokytojams ir projekto nenuspėjamumu. Aptariami projektų privalumai: geri mokymosi rezultatai, moksleivių motyvacija ir bendradarbiavimas realiaame gyvenime. Projekto naudojimas reikalauja keisti tvarkaraštį ir įprastą darbo organizaciją.