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A method for learning in project management
-Learning by projects-
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ABSTRACT

We introduce in this paper a project-based-experiential learning method that could be used to enhance project management education for engineering students in undergraduate level. The method is targeting active and sensing learners, based on Felder index of learning styles. The idea here is to get the students to work in groups in order to solve real world project problems from various engineering sectors. The task (problem solving) is conducted as a project in itself, with predefined scope, goal, objectives, project plan, and risk assessment. This method helps the students getting a first hand experience in running projects, as a cooperative problem solving approach. Various project management concepts, methods, and techniques are taught to the students in advance to the project assignment through lectures sessions, multimedia online lectures and group discussions. The paper discusses the advantages as well as the main success factors for implementing this approach.

INTRODUCTION AND BACKGROUND

Project management is defined as [PMBOK 2003] the application of skills, tools, knowledge and techniques to project work activities to meet project requirements. Project management is accomplished through the use of processes such as initiating, planning, executing, controlling and closing. This definition of project management indicates that project management is rather a professional discipline than an abstract one (such as mathematics). Therefore, the main objective of project management education should be to train the students to use and apply, effectively, these various tools, methods and knowledge that are needed to deliver project objectives within the specified constraints.

An introductory course in project management is taught as a part of the master program in technology at NTNU. The students attending the course have negligible or no prior instruction in project management methods or techniques.

Learning styles

It is argued that examining students' learning styles can yield information that might be useful to the design of learning activities and courses (Dee, 2002). (Larsen, 2004} points also to the strong correlation between the students reported learning style preferences, satisfaction, and success in the course.

A variety of measures have been used to characterize learning styles for engineering students, but the literature contains little information specific to the field of project management. We shall, therefore, utilize Felder's Index of Learning Styles (Felder, 988} to investigate the learning style preferences of project management students at NTNU. The reason behind choosing ILS indicator is that it is available for free on the internet. And there exist a considerable amount of literature on this subject. Our goal is to identify a suitable method to accommodate the widest possible variety of learning styles. It must be mentioned that we are no by any means planning to device a complete set of

teaching strategies. We would rather "spice up" our existing teaching strategy by adapting small number of instructional techniques to cover all poles of the learning style dimensions.

(ILS) is an instrument that was developed at North Carolina State University to determine the different dimension of learning. This paper reports ILS responses from third and forth year engineering students at the NTNU taking project management course. The ILS defines four dimensions, of learning style preferences. Within each domain there are two opposing poles. Please see Table 1. The ILS summarizes self reported preferences concerning whether:

1) Manner of processing information, actively or in a reflective manner. This is parallel to the learning styles model of Davids Kolb which has the same name.
2) Manner of receiving information, visually or verbally
3) Type of data, sensory information, what is seen, heard, or intuitive information such as ideas, theories and possibilities. Its counter part in Davids Kolbs model is the concrete/abstract styles.
4) Manner of progress towards understanding, in a sequential or a holistic (global) manner.

Dimension 1 (manner of processing)	Dimension 2 (manner of receiving)	Dimension 3 Perception (type of data)	Dimension 4 (manner of progress towards understanding)
Active	Visual	Sensor	Sequential
Likes to process information while doing an activity. Learns a good deal from group work	Prefers to see pictures diagrams, films, and apparatus. Key word (Show me what you are talking about)	Prefers concrete facts, data, and relation to real world around.	Can function with partial understanding, makes steady progress Good at detailed analysis (I need to focus on and finish one part of the problem at a time)
Reflective	Verbal	Intuitive	Global
Learns a good deal from independent work Likes to process information introspectively	Prefers written words and formulas. (Explain to me what you are talking about)	Focuses on ideas and possibilities Prefers abstractions, theories, models	Needs to see the big picture, Good at creative synthesis (I need to see how it all fits together before I can start doing anything.)

Table 1. Dimensions of Felder learning styles.

We shall use the ILS to establish an indicator about the learning style of our students taking the project management course. Our goal is to enhance our teaching strategy so that it covers the entire space of student preferred learning style. We must point out that our investigation does not take into account other factors such as gender, age and former work experience.

Findings

The ILS questionnaire, which is publicly accessible on the World Wide Web [http://www.engr.ncsu.edu/learningstyles/ilsweb.html], was administered to all students taking the project management course. They belong to three different departments at NTNU:

- Civil engineering department
- Production and quality engineering department
- Industrial economy and technology management department

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The number of students who takes the course is about 100 students. The size of the student sample who participated in the delivered response was 26 students. The participation was conducted on voluntary basis. We found out that the percentage of the students who prefer to process information actively is 81% of the student sample. 92% of the student sample indicated preference to receive information visually rather than verbally. Please see Figure 1.
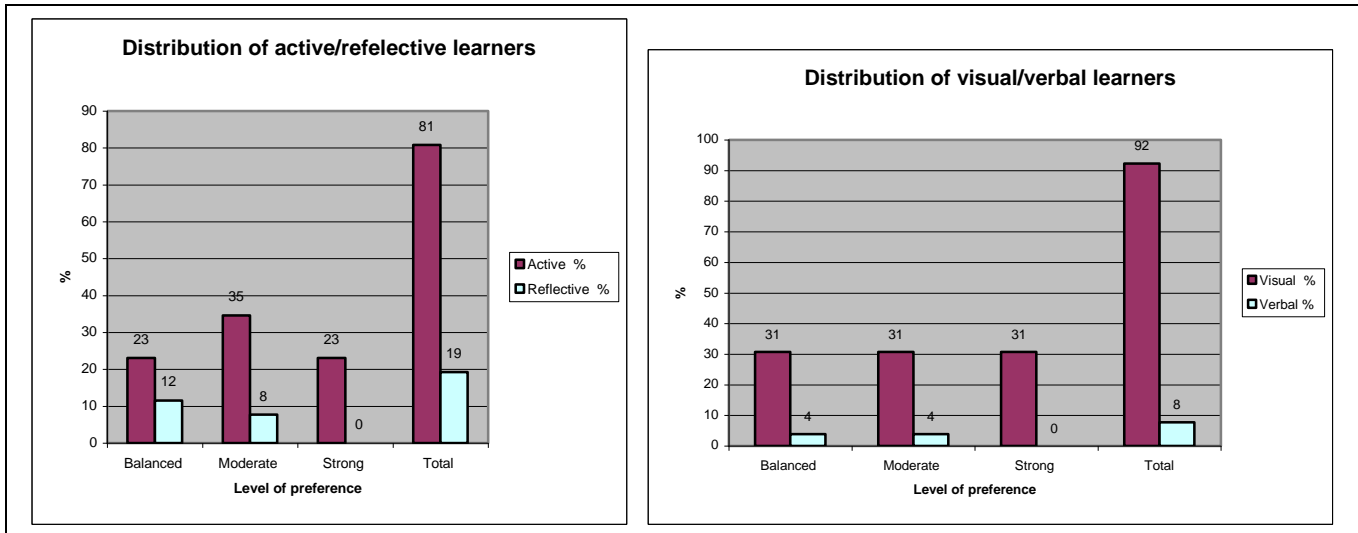

Figure 1. Distribution of active/reflective and visual/verbal learners among student sample.

Collected data also shows that 69% of student sample focuses on sensory information instead of intuitive information. We also notice a balance between the ways the student understand information, 54% understand it sequentially, and 46% globally. 63% of the sample has balanced preference to this learning style. Please see Figure 2.
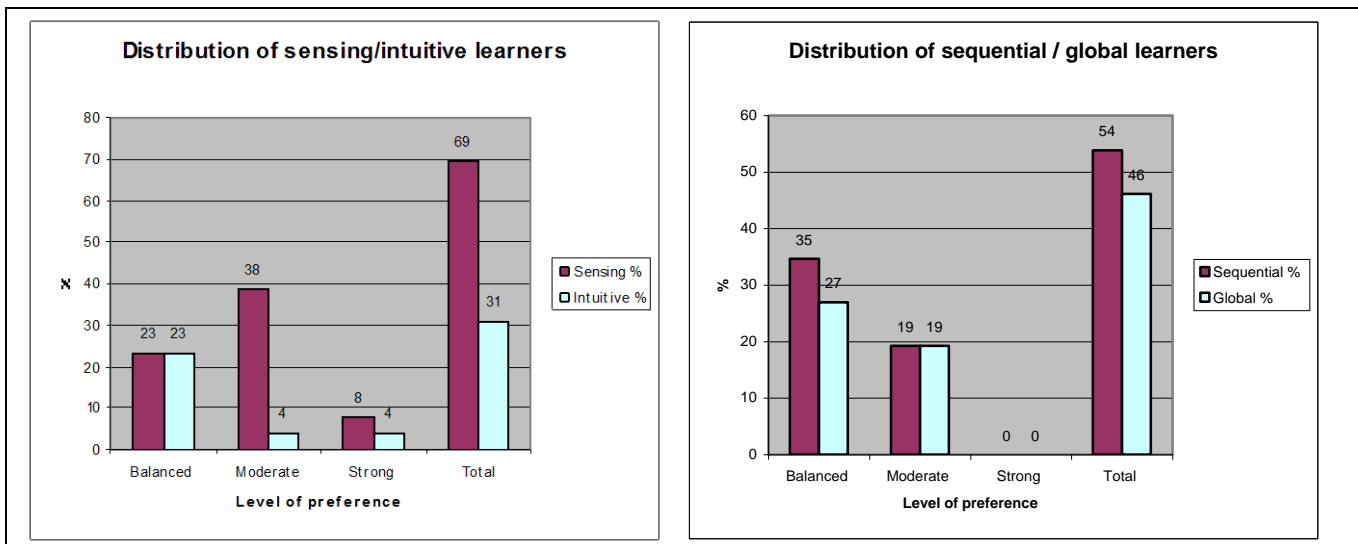

Figure 2. Distribution of sensing/intuitive and sequential/global learners among student sample.

Figure 3 shows the distribution of combination of the four learning styles. Our investigation shows that some learning styles actually do not exist at all among our student population. Such as, reflective + intuitive learners, or reflective + verbal learners, or verbal + global learners. We notice a strong representation (77%) of active + visual learner, and also a strong representation (62%) of sensing + visual learner group. Active + sensing learners constituted 50% of the total student sample.

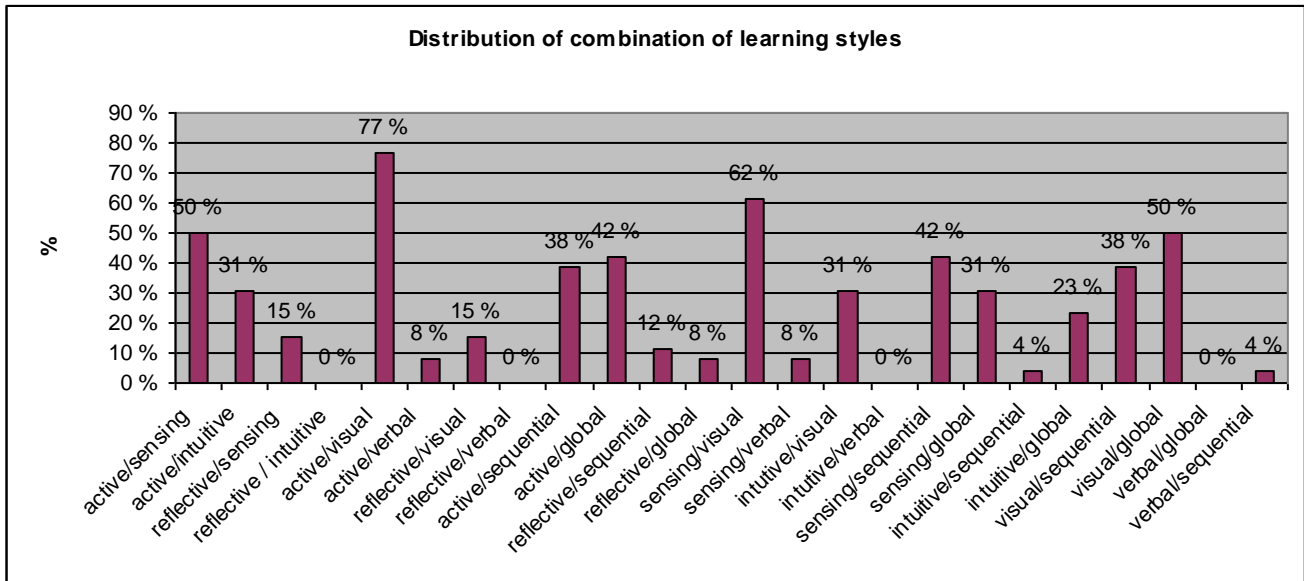**Distribution of combination of learning styles**

Figure 3. Combination of the four learning styles among student population.

Active + sensing learning or "learning by projects" how does it fit in?

This investigation confirms the existence of a range of learning styles within the student group attending project management course. The ILS results provide support for arguments advanced already by (Felder, 1993) for variation in engineering teaching strategies. These can be summarized as follows:

1. The vast majority of students who have participated in our questionnaire are active learners (82%). Strictly lecture-based teaching that provides no active and cooperative learning experiences inside or outside the classroom works to the disadvantage of the majority of the student population.

2. A considerable majority of student population are sensing learners (69%). Instruction that emphasizes only abstract concepts at the expense of concrete real-world applications and examples puts the sensing majority at a disadvantage.

3. The vast majority of students are visual learners. Instruction that is exclusively verbal with only occasional visual content is likely to be ineffective for the vast majority of students.

4. Presentations that fail to indicate the broad context within which a particular body of information falls are likely to be ineffective for global learners. Who although in the minority (in our case 46%), may include many of the most inventive thinkers among the student population.

Learning by projects is an approach which is implemented to match the needs of student population, in particular to match the needs of active + sensing learners. This group of learners constituted 50% of the student population. Active + sensing learning style has it is equivalent in Kolb's Learning Style Model represented by learner type 4 (Active + concrete) (Kolb, 1986). Type 4 learners like applying course material in new situations to solve real problems. Learning by projects fits this group of learners. Our approach can be described as a combination of cooperative learning and field investigation methods conducted in a project framework. By that we mean, a cooperative effort for problem solving, accomplished through the use of project management processes (initiating, planning, executing, controlling and closing.) Students will thus acquire skills in applying the principles of project management to the problem at hands. Thus giving them a taste of how it will be to work as a project management, and what is management is all about. In addition, they will develop/refine interpersonal, team, and communication skills.

Over a fourteen-week term the students are taught various components of project management knowledge areas through lecture sessions, and on-line video lectures. Lecture sessions are

supplemented by various assignments and small case studies. These provide students with the background knowledge they need for executing project assignment. The project assignment starts in week 9 after the students having completed 75 % of the course content. Student teams are formed with 3-4 students per team. Each team nominates a project coordinator. Project coordinator is responsible to coordinate activities within the group, ensure adherence to the time frame developed by each team, communicate problems/issues to the supervisor, and ensure the timely delivery of progress reports and other documentations. Student groups are challenged by real world problems from various sectors such as a) research and development sector, b) service sector, c) civil engineering sector, d) manufacturing sector. This approach is conducted in close cooperation with local companies, industries and organizations in Trondheim region. Students are expected to conduct an investigation and analysis of a company-related problem area in a given time frame. Some examples are shown in Table 2

Problem areas
Investigation of competence level of risk management at the transportation department in Trondheim
Investigation of project selection and evaluation methods in Trondheim city planning office
Developing a project handbook for the students attending a course at NTNU
Investigation of selection methods of research and development projects
Methods applies for stakeholders management at school sector projects

Table 2. Problem areas for project assignnemt

The work of each team is documented in detail in a final report. This report includes the problem statement, goals and objectives, estimated workload, risk factors, work breakdown structure WBS, time table, Gantt chart, a brief description of literature, research method, and accurate and complete documentation of the work done. Project assignment accounts for 30% of the overall course grade. The project grade is based upon the following factors: overall quality of the work presented to include all steps of initiation, planning, executing and controlling of the project; and the quality and clarity of the documentation.

. The final report of the project assignment documents the 1) describtion and narrowing of the problem. 2) theoretical background, 3) research method and approach used to handle and solve these problems, 4) the outcome of the approach, 5) competences and experiences gained at the end of the project.

Learning by - projects is a pedagogical approach that has long been used in further education programs in projectr management at NTNU, and proved to be very successful (Hussein, 2002). Various specially tailored project management education programs had been conducted with international companies such as Kværner, Statoil and Norsk Hydeo in the last 5 years at NTNU. An adapted version of the program is offered now only to STATOIL employees. In the period 1999-2004 over 300 employees from these companies took part in project management education programs. The educational model is a mix of different models of instructional delivery, web-based teaching and plenary sessions. Both aimed at achieving cost efficiency and – not least – enhancing the learning value for the participants and their organizations. In parallel with the plenary and the web-based sessions, the student works in groups on their project assignment. These project assignments explore a topic relevant to project management in Statoil, and comply with academic standards. It is recommended that the students use cases from an actual project. It was also emphasised that the results of project work should help their companies enhancing their project management best practice.

CONCLUSION & LESSONS LEARNED

The advantages of this approach can be summarized as follows;

- The method gives the students the opportunity to get familiar with the type of practical problems that faces project organizations in real situations.
- Provides the students with hands-on experiences on how to handle these problems most effectively.
- Offers the students the valuable experience of working in teams. And providing students with a learning experience that is superior to isolated experiences targeting the individual.
- It offers the students the opportunity to get in touch with experienced project mangers who works on actual projects.
- It strengthens the mutual relationship between the local industry and the university through these common assignments.

The use of learning by projects has in general been very successful at NTNU. Students claim that this is the most interesting part of the course, because problems and situations are real and relevant. However, learning by projects is time consuming, and may be heavy to accomplish. Summarized, we have experienced these success factors for successful use of project assignments (not prioritized):

- To be effective, the instructor should balance his/her involvement in the work between directing and coaching. Coaching will maxim opportunities for the students to discover things for themselves providing that these students have strong motivation. Directing becomes important when student groups needs academic assistance on the subject matter.
- Commitment from all participants is necessary for a successful completing. Students must be ready to invest significant amounts of time in planning and investigation.
- Students must be motivated by having the opportunity to apply the knowledge acquired in the first few weeks to a real world situation.
- It is imperative that problem definitions are narrowed. Teams must stay focused on this particular problem. Instructor involvement in this phase is essential.
- It is important to link this problem solving approach with literature study, relation to other subjects.

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