Mixture of Term Assignments, Tutorials, Laboratory Assignments and Problem Based Learning for Masters Degree in Engineering - an Alternative to Traditional Learning and Examination Forms

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Abstract: *We look at a course as a process of continuous learning and assessment of knowledge transfer to the students. In this context, we use a mixture of term assignments, tutorials, laboratory assignments and Problem Based Learning (PBL) for a Masters Degree course in Engineering. In this process, a mixture of modules is offered to enable the students to gain knowledge and to be responsible for their successes and failures. The "teacher" is viewed here as a person very tightly involved in the process and at the same time allowing enough freedom to the students to get their own experience in a selected area of interest in the context of problem based learning.*

We look into different scenarios of selecting the mixture of modules. We weigh the pros and cons of traditional learning / teaching and examining the students as compared to the modules mixture we are presenting. This method has been successfully implemented with good results in different departments and colleges in Norway and elsewhere.

The paper ends up with an overview of students'/teachers' experience with such modules mixture courses with some comments and observations from peers. Finally, the implications of such educational method to the examination form are also briefly discussed.

Keywords: *modules, Problem Based Learning (PBL), evaluation, continuous assessment, examination forms*

1 Introduction

In the last two decades, decentralising has been the trend in the Norwegian educational institutions. Detailed syllabuses have been substituted by general frameworks of studies through reforms coming from the higher echelons of the educational authorities, which have given considerable freedom in the selection of learning materials and teaching methods. This ideology of decentralisation, particularly of higher education, is noticeable as a common trend in many countries of Western Europe, leading to an increasing degree of autonomy in decision making by institutions in the process of selecting topics of studies and deciding forms of examinations and evaluations. Higher educational institutions tend to develop their own learning package, mostly suited to local needs and developments. The students have more say in the selection of subjects and relevant topics within each subject including learning methods and organisation of the teaching/learning process.

Earlier, it was usual for the teacher to convey (transmit, impregnate) the needed know-how (which ultimately will become the knowledge of the student) within a field in an almost unidirectional process. The information flow was from teacher to student: the student was supposed to learn what the teacher has taught. When the teacher has gone through the whole syllabus, the teacher felt comfortable, secure and even confident on behalf of himself and the institution.

The well-known information processing approach of Norman to teaching and learning is appropriate to be mentioned here. Norman says:

"What was wrong was the simple theory of learning. Essentially, I had assumed that students were passive receptacles and that an ideal teaching situation would be one where the students would come into the classroom, unscrew the top of their skulls, and the instructor could walk around the class, peer intently into he brain of student, and say something like, 'Hmmm, you seem to have this connection missing,' and proceed to add the necessary connections. What a lovely vision!
But students are not passive receptors of knowledge."

Norman goes onto describing the iceberg model of learning. The small visible part of the iceberg represents the facts presented by the teacher. Based on these facts, the learner must determine the larger structure of knowledge these facts represent.

Things have changed due to various developments. We try to cover the background material for the changes, before we embark on our topic, due to the relevance of these developments.

2 Has Sartre a role in the changes occurring?

This is a question we ask without giving a concrete answer. We give the scenario as observed by many.

In 1968, as the result of a general cultural crisis regarding the legitimate authority within the Universities, the cry was not only for the displacement of traditional, old fashioned unidirectional knowledge transfer from teacher to student by new pedagogy and knowledge, but also for an increased tug of wars between authoritarian vs. antiauthoritarian forms of teaching and learning and steering by teacher vs. steering by students. It is interesting to note the culmination of these developments in a general unrest among youths in Europe leading to the well known Paris demonstrations of 1973 with the support of the born rebellion and existentialist Jean Paul Sartre. It is interesting to cite from [2], on Sartre:

"To Existentialism Sartre has contributed a classically brilliant French mind. If he is not the leader that Americans first took him to be, he is certainly one of the leaders. And his forthrightness, his skill as a writer, his acuity and originality, have won him a wider audience than any philosopher, probably, has ever enjoyed in his own lifetime. He has brought to his work a characteristically French mentality, viz., attuned less to metaphysical than to psychological modes of reasoning. Paradoxically - for Descartes was a leader of Renaissance rationalism - Sartre is an existentialist who operates in the Cartesian tradition; at the beginning of any investigation he poses the cogito, the self-that-is. From this duality, in most endless brilliant progressions, he moves through other dualities: knowing-doing, being-becoming, nature-freedom, etc. Only the professional philosopher can follow all the way. But Sartre would undoubtedly subscribe to Nietzsche's remark: "I honor a philosopher only if he is able to be an example." He himself is an example, and has been at great pains to define and enforce his exemplitude: in journalism, in fiction, in drama, in political activity, and in teaching. The question naturally arises: who is this Sartre? - by Hayden Carruth".

The Nobel Prize Internet Archive gives the following citation on Sartre: "1964 Nobel laureate in Literature: for his work which, rich in ideas and filled with the spirit of freedom and the quest for truth, has exerted a far-reaching influence on our age. (Declined the prize.)"

From one of the author's (Saba M.) student days in West Berlin and West Germany, there has been ample evidence of antiauthoritarian wave not only in higher educational institutions but also in secondary schools, leading to a series of voluntary resignations by hardcore traditionalists in universities and schools in West Germany and West Berlin. There have been even cases of nervous breakdown of teachers in secondary schools. In some extreme cases, there have been events of organised violence against teachers by the students.

Suffice is to say that such waves of rebellion had an irreversible effect on youths of those days, who are teachers or parents of youths of today. Change of attitude and modus operandi in the educational sector is an imperative without any exception.

The path for change in the educational arena was then being moulded certainly in the Western World. The roles of students began to change with these developments. Students did not even have the right to make any complaints. From the state of being rather passive receiver, the student was alerted to take a position of a participating actor in the process of teaching and learning.

Earlier the focus was on types of students, individual abilities, social background, previous examination results etc. Increased focus is given now to the content and context of the studies. Teaching quality, organisation of the education, environmental and social needs are openly discussed nowadays, including matters related to the ability and qualification of teachers responsible for their subjects.

3 Emancipation of the students

The partly violent revolution followed by a series of subtle changes in the minds of teachers and students over the past three decades made considerable change in their attitudes, thoughts and deeds. There has been a cultural change within educational institutions. The teachers are willing to share their authority, when it comes to the content and form of teaching and methods of evaluation. Students take responsibility for their studies by shifting from passive receivers and teachers as active transmitters. To take the analogy from electronics and telecommunications, the communication has become bi-directional and the teachers and students are operating as transceivers (Tx/Rx).

Students have not only the right but also the duty to participate in the planning, structuring and implementing of educational activities. The whole pedagogical structure is transformed into a collaborative effort and actions from a pure pedagogy of

transmission of knowledge.

Within the Norwegian educational system, we hear words like Student parliament, student members of the board etc. Similar trends are observed in many educational institutions of the democratic world accepting a transition from authoritarian to antiauthoritarian status of educational activities. The teacher centred era has been displaced by student centred era, [3].

4 The implications for the teachers

Such a dramatic change cannot be accommodated without personnel development strategies in educational institutions and continuing the education of the educators. Change of attitude alone is not sufficient. The teachers have to be taught how to teach and must be prepared to learn new material in his or her field to be at the front-end of developments, as well as in pedagogy. Quality of study will be only part of the total quality assessment in a modern educational environment.

5 Developmental Trends

Classroom teaching has been and is still partly the form of teaching in many of the educational institutions, not only in the engineering colleges. Due to our selected topic, the focus, from here onwards, will be on engineering education. Generally in Europe, the relationship between engineering education and university education has not been that simple.

The German universities found out that the school type teaching and absence of general science subjects in the curricula of the engineering education put the engineering education on a different platform than the traditional "thorough in fundamental general science" oriented universities. From these perspectives and from the need for engineers for building up of the post-war Germany, the "Technische Universitaet" was founded and still exist all over Germany. In the beginning seventies, the " Fachhochschule" was founded to give more focus on practical engineering know-how and abilities. Nowadays, the "Fachhochschule" is called as "University of Applied Sciences" and are characterised by the German Educational Authorities as "gleichwertig aber andersartig" (equivalent but different) to the universities.

These turbulent changes have led to formation of different cultures in educational institutions even within national boundaries. There is a strong need for integration and collaboration. Stronger is the need for mutual learning.

In this context, the ERASMUS/SOCRTES programs and similar EU programs can have a strong influence on the changing educational scenario, not only in Europe but also worldwide.

6 The Situation in Europe

EU programs are striving for an increased student and teacher mobility. Project collaboration is under focus. Cultural awareness and European dimension are often discussed at all levels of education.

Particularly under these developments, a need is felt for adopting teaching and evaluating methods conducive to quality improvement and to integration of students from different countries leading possibly to a group of students speaking different languages.

Status quo of the education is such in Europe. The problem based learning or project based learning will be particularly useful for groups of students from different institutions, as is often the case with student and teacher mobility programs. Our experience with such students confirms this observation.

7 Problem based learning (PBL)

7.1 PBL in general

Traditional teaching has also been changing considerably during the last few decades. One-sided presentation is not a usual approach. Dialogue can be very prominent. Lectures, laboratory work, tutorials with the teacher or dedicated student assistants, group work and term assignments are some of the ingredients. The organisation is mostly in such form that the students have to do some independent self-study using assigned literature or from the learning resource centres. The final year project is usually done, especially in engineering disciplines, in close collaboration with he industry.

PBL differs considerably from these, [4], [5], [6], [7], [8] and [9]. There should be support from central, departmental and institutional level. PBL demands independent work discipline from the students. PBL needs teamwork and expects a certain amount of outgoing characteristics from the students. PBL can involve collaborating with external sources (experts, firms, organisations etc.). PBL might need some days of full dedication to the problem thus taking time away from other subjects in the

curricula.

Like the model described in section 8 of this paper, PBL may involve institutional involvement right from the first semester immediately after the registration of the student in the institution. PBL can be classified in the following phases:

1. Initiative (starting phase)
2. Planning (analysis, suggestions for solutions)
3. Implementation
4. Assessment and evaluation

When going through these four stages, the students working closely with their peers and adviser (supervisor) learn about working methods, tackling attitudes and taking responsibilities. These are important aspects in a future employment scenario and are very difficult to impart through traditional teaching methods.

Different learning aspects are observed in PBL:

1. Project organisation: A goal has to be defined. Students in the project group should know how to plan the activities in such a way that the goal is reached in the allocated time.
2. Problem Oriented Work: The problem definition is very often open-ended. There is no complete solution or even a suggestion for solution as usually observed in text book problems from traditional teaching methods, such as "show that if y = 2x, then y'=2". Students must understand the problem, limit the extent of the problem and develop solution strategies. Two groups working independently on the same problem may not reach he same solution. This aspect is often found as very upsetting for students acquainted with the traditional teaching methods. Similar problems are discussed in [4].
3. Real life situations: Similarity to practical situations can influence the working methods and the project itself.
4. Synergy and cross-fertilisation: The know-how needed to solve the problem can be from different disciplines. These aspect gives more work for students and for the responsible teacher and other teachers form other relevant disciplines. Teamwork expected from the students as well as from the students.
5. Group work: Group work is essential in PBL. Workload and responsibility have to be distributed. Implementing the set out activities and presenting them in a collaborative atmosphere is essential. Evaluation of group work is mandatory for good PBL. Free-wheelers cannot be tolerated.
6. Control of participants: Control of participants vs. control of pedagogical activities have to be balanced. Adviser has to be careful not to interfere with he independent nature of the PBL.
7. Process analysis: Working methods and interpersonal relationships have to look into carefully to induce efficiency and creativity. The account of this analysis can be noted down in the project handbook.
8. Awareness of the learning experience: The students are experiencing the learning process during PBL. They should be stimulated to contemplate over the learning process via various learning methods in the PBL. They should write these down in their project handbook with necessary didactical /pedagogical comments.

Summarising, we can use Hull's approach to PBL as shown in Table 1.

Table 1. Hull's theory as applied to PBL adapted from [10].

Cause	***What the learner must do***	***Teacher in PBL scenario***
Drive	The learner must want something	Provide something the learner wants
Cue	The learner must attend to something	Define activities in collaboration with group and external collaborators.
Response	The learner must do something	Activities in PBL
Reinforcement	The learner's response must get the learner something the learner wants	Presentation and discussions are conducive to this goal

7.2 Problems with PBL

PBL involves the students extensively. As a result, it can be seen as heavy and exploiting the resources at all levels, students' time, teachers' time, library resources, examination resources, computer resources etc.

PBL assumes a well-planned structure from the adviser and support at all these levels. PBL expects peer level support among students and among teachers. Not to be forgotten is the administrative involvement with PBL, as PBL has a lot of unexpected extra expenditures. This is particularly true for Norway, as will be described later on in this paper.

8 The Telemark Model

8.1 Engineering Education of 3 years duration

The Telemark Model, as discussed in [7,] is a slightly modified version of the pedagogic approach used at the Aalborg University in Denmark. Engineering education at Hoegskolen i Telemark lasts for 3 years, each year is divided into 2 semesters. The semesters are numbered from 1 to 6, where the 6^{th} semester is the graduation semester.

The Telemark Model is characterised by *the group, the project, the adviser, the documentation,* and *the evaluation.*

1. *The Group*. Consists normally of 4-7 students but special arrangements may be made on demand. The group is expected to constitute themselves, define standards for group behaviour, exert self-discipline etc. The group is officially organised for the project-oriented part of the studies. But many group members are co-operating also in courses taught in traditional ways.
2. *The Project*. There are different types of projects:

    a. First Semester's Project should have a broad scope, dealing with general problems of interest to society at large - typically with an environmental emphasis. Ideally, this project is supposed to introduce the student to a scientific way of thinking, working and writing. The group from a list provided by the teacher may choose the topics.
    b. The second semester: Technical projects, often in co-operation with industry or public utility companies. The problem is defined usually by the teacher.
    c. Sixth semester's project (main project, 60 % of the semester or more): A technical project given by the teacher or others

    Common to all projects: The group members are required to present their report orally to an audience.

3. *The Advisers*. Each group is assigned one adviser and censor. Both the adviser and censor are normally members of the ordinary staff. However, some external project partners have signalled their interest in closer co-operation. A handbook has been worked out to assist advisers and students during the process.
4. *The Documentation*. The group's activities and progress should be documented by a "project file" containing notes etc., a "process description" where the group evaluate their progress, and the formal report.
5. *Evaluation*. There is a pass/fail system. Only the final report is graded, with individual grades for each group member.

8.1.1 Change of Course Content

The Telemark model is, depending on the engineering departmental needs, allocating 25-30 % of the total organised time for project work. The rest of the weekly schedule is filled with "traditional activities".

As the technical content of the project work can only partly be selected and controlled by the teacher, he will play a less active role than usual, to provide the "useful" material for his students. Instead: Co-operative partners outside the college will have (and use) the opportunity to influence the college directly through student work. Experience shows that teachers indeed learn from their students' reports and often include such material in their own classroom work.

An important aspect of the Telemark model is the opportunity of specialisation - limited by the narrow frames given by the 3-year's program. Some graduates are reported to have been hired just because of the topic of the final semester's project. But this is not "the general rule".

8.1.2 Change of Educational Methods

Compared to what has been referred to as "traditional activities", project oriented studies above all mean a change of methods.

The change is **fundamental** since the objectives of project oriented studies are something more than just a curriculum replacement: While a "traditional" program normally emphasises certain selected fields of specific knowledge, project oriented studies are trying to realise objectives like

1. Teaching the fundamentals
2. Helping the students how to learn, and
3. Giving the students some training in solving problems.

Performed successfully, project oriented studies should have the ideal objective of helping the students learn to know themselves, making them fit for working in a constantly changing world.

8.1.3 Change of the Teacher's Role

The ideal role of the teacher serving as an adviser, may be formulated like this:

"The real challenge in college teaching is not covering the material for the students, it's uncovering the material with the students"

Consequently, the adviser needs neither be the expert of the topic chosen by the group nor in command of the group process. He should instead be the insightful indirect **leader** letting things happen.

This change may be described as fundamental. Maybe the "change of the teacher" will be the key element in restructuring engineering education for tomorrow's needs?

8.1.4 Curriculum Change

The partial shift of responsibility from the teacher to student groups will lead to the growth of "new" curricula containing several elements necessary to cope with the realities in the world of today.

The "new" curriculum may include *tangible* as well as *intangible* features:

1. Among the *tangible* aspects are training in practical leadership, applied to handling and following up formal meetings, making oral presentations, basic technical writing including style, grammar, spelling etc. And - of course - training in finding and applying appropriate technical solutions even in fields not taught at the college.
2. Some *intangible* parts of the "new" curriculum include experience with a variety of group psychology processes, development of personal attributes as creativity, social adjustment, responsibility, flexibility, initiative, courage and perseverance.

8.1.5 A Holistic Approach

Thus, it is believed and documented that there are indications that this way of conducting learning processes do respond to society's demand for broad-scoped engineering graduates, well fit for entering the workforce as well as well as prepared for advanced studies in a multitude of fields.

9 The Model from Bergen College

Bergen College (Hoegskolen i Bergen) has also a three year engineering degree programs almost on par with the engineering degrees offered by the University of Applied Sciences of Germany, discussed earlier in this paper. One of the authors of this paper has been responsible for two subjects in the Bergen College:

1. Instrumentation and Measurements for second year control engineering students
2. Sensorics (Sensors + Electronics) introduced by the author for the final year electronic engineering students

The integration of PBL with traditional learning/teaching methods has been practised by the author (Saba M.) from 1994 in Bergen College. The students' responses have been overwhelmingly positive, although, problems associated with the PBL enlisted above have been encountered almost every year. There is still a long way to go in educational organisations to fully integrate PBL without some or other problems. The teacher taking up PBL as an alternative is imposing on himself additional workload and creating small frictions between peers, due to students using more time on PBL than on other subjects. If the interest for PBL assignment is strong, this might be a factual situation.

9.1 Tutorials

The number of tutorials and problems in each tutorial varies from subject to subject. Due to the fact that the students having PBL assignments throughout the semester, five tutorials with 3 problems in each were viewed as mandatory. The tutorials were designed to have some relevance to the PBL assignments.

Three tutorials were given for practice and these were discussed in classroom situations.

9.2 Problem based learning

Having given 30% weighting to PBL assignment, the class was divided into 7 to 10 groups of three depending on the class size.

The students, using keywords from the teacher, in close collaboration with the industry in Bergen and the suburbs very often formulated the problem (project).

After kick-off meetings in the classroom, the students worked in their respective groups independently. Each student had his own logbook (project handbook) and each group had regular meetings with the teacher. The status report was delivered and discussed in classroom situations. Conflicts were resolved mostly in the teacher's office. The classroom presentation of the status reports had a strong information content to all groups and promoted mutual learning.

Some of the groups had very strong involvement and support from the firms where they were working on their PBL assignments. Particularly, R&D departments and service departments and firms with recruitment needs were willing to help the students by spending great amount of the valuable time of their employers. Some students got almost in-plant training in the course of their PBL assignments.

Many students used professional project planning tools like Microsoft Project for planning their PBL activities and coupling them to dedicated Gannt diagrams.

Involvement in PBL was viewed as an asset by the second year students of control engineering, as they were able to use the techniques learned in their final year project works with 12 ECT credits. The final year electronic engineering students were usually working on their pre-project work in the autumn semester and expressed that they should have learned these techniques of PBL before.

On completion of the PBL, students presented the PBL in the classroom. This presentation was very educative for the other students and also for the teacher. The effect obtained by using PBL can almost certainly not achieved by purely relying on traditional methods.

9.3 Laboratory Work

Laboratory work involving recipe form was avoided as much as possible. Demonstrations were performed by lab-engineers. Four out of six laboratory works were very often viewed as compulsory with mandatory report submissions. These reports helped them to learn the necessary documentation and good laboratory practice was emphasized.

The successful completion of the four laboratory assignments and the submission of the respective laboratory reports allowed the students to have the lab part accepted for the examination.

The laboratory group was not the same as the PBL group, due to lab logistic problems. The students as well as the teacher felt this aspect of group formation as a handicap.

9.4 Traditional lecture and student presentations

Normal lectures were held in selected topics. The syllabus was already given at the beginning of the semester. Selected topics were assigned to the same group members to be presented and discussed in the classroom. Many of the students read more than what was given in the syllabus and presented the material in a very professional way. This technique of requiring student presentations had a strong influence of inducing a certain amount of healthy competition.

Former students, who are now working in the industries, express the view that these student presentations have been very educative and gave them training to handle group discussions and presentation in their work places.

9.5 Traditional written examination

As mentioned earlier, in the model used by Bergen College, 30% weighting was allocated to PBL assignment. Hence 70% weighting was left for the traditional examination form based on the lecture material and student presentations and guest lectures. Examination had usually 5 problems, four on lectures and one on PBL.

In later versions, there were only four problems in the exam, if the students had already been examined on their PBL assignments separately.

10 Modification of the Bergen College Model: Masters degree in Engineering in Telemark College

Finally, we shall look into the topic of this paper: using a mixture of various elements of teaching for masters degree course in engineering. The method discussed here has been applied in the first year of the masters degree course in process automation in

the subject, Measurement and Instrumentation. Thirteen students coming from various colleges with three years of engineering education. On completing successfully another two years of study, these students will be awarded the masters degree.

These students consented to a mixture of PBL and elements of the Bergen model discussed above in their curricula. The final structure was in place after a series of discussions with the students themselves.

10.1 Elements in the pedagogical approach in the subject of Instrumentation and Measurements

The usual practice is to have a purely oral examination or written examination in this subject, after the students have fulfilled the mandatory requirements related to tutorials and laboratory assignments. We had all the elements of the Bergen Model. We determined to do away with the written examination of four to five hours and introduce a form of take home examination, very frequently used by teachers in music and medicine.

10.2 Take home examination

Take home exams were based on practical cases of instrumentation and measurements. Similar methodas have been tested by others and are used elsewhere too, probably in slightly modified forms, [4]. We introduced a PBL based term assignment in addition and weighted it 30%. The students were given a set of 4 problems of equivalent nature. Three were common. One special problem was assigned to each student. The student had three days to solve the problems. Each student was examined separately based on his or her written answer and presentation.

11 Evaluation

Evaluation basket is shown in Figure 1. The teacher has the flexibility of weighting the different elements in the basket for a particular classroom situation.

The presentation of PBL based semester assignment was done with the teacher and external examiner (called often as censor in Norway). This took for the four groups of students almost five hours.

The final part of the exam took a whole day from 08.00-17.00. Norway is criticised in an OECD report on education as spending a lot of time on money on controlling the examination results. With present day stipulations of the censor having the need to go through each and every answer independently and assessing each candidate, the extra costs involved in the evaluation process is obvious.

Table 2. Selected criteria (not exhaustive due to want of space in this paper) used in evaluating the marks for individual members of a PBL group. Each column will have a minimum score of 0 and a maximum score of 10. The formula for the Norwegian marking scheme in EXCEL will then give the value in the last column. P&ID (Piping and Instrumentation Diagramme) is relevant to the subject of Measurement and Instrumentation

Group Nr	Report	Presentation	Under-standing	Answer to questions	Extent	Depth	Use of Literature	Use of Industry	Program	P&ID	TOTAL	Evaluation based on total points
N.N												

12 Experience from Telemark College and Bergen College

The comments and criticism from teachers and students emphasize the popularity of the PBL assignments and their assignments. The workload and the corresponding evaluation basket as shown in Figure 1 indicate that we have to do more experiments with this model until we find an optimal model. The workload for the teacher is very much higher than for for the same teacher using traditional classroom based lectures only.

There is a need to make adjustments necessary for physically handicapped students or students not feeling comfortable in presenting their results orally.

We have to emphasize the following:

1. A commitment from the higher echelons down to the bottom within the colleges a
2. Independent working habit and dedication from students
3. Peer support and understanding among teaching colleagues

As shown in Figure 2, a form of feedback arrangement can be used to improve the learning and teaching processes. Project work alone is the normal form found in many engineering colleges. This is a final year activity with a report submitted for assessment.

In going to a model involving PBL, an integration of Information, Communication Technology (ICT), the students and teachers have a plethora of advantageous. Such a model is shown in Figure 2.

13 Conclusions

The experiences of various practitioners of PBL show that the learning and teaching processes become more lively, more relevant as far as the applications are concerned. The teacher and the student learn in the process. The resource use may become the limiting factor in classes with large number of students. The group dynamics needed to handle a PBL based model as discussed in this paper demands new thinking among teachers as well as students.

Students with specific problems such as physical handicap or are overly sensitive to presentations in front of people may need separate arrangements, meaning additional work for the teacher and administration. This would be the case even in a traditional teaching and learning scenario.

The learning content is deep and wide in a PBL based teaching. As such PBL should be seen as an important medium of modern engineering education.

14 Acknowledgement

Students and teachers of Bergen College and Telemark College provided many useful comments and criticisms.

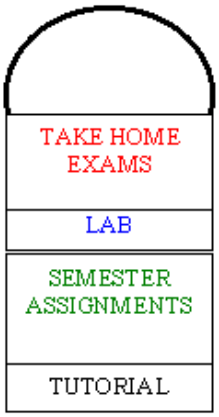

Figure 1. Evaluation based on a basket of activities spread over the whole term

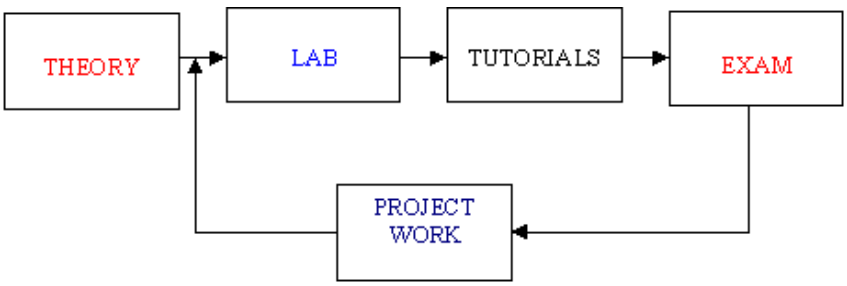

Figure 2. Traditional teaching and evaluation (Linear model)

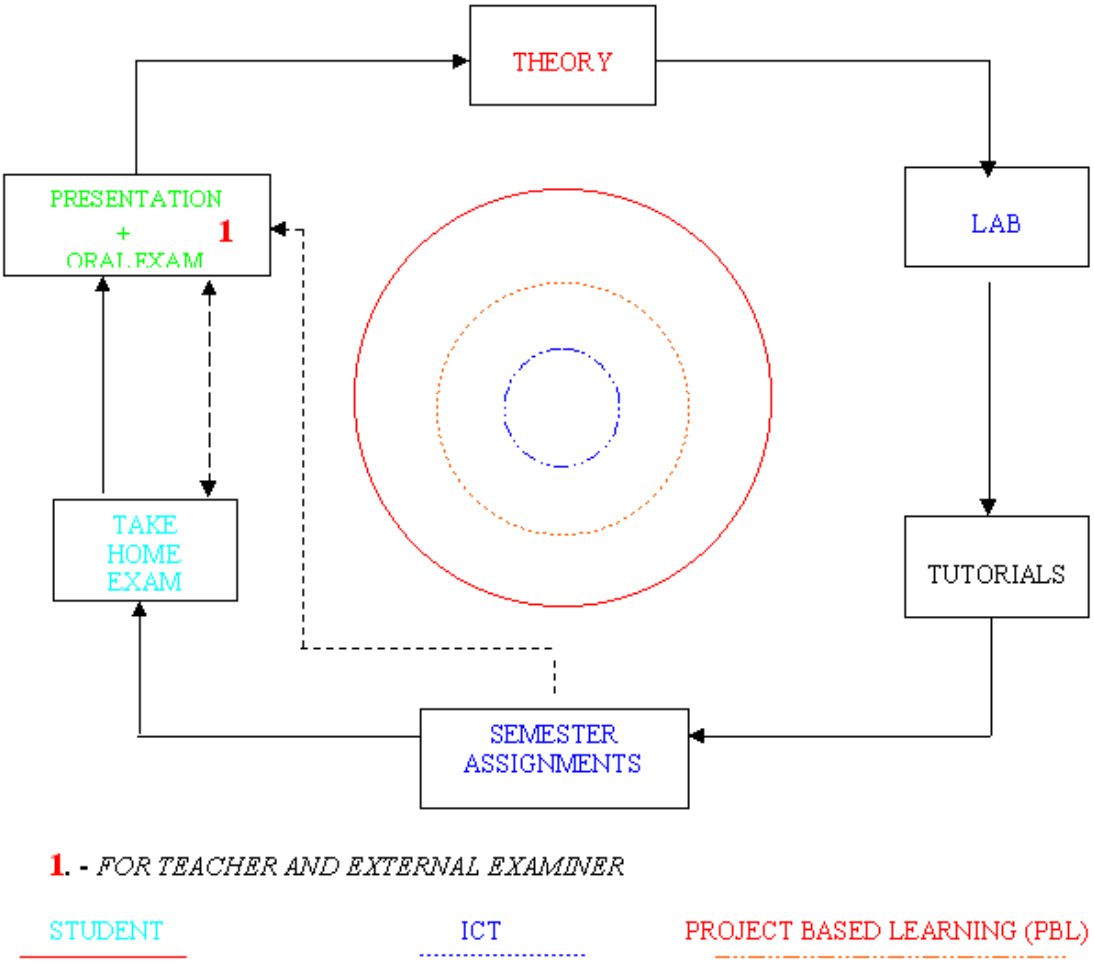

Figure 3. Mixture of Term Assignments, Tutorials, Laboratory Assignments and Problem Based Learning (Cyclic Model). ICT is for Information Communication Technology, the jargon of today. From [12]. More on the use of ICT in [11].

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