The impact of students' knowledge levels on the performances in a Design-Build project

Jensen, Lars Bogø; Jessen, Flemming; Andersson, Pernille Hammar

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The impact of students' knowledge levels on the performances in a Design-Build project

Jensen, L. B.[(1)], Jessen, F[(2)]. and Hammar Andersson, P.[(3)],

The Technical University of Denmark
National Food Institute, Division of Food Microbiology [(1)], Division of Industrial Food Research [(2)] and LearningLab DTU[(3)]

ABSTRACT

Today an important part of teaching at the university level is group work relying on the Learning pyramid (NTL), where teaching one another is much more beneficial for students than lecturing. In group work students are either put in groups of their own choice (mostly relying on social behavior) or put into predesigned groups. In this paper we have reflected on the consequences of the composition of the predesigned group and tried to evaluate the outcome based on marks given for assignments delivered as reports and oral exams. Preliminary findings indicate that the composition of the group could have an influence on the intended learning outcome (ILO -here tested by marks and knowledge of student performance); and if group composition is highly diverse (by including both students with reflective learning and superficial learning), preliminary findings presented here indicate that the ILO can be lower compared with the best individual student in the group. This finding in some ways contradicts the common perception that both reflective and superficial students will benefit from working together, however, further observations on a larger number of students are needed to verify these initial findings.

KEYWORDS

Group work, Group composition, Intended Learning Outcome (ILO), CDIO Standards 7 & 8

INTRODUCTION

Fifteen students participating in the first-year compulsory design-build course (12.5 ETCS) on a CDIO-based Bachelor of Engineering program in Food Analysis at The Technical University of Denmark (DTU) were evaluated using five reports and a final oral exam as formative assessment. At the oral exam, individual marks were given based on performance and answers to raised questions. These five reports occurred throughout the course to ensure progression in the intended learning outcomes (ILOs) and achievement of the learning objectives for the course and to help the progress of changing "pupils to students", a focus area for first-year students at DTU (Biggs, J & Tang, C 2011).

The reports assigned throughout the course were created to align the student's perception of their present status during the semester with the teacher's understanding of what was taught and to give students time to reflect on different subjects in the course. Furthermore, this was

done to force the students to work throughout the semester hoping to achieve deeper learning in contrast to superficial learning, which focuses the students' effort on preparing for the final exam. The basis for the alignment of student expectation and teacher understanding of student perception is the concept of "community of practice" (Wenger, E 1998) in which students and teachers create a social context around the learning process facilitating the quality of learning (Vescio et al 2008). Here students should be treated as "coming kinsmen", which will lead to the students taking responsibility for their own learning.

Supporting lectures, laboratory experiments and group work were performed before handing in each report that covered specific learning objectives, during the initial 13 weeks: This was followed by Problem Based Learning (PBL) in an open-ended project for three weeks and an oral exam. The focus of this paper is on the group work, trying to elucidate the influence of the group composition on the ILO.

Group work

Group work is an essential part of this first semester course for the Bachelor of Engineering in Food Analysis, but is generally not seen as a teaching concept or "a way of improvement of personal skills" by the students. We observed that first-year students do enhance their personal skills by ways of communication and exchange of knowledge. In group work, the students become facilitators for the reflective learning of the members of the group and as indicated by the Learning pyramid (NLT) deeper learning is increased when compared with lecturing. In this first semester course, the students worked in predesigned groups, not based on any prior knowledge or on their personal abilities, but by random selection. Some students heavily objected to the random composition of the groups, most likely due to a feeling of leaving their own comfort zone and engaging in work with unknown fellow students. By forcing group composition, a broader social network is created between the students supporting the community of practice.

In this first semester course, the compositions of the groups were changed mid-way through the semester, first of all to improve personal skills in communication, cooperation and social networking but also to evaluate if group composition would have an influence on the ILO. In the final PBL project, students were given the opportunity to change groups, very few students changed groups at this point.

Marks

Marks are as such NOT an indicator for deeper learning. Combined with existing knowledge of student behavior marks can indicate whether the student is *diligent* (driver of the ILO), *neutral* (having little or maybe a positive influence on the ILO) or *superficial* (having a negative influence on the ILO by just "doing what is necessary") (see Table 1). The 15 participating students in this first semester course were divided into these three categories after evaluating their performance throughout the semester. By defining the roles of the individuals in the groups, the composition of the group was established (see Table 2) and the influence of this composition on the given marks evaluated.

Group composition influence on ILO

When looking at the achieved marks for the reports and the final oral group exam with individual marks for the students, two observations were made..

First, the progress of changing “pupils to students” was observed. Students did adapt to the change from being secondary school students to being university students by aligning with the expectations from the teachers to the content of the reports. One sign for this transformation could be the gradual increase in marks during the first part of the semester.

Table 1. The role of the individual student

Student	1	2	3	4	5	6	Role	Final mark
I	C (3)	A(3)	D(3)	C(3)	C(3)	C(3)	Superficial	C
II	B (5)	B(5)	A(5)	B(5)	A(5)	A(5)	Diligent	A
III	B(2)	C(2)	B(2)	B(5)	A(5)	B(5)	Neutral	B
IV	B(6)	B(6)	A+(6)	A+(1)	A(1)	A+(1)	Diligent	A+
V	B(5)	B(5)	A(5)	B(2)	A(2)	A(2)	Neutral	B+
VI	C(3)	A(3)	D(3)	A+(4)	B(4)	A(4)	Neutral	B
VII	B(2)	C(2)	B(2)	B(2)	A(2)	A(2)	Neutral	A
VIII	C(3)	A(3)	D(3)	B(5)	A(5)	A(5)	Neutral	A
IX	B(2)	C(2)	B(2)	C(3)	C(3)	C(3)	Superficial	C
X	A(1)	B(1)	A(1)	A+(1)	A(1)	A+(1)	Diligent	A+
XI	B(6)	B(6)	A+(6)	A(4)	B(4)	A(4)	Neutral	A
XII	B(6)	B(6)	A+(6)	A+(1)	A(1)	A+(1)	Diligent	A+
XIII	B(4)	A(4)	A(4)	B(2)	A(2)	B(2)	Neutral	C
XIV	B(4)	A(4)	A(4)	A(4)	B(4)	A(4)	Diligent	A
XV	A(1)	B(1)	A(1)	C(3)	C(3)	C(3)	Superficial	B

In Table 1 the marks of the individual students are given for the six assignments (1 to 6, where the last is an oral exam). The last column gives the mark achieved by the individual students which is NOT the average of the marks since the oral exam (6) counts more. Numbers in parentheses indicate the group numbers in the first (assignment 1-3) and last part (assignment 4-5+oral exam) of the course (see Table 2).

Secondly, three types of students were identified (*diligent*, *neutral* and *superficial*). We observed during lectures and group work, that the the different student types could be identified and these types were confirmed by the obtained marks for the course. This process was possible due to the low number of students.

The *superficial* student seems to do what was needed for fulfilling the requirement of the reports to be handled in but not more. The student seems not to acquire deeper learning. If the group in which they participated contained too many of these types of students, the overall grade given for the assignment was lower. Furthermore, if the average score of marks given for the reports aligns with the marks given for the final oral presentation, that reflecting that it was not the media of presentation but the student’s ability that was evaluated. Furthermore the final grade for the superficial students was below the average grade for the course.

The *neutral* student did contribute to the improvement of the written assignments but did not have a negative effect on the marks given for the written assignments. The final oral marks for the *neutral* students reflected the average score of the course.

The *diligent* student was the driver of the marks obtained for the reports. When reviewing the average score of the reports, we saw a tendency that the scores were higher if there were more *diligent* students in the group than other types of students. If more *superficial* students were present in the group, the marks were lower. Diligent students recognize this trait and therefore seek to group with like-minded students. The reason for this is they related higher grade to furthering their education or eventually a better job. Marks given in the final oral examination for the diligent students were higher than the course average.

Table 2. The group composition.

Number	Part I	Part II
1	DSS	DDD
2	NSN	NNN
3	NNS	SSS
4	ND	NND
5	ND	DNN
6	DND	

Composition of the groups was defined according to the individual members. These were characterized as Diligent (D), Neutral (N) or Superficial(S). Group compositions were changed half way through the semester (Part I: 1-3 and Part II: 4-6) to evaluate the influence of group composition on the ILO.

Bahrami et al (2010) have developed four models for communication and prediction of the outcome (in this study, marks given and ILO). In accordance with our results they found that the best model for description of obtained result is the weighted confidence sharing (WCS) model in which results are obtained as a consequence of the internal estimation of achieving the correct results. Furthermore it is estimated that if the group composition is too diverse, the obtained result would NOT be better that the best performance in the group and even sometimes lower than the best performer, meaning “two heads are not better than one”. The conclusion here is that groups seldom outcompete the best member of the group and that information is shared but used suboptimal. In Teamology (Wilde, D.J. 2009) the focus is on the cognitive modes of the individual student and ILO will be improved if composition of group are designed according to the MBTI categories (Myers et al 1998) (Extraversion, Introversion, Sensing, Intuition, Thinking, Feeling, Judging and Perception). Individual cognitive modes can be identified by simple questionnaires but this was not done in this preliminary finding.

The preliminary findings raise questions about how students with different abilities and on different levels cooperate in groups and what impact they have on each other’s ILO and results, and how strategies could be used to optimize the ILO of Design-Build projects in a

CDIO context. We suggest that composition of groups should be investigated, and individuals with similar performance but different cognitive modes could improve ILO by being included in the same group, while trying to attempt creation of groups with students of different capacities might lead to failures in the ILO. Future investigations are needed to verify these initial findings.

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BIBLIOGRAFIC INFORMATION

Lars Bogø Jensen, PhD, is an Associate Professor at The National Food Institute, Division of Food Microbiology at DTU and the head of the study board at the National Food Institute and study leader for the Bachelor of Engineering Program in Food Analysis at DTU. His current research focuses on the identification of antimicrobial resistance and virulence determinants in bacteria. He currently teaches undergraduate and graduate students at DTU in microbiology and genetics.

Flemming Jessen, Ph.D. is a Senior Scientist at the National Food Institute, Division of Industrial Food Research, Technical University of Denmark (DTU). His research is focused on understanding the influence of biological aspects such as composition of feed for and stress of living fish on the food quality of fish. He currently teaches undergraduate and graduate students at DTU in biochemistry and food science.

Pernille Hammar Andersson works as an educational consultant at LearningLab DTU at the Technical University of Denmark. She is coordinator and responsible for the teacher training programmes at DTU as well as other competency developing activities in teaching and learning. She works with projects aimed at developing teaching and learning at DTU

departments and at DTU in general. She also works with deeper evaluation of new teaching methods and teaching and learning initiatives at DTU. She is a representative in the steering committee of IUPN, a national network supporting educational development in Danish Engineering Education and she is the vice chair of the International Active Learning in Engineering Education network. Her academic background is in psychology and educational science.

Corresponding author

Dr. Lars B. Jensen
Technical University of Denmark
Division of Food Microbiology
Mørkhøj Bygade 19
DK-2860 Søborg
Denmark
(+45) 22768169
lboj@food.dtu.dk