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Constructive Alignment in Practice – Integration of Theoretical and Practical Teaching by use of Clickers

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Given my earlier experience as a student and as a teacher, I had often experienced that the theoretical and practical components of teaching do not supplement each other and the two components are seen as two distinctively separate from each other. During the Adjunktpædagogikum course, my introduction to the paradigm 'Constructive Alignment' (Biggs & Tang 2007, Biggs 2003, Le & Tam 2007) aroused immense interest in me and I was motivated to try the concept within my own teaching context. Constructive alignment concept basically builds on two important tenets of learning: the teacher creates a conducive learning environment and the student constructs his own understanding of the knowledge based on his existing experience with the knowledge (Bowden 2004, Bowden & Marton 1998). Constructive alignment is the logical alignment of intended learning objectives (ILOs), actual theoretical teaching in the classroom, the teaching activities during the practical session and the assessment at the end of the course so that each component of the course supplements each other, to support the learning process of the students in their own ways (Bowden & Masters 1993). Diagrammatically, constructive alignment can be depicted as in figure 18.1 with learning process as the central element and the goal to be achieved by integrating different components (different circles in figure 18.1) supporting the learning process.

Clickers

Use of clickers is a proven tool as an effective means of teaching for active learning by students (CWSEI & CU-SEI 2009), where multiple choice concept tests (Mazur 1997) are answered by each student, followed by peer discussion (buzz groups) and a re-poll after discussion. The basic concept of the tool is that each student, with the help of a clicker, responds electronically to the concept test questions, ensuring participation from all the students, the result of which is then shown on a chart in a slide, providing the teacher an idea of the level of understanding of the taught theoretical concepts. If the chart shows poor results e.g more than 50% providing wrong answer, then a two-minute discussion is done with the neighbours sitting next to you, after which a re-poll is taken to see the benefits of the discussion with the neighbours. During the Adjunktpædagogikum course, I attended one session on use of clickers and I was fascinated by the benefits of the use of clickers and therefore, I developed interest to use the clickers in my own teaching to provide as far as possible effective learning environment. My reasons for use of clickers in a classroom environment are as follows:

- Keep the students active and motivated in a classroom environment
- Students take responsibility to prepare for the clicker questions to get the right answers
- Students can discuss and share the views with fellow students
- Students can check their answers anonymously encouraging participation

Overview of my teaching

I had teaching in the course ‘Tropical crop production’ an elective course at M.Sc. level, which can be taken during M.Sc. study year 1 or 2 and the students with an interest in tropical crop production in the context of developing countries, followed the course. Given that that the course has a strong focus on crop production in the developing countries, many of the students in the course came from the M.Sc. programme ‘Agricultural Development’. The course details with block structure, credit points, assessment format and expectations of skills and competencies to be gained on completing the course are provided in appendix A. The course has been

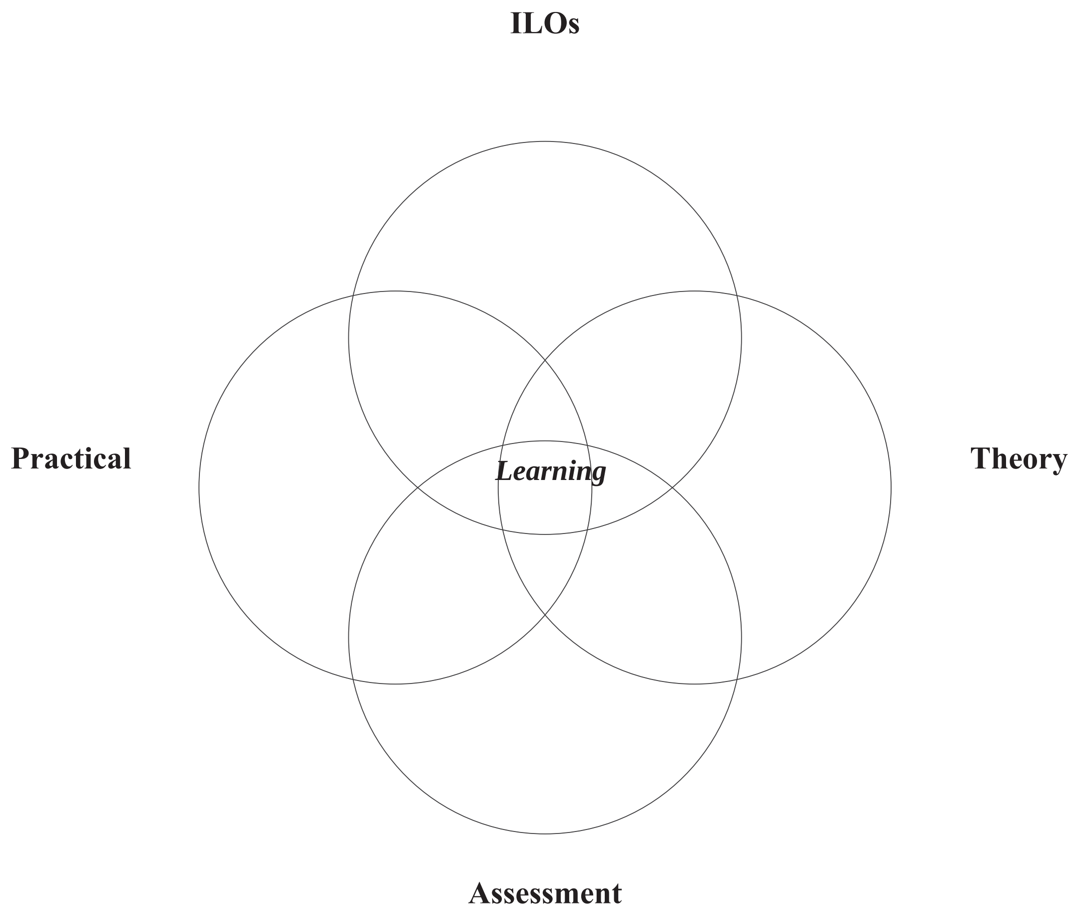

Fig. 18.1. Different components of constructive alignment and their interrelationship for an effective learning environment

running for couple of years and I was responsible for two lectures. The first lecture was on 'Tropical maize production' which consisted of theoretical and practical components. There were 26 slides in total for the theoretical and the practical component. Of the total time allocated for the lecture of 2 hours and 20 minutes, the theoretical component consisted of 1 hour and 20 minutes and the practical component consisted of 1 hour. The theoretical part consisted of power point slide presentation with clicker sessions in between to create an interactive environment for discussion as well as to clarify the doubts that the students had during the lecture. In the practical component, an exercise was presented and the students worked in groups of 3-4 people, which had to be completed in a week and submitted to me. The second lecture was on 'on-farm trials' and I had a total of 27 slides: 16 slides for the lecture and 11 slides for the clicker session. The lecture and the clicker session was organized in a way that the students grasped the concepts of on-farm trial types and design in the lecture and the clicker session was meant to test the students understanding of the teaching by solving a real life problem in designing a on-farm trial using two cultivars of rice with two levels of nitrogen fertilizer.

Problem formulation

During the second lecture on 'on-farm trial', my aim was to implement constructive alignment within a teaching session by integrating the theoretical teaching and practical session so that students can test their understanding of the subject matter taught in the theory by solving a real-life problem situation. I formulated the intended learning objectives (ILOs) with SMART principle, in mind and prepared the slides for the theoretical lecture and the practical/clicker session to far as possible match the ILOs and vice-versa. My objectives were to

- match ILOS, theoretical teaching and the practical/clicker session
- to test the combined use of clickers and buzz session to encourage enhanced participation and enriched understanding of the taught subject matter

Methods and Materials

The results provided here are based on the teaching on the on-farm trial (Appendix B) followed by the responses provided by 26 students to the six clicker questions; five clicker questions on the subject matter (Q1-Q5) and Q6 on the opinion of the students on the usefulness of the clickers for learning. The six questions were:
Q1: Which on-farm trial type do you suggest
Q2: Do you need a control treatment
Q3: How many treatments are required
Q4: How will you place your treatments
Q5: Which on-farm trial design do you suggest
Q6: Is use of clickers a good aid for teaching

Q6: Possible response choices

1. Excellent tool for learning
2. Helps me to learn by interacting with others
3. I like it just for fun
4. It is ok to use it
5. It distracts me

Each student had one clicker device and when a question (Q1, Q2, Q3, Q4, Q5) was presented on a slide, each student was asked to provide an answer to the question. The result for each question was shown on a chart with percentage of students providing different answers (multiple choices) for the question. The students were then asked to go into buzz groups of two each, with the fellow students sitting next to him/her in the classroom and discuss the answer. During the two-minute buzz session, each student tried to convince the other student his/her own answer by providing reasons for the answer. After the buzz session was over, a re-poll was done, where the students provided an answer to the question individually. The answers were charted and shown in a slide and the right answer was indicated in the chart so that students could see if they answered the question right. I recorded the number of students (responses) providing the right answer before and after the buzz session. Towards the end of the session, Q6 was asked with 5 different response choices (1-5) to provide the students an opportunity to evaluate usefulness of clickers in a learning environment.

Results

The results are provided in percentile of right answers before and after buzz session for each question. Before the buzz session, 60-80% of students provided the right answer, depending on whether the answers to the question could be directly extracted from the lecture or not. 80% of the students in the class provided the right answer when they are asked to answer on the type of trial design to be suggested (Q5) whereas only 60% answered right when they were asked if control treatments were required for the experiment (Q2) (Fig. 18.2). The reason for high number of students providing right answer in Q5 is that the students had already gone through the details of the trial treatments and the trial placement in the field (Q1-Q4), which provided them a good idea of the trial design, and so the answer could be taken directly from the theoretical teaching. However, Q2 was more a conceptual question and the answer could not be taken directly from the taught lecture. In both situations, the advantage of the buzz round could be seen in significant improvements in number of right answers. After the buzz session, there was 10-20% increase in the number of students providing the right answers, as an outcome of the buzz session. The clicker session provided a clear picture of where the students had difficulty in understanding the theoretical concepts and in this teaching, I need to focus on control treatment (Q2) and its significance. So, the combination of clicker with the buzz session not only created an enabling environment for learning by discussing in buzz groups but also provided me a good picture of where I needed to focus on in the next teaching. In this way, the findings were useful for the students to know the benefits of the buzz group as well as to me in terms of how to improve and reflect on my teaching (e.g. control treatment in my teaching, Q2) where students had difficulty in understanding. To the question on how the student perceived the clicker as a teaching tool (Q6), 85% answered as ‘excellent tool for learning’ (response choice 1) and 15% answered as ‘helps me to learn by interacting with others’ (response choice 2) whereas none thought that it was distracting or not useful for learning (Fig. 18.3), which provided motivation for use of clickers.

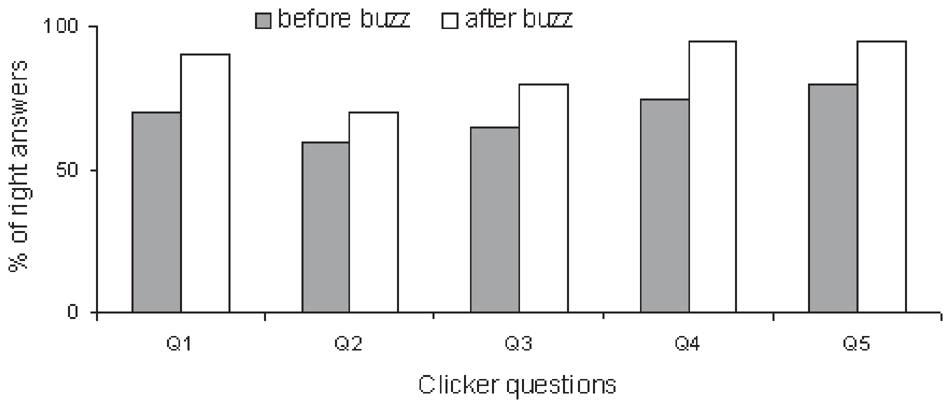

Fig. 18.2. Percentage (%) of right answers for different clicker questions (Q1-Q5), before and after the buzz round

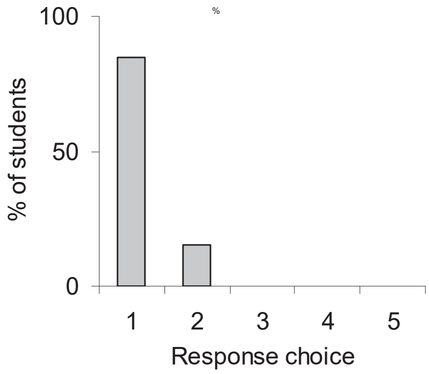

Fig. 18.3. Percentage (%) of students, who provided different response choices on the benefits of clicker use (Q6)

Conclusions

I think I have, to a certain extent, succeeded in matching the ILOs, theoretical teaching and the practical session during my teaching on on-farm trial. The findings that the buzz group discussion increased the number of right answers is evidence that peer-peer discussion helped in providing an enabling environment for learning and for the teacher to reflect and improve on the teaching based on the responses charted in the graphs. The students' overwhelmingly good response, with 85% stating that clicker is an excellent tool for learning and another 15% answering 'helps me to learn by interacting with others' are good indicators to justify the use of clickers for teaching. Some of the students also preferred to use the tool to evaluate a course as use of clickers would encourage participation by individual students and can be a potential tool for course evaluation, the outcome of which can be used by the teachers to improve the future teaching in those teaching sessions where students have difficulty in understanding.

A Course description, excerpt

Title: Tropical Crop Production – LPLK10367
Department: Department of Agriculture and Ecology
Credits: 7.5 ECTS
Level of Course: Msc
Examination: Final Examination, written examination, all aids allowed.

Course Content: The course focuses on capacity development in tropical crop production. The students will be exposed to the three major crop science elements that are instrumental to optimal crop production 1) Plant breeding and crop varieties, 2) fertilizer (organic/unorganic) and 3) crop protection. [. . .]

Teaching and learning Methods: The course combines lectures and theoretical and practical exercises. Lectures will outline the background and support the exercises.

Learning Outcome: Provide students, having a BSc-level background in agricultural sciences or equivalent, with a comprehensive understanding of the intrinsic properties of selected tropical crop species and their management in tropical rainfed and irrigated agro-ecosystems. Focus is on bio-physical related production constraints and human endeavour to optimize crop production in small-scale farming systems, within the context of poverty alleviation and sustainable crop production.

When students have completed the course they should be able to:

- **Knowledge**
  - Demonstrate knowledge of the principles of tropical crop production
  - Understand the characteristics of major tropical crops
  - Demonstrate overview of tropical farming systems in relation to agro-ecological and socio-economic conditions.
- **Skills**
  - Analyse and synthesize diverse types of information on tropical crop production
  - Design cropping calendars for selected major crops species
  - Develop tropical crop production plans in relation to given agro-ecological and socioeconomic conditions
  - Design, implement and analyze research projects in a tropical crop production environment
- **Competences**
  - Assess and formulate agronomic components of development support programmes
  - Advise extension and research institutions in tropical countries
  - Do statistical and graphical analysis of field experiments.

B On-farm trial – theoretical session

On-farm trials (tropical context)

Intended learning objectives:

- Differentiate between on-farm and on- station trials
- Describe and differentiate between different types of on-farm trials
- Apply an on-farm trial design based on the on-farm trial objective

What is on-farm and on-station trial

- On-farm trials
  - Field trials placed in farmers' fields
  - Testing of technologies after on-station evaluation
- On-station trials
  - Field trials in a research station/ university experimental farm
  - Testing of the technologies for the first time in the area/country/region

Why on-farm trials

- Common platform for researchers and farmers to communicate
- Technology assessment by farmers
- Technology evaluation under wide range of environments
- Realistic production input and output information
- Feedback mechanism for research priority setting to real farmer needs

Types of on-farm trial

Three categories

- ❖ Researcher-designed and researcher-managed
- ❖ Researcher-designed and farmer-managed
- ❖ Farmer-designed and farmer-managed

Researcher-designed & researcher-managed

- Farmer involvement is minimum
- Researcher takes control
- Similar trial design rigor as on-station
  - Control plot, replication, plot size
- Representative of farmers' environment
- Often involve renting land from farmers
- Biophysical performance evaluation

Researcher-designed & farmer-managed

- Researchers consult with farmers
  - Design and implementation
- Test treatments are compared with control
- Farmers follow same standard practice across the farms
- Farmers responsible for field operations
- Biophysical data and farmers assesment
- Analysis of costs and returns

Farmer-designed & farmer-managed

- Farmers are on their own
- Farmers design trial without control
- Plot size and management varies
- Researcher monitor a sub-sample of trials
- Realistic farmers assessment
- Farmer-to-farmer visits to share experiences amongst farmers

Comparisons of on-farm trial types

Design	Researcher	Researcher	Farmer
Management	Researcher	Farmer	Farmer
Crop yield			
Cost/benefit analysis			
Farmers Assessment			

Suitability of on-farm trial types to gather data (Low, medium and high)

Key on-farm trial designs

- Completely randomised design
- Randomised complete block design
- Split plot design

Completely randomised design

- 2 maize cultivars (M1 and M2),
- 2 nitrogen levels (0 and 30 kg N ha^{-1})
- 3 replicates

M1, 0	M2,30	M2, 0
M2,30	M1,30	M1, 0
M1,30	M2, 0	M2,30
M2, 0	M1, 0	M1,30

Completely randomised design

- Each plot has equal chance of receiving a treatment
- Treatments assigned randomly to all plots
- Simple design to use
- Best suited with few number of treatments
- Best if experimental units are homogenous
- Usually, not ideal design for field trials

Randomised complete block design

- 2 maize cultivars (M1 and M2),
- 2 nitrogen levels (0 and 30 kg N ha^{-1})
- 3 replicates

Block 1	M1,0	M2,30	M1,30	M2,0
Block 2	M2,0	M1,30	M1,0	M2,30
Block 3	M1,30	M2,0	M1,0	M2,30

Randomised complete block design

- Equally sized blocks with all treatments
- Each block contains complete set of treatments
- Number of blocks are the number of replications
- Treatments are assigned randomly within the blocks
- Best suited for field trials due to heterogeniety in field characteristics

Split plot design

- 2 main plot (irrigation treatments, W1 and W2)
- 2 subplots in each mainplot (2 maize cultivars, M1 and M2)
- 3 replicates

Block 1	W1M1	W1M2	W2M2	W2M1
Block 2	W2M2	W2M1	W1M1	W1M2
Block 3	W1M1	W1M2	W2M2	W2M1

Split plot design

- 3 layers in trial set-up
  - Block
  - Mainplots
  - Subplot
- Higher precision in subplots than mainplots
- Greater precision required for one factor relative to the other
- Practical limit for one factor is bigger than for other factor for comparison

C On-farm trial – practical/clicker session

Internship assignment

- IRRI is interested in evaluation of
  - 2 high-yielding rice cultivars (IR64 and IR8) with 2 nitrogen fertilizer rates (0 and 60 kg N ha-1)
- Both cultivars have been tested on-station and yield higher than local cultivar
- Cultivars need to be tested on-farm under farmers management
- Data on biophysical performance and farmers evaluation required

Farming environment

- Farmers have < 1 hectare rice fields
- Most farmers grow a local cultivar (Pita)
- Local cultivar yields are low (1-2 t ha^{-1})
- Farmers can provide 2 paddy terraces for testing the cultivars
- Each rice paddy is minimum 30 x 10 m^2

Q1: Which on-farm trial type do you suggest

1. Researcher designed and researcher managed
2. Researcher designed and farmer managed
3. Farmer designed and farmer managed

Q2:Do you need a control treatment

1. Yes
2. No
3. Maybe

Q3: How many treatments are required

1. 4
2. 8
3. 12
4. 6

Q4:How will you place your treatments 1. Cultivar treatments in one paddy terrace and fertilizer treatments in another terrace ✓ 2. Each terrace is assigned to one fertilizer level 3. Each terrace is assigned to one cultivar	**Q5:Which on-farm trial design do you suggest** 1. Completely randomised design 2. Randomised complete block design ✓ 3. Split plot design
Q6:Is use of clickers a good aid for teaching 1. Excellent tool 2. I like it very much 3. It is ok to use it 4. It distracts me	

All contributions to this volume can be found at:

http://www.ind.ku.dk/publikationer/up_projekter/2011-4/

The bibliography can be found at:

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