Experiments in laboratory teaching

- personal experiences of alternative approaches to laboratory teaching in biology

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Pu-rapport nr 1998:1

Pedagogiskt utveckingsarbete

Stockholms universitet

ABSTRACT

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In two experiments, alternative approaches were used to maintain teaching quality against a background of reduced teaching time and a mature 'NT-svux' student group who were used to the problem-based learning (PBL) approach. Experiment I was carried out on a 4 day course in basic laboratory techniques. On the course, the students were given 'Thinking and Doing' problems which were 'solved' by laboratory work. Experiment II was done on a 10 day animal physiology course. Here, the students learned the Scientific Method and then applied the Method practically to gain knowledge in animal physiology. Both teaching experiments promoted independent student activity and learning as well as practical decision-making. I believe that these alternative approaches to laboratory teaching maintained a high teaching quality and, as complements to the PBL method, seemed to meet the expectations of the student group involved.

BACKGROUND

In the autumn term of 1995, a new course in biology for NT-svux (see footnote) students was initiated at Stockholm University. The 'NT-svux' students were given the opportunity to read a 40 week biology course built-up around the problem-based learning (PBL) method (see 'Grundkurs i Biologi med PBL som undervisningsmetod'. V. Flodin och M. Samuelson. Stockholms Universitet. Pu rapport nr 1996:7); the course being almost entirely theoretical. It rapidly became apparent, however, that many of the 'NT-svux' students wished to continue studying up to degree level and therefore, I was asked to plan and organise a complementary 'practical' course in order to allow them to do so. This 20 week 'practical' course ('Biologiska arbetsmetoder' - see 'Kursplan) has now been run twice in the spring and autumn terms of 1997.

For pragmatic reasons, 'Biologiska arbetsmetoder' had to be organised into short teaching blocks of about 1 to 2 weeks for each subject area - which was considerably less time than on a corresponding 'ordinary' course in biology. This put the responsible teacher (for each subject area) under pressure to organise their teaching in such a way that the quality (and quantity) of student learning (teaching) would remain high. As an additional prerequisite, teaching which emphasised independent work and problem-solving by the students (on longer experimental projects) was also encouraged - in order to allow further development of the general skills acquired by the students through using PBL.

This report describes my own efforts on 'Biologiska arbetsmetoder' (autumn term 1997) towards maintaining quality with less teaching time and a mature ('NT-svux ') student group which was used to the problem-based approach. I wanted to try something different and so, I tried some 'Experiments in Laboratory Teaching'. This is a personal account of my experiences. Experiment I concerns the use of 'Thinking and Doing' stations (inspired by Johnstone and Reid; 1997) in teaching 'basic laboratory techniques'. Experiment II describes the application of the Scientific Method (as described Barnard et al.; 1993) towards 'Asking questions in animal physiology'. The report is primarily aimed at biology teachers who do practical classes at University or College level.

'NT-svux' = 'naturvetenskaplig och teknisk - särskild vuxenstudiestöd'

EXPERIMENT I

'Basic laboratory techniques'

Introduction. Well, you can imagine the problem. What you have to do is teach the students how to make solutions, how to use a pipette, how to measure pH and other 'basic laboratory techniques'. Your colleagues scorn - "that sounds really boring ! I'm glad I'm not doing that course !" But there you are, lumbered with it ! What are you going to do ?

This was basically the scenario that I was faced with about a year ago when I volunteered (oops !) to teach 'basic laboratory techniques' to a group of mature (NT-svux) students who were reading a 20 week course whose title was roughly translated from 'Biologiska arbetsmetoder' to the 'lab kursen' by the students and to 'ways of working in biology' by me (which is more flexible).

'Thinking and Doing'. Fortunately, help was on its way from Scotland (University of Glasgow) in the form of Professor Alex Johnstone and Dr Norman Reid (Johnstone and Reid; 1997) who held an unusual and most inspiring workshop which dealt, amongst other things, with the problems of teaching laboratory practical work. One of the didactic (not chemical) solutions offered to reduce the signal to noise ratio - the high level of which apparently incapacitates students in laboratory situations - was the 'post-lab'. The 'post-lab' is used after the 'real' laboratory work is over and is designed to make the student think and apply what he/she has learned during the practical session in a slightly different (very different ?) context. I personally was thrilled by doing some of the 'post-labs' on offer during the workshop and this experience inspired me to try something similar on my students. I therefore decided to do laboratory stations under the working title of 'Thinking and Doing' (see Experiment I - Course details). I was also inspired by taking a trip to Tom Tits Experiment in Södertälje in the south of

Stockholm, but I don't remember why ! - maybe it was the feeling that the place gave that 'discovering things is great !' Alternatively, maybe I just liked the waffles !

Course design. Well, there was a lot to pack in about three and a half days - safety, use of basic laboratory equipment, how to work in the laboratory, how to use balances (see Experiment I - Course details)...whew! But I had decided on my core teaching method - stations of 'Thinking and Doing'. I was going to have to demonstrate a lot of stuff on the first day because I could n't think of a better way of doing things. In addition, because I had earlier worked for 5 years in hospital clinical chemistry and I believed that I was one of the most competent pipetters at Stockholm University (probably a dubious honour !) and could really show 'em - how to keep the automatic pipette straight, not to immerse the pipette tip too deeply in the liquid, draw the liquid in the tip while watching for air bubbles, to carefully wipe the pipette tip with a Kleenex, to expire the liquid and observe that everything is expired, forward mode, reverse mode... oops !, I'm just showing off now. Well, the thing is, in my experience, I have had students on advanced courses who were doing complicated experiments who really had very little idea how to use an automatic pipette properly - fat chance of the experiment working ! Have you also noticed this ? So somewhere along the line we expect the students to pick these things up, but maybe not all do, do they !?

Student background. I knew from talking earlier to the students that many of them had not been in a laboratory for many years and really needed to start from scratch building up their laboratory skills again. At the same time, I wanted to offer them a challenge while doing 'basic' things. I therefore choose to set them 'Thinking and Doing' problems (to get them to do things in the lab) which would require them to think and make a lot of their own decisions in the laboratory and thereby hopefully encourage independence.

Basic didactic approach. I had also decided that my basic didactic approach would be similar to that of a group supervisor using the problem-based learning (PBL) method (Kjellgren et al.; 1993) i.e. that of, 'balling' questions back to the students. For example, by saying (gently), " well, what do you think the answer is ?"

Students assessment. For reasons beyond my control, it was necessary to grade the students using the scale - good pass, pass and fail - based on only a few days work. At the same time, I wanted the students to feel that they had plenty of time to get used to working in the laboratory and learn, and not get stressed-up about assessment. Finally, I decided that the students would be assessed based on observed activity, a short test, and the quality of a laboratory report. It was only possible to fail by lack of attendance.

Evaluation of the experiment

Observation by me. In general, I observed that the students were fully absorbed by the problems set. Surprisingly (and contrary to the comments from my colleagues), there was no signs of boredom. The approach of 'balling' questions back to the students seemed to work too, once they had understood that I would probably answer a question with a question. Often, they had already decided what to do and only needed a bit of encouragement to get going.

Comments from students. I asked the students if the tasks were too easy. My impression was that they thought that the level of the problems was just right - offering a challenge, while at the same time allowing them the opportunity to regain (gain ?) skills and confidence in working in laboratory. After the course, one student commented on how much she appreciated the opportunity to work independently. Another commented that she had gained a lot of self-confidence in the laboratory by learning 'basic laboratory techniques' through 'Thinking and Doing'. Yet another student (former teacher) thought that this pedagogic approach 'felt' right and would be useful at school level too - since it promoted curiosity. No-one made negative comments about the teaching approach.

Post-course analysis

'Thinking and Doing ' problems. After the course, I analysed the 'Thinking and Doing' problems according to the classification of 'problems' outlined in Appendix 1. Although this classification is somewhat difficult to apply, I believe that the 'Thinking and Doing' problems were of type 3 or 4, in other words, the students knew the goal but were given incomplete data and were fairly unfamiliar with the method. Was this the reason why they seemed to be so absorbed in what on the face of it seemed to be dull, basic 'basics'. Mm !?

'Basic laboratory techniques'. Did my teaching approach on the course contain the 6 principles of good teaching as outlined in Ramsden (1996) i.e. (a) interest and explanation, (b) concern and respect for the students and student learning (c) appropriate assessment and feedback, (d) clear goals and intellectual challenge, (e) independence, control and active engagement and (f) learning from students. Well, more or less, I think ! The approach adopted had little to do with pure transmission of information but much more to do with organising student activity and making learning possible (see higher education teacher's theories of teaching - Ramsden; 1996).

Development. Well, a lot more could have been done - more 'Thinking and Doing' problems covering more areas, more use of 'results' for better (?) assessment of gained practical skills...but this will have to wait until next autumn.

What do I think about the teaching experiment on reflection ?

I really enjoyed working with the students using the 'Thinking and Doing' stations and it was a challenge to deal with all the activity of the group. It was gratifying to watch the students grapple with the tasks and usually succeed in solving the problems by themselves - I could see that they got a feeling of self-accomplishment. On the whole, it was satisfying teaching !

Summary

A group of mature (NT-svux) students with 'rusty' laboratory skills were given a short course in 'basic laboratory techniques' as preparation for further laboratory studies in biology. A number of 'Thinking and Doing' problems (type 3 or 4) were used to encourage independent thought, decision-making and activity in the laboratory. Through observation and oral feedback, the outcome of this teaching approach seemed to be positive and satisfying for both student and teacher.

EXPERIMENT I - COURSE DETAILS

A short introductory course (approximately 4 days) in 'basic laboratory techniques'

Aim: to provide the opportunity to learn basic laboratory skills applicable to all laboratory work in biology.

Goals: after the course you should have -
* become accustomed to the laboratory
* learned how to work safely in the laboratory
* developed general laboratory handling and observational skills.
* learned the names of and know how to use basic laboratory equipment
* learned something about standard curves
* gained understanding of the concepts: 'accuracy' and 'precision'
* learned how to calculate mean, standard deviation and coefficient of variation
* practised calculating molarity and dilutions
* understood the importance of the use of deionised (and distilled) water
* made solutions of varying concentration
* practised handling a strong acid and alkali
* gained an understanding of the concept of pH
* learned how to measure pH
* learned how to select a laboratory buffer (based on pKa)
* carried out an experiment (according to instructions)
* designed and performed an experiment
* learned how to write a laboratory report
* practised oral presentation

Contents: safety (including fire hazards, safe handling of chemicals and radioactivity etc), basic laboratory equipment, how to work in the laboratory, use of balances, volume measurement, molarity, accuracy and precision, simple statistics, dilutions, the standard curve, pH measurement, selecting biological buffers, experimental design, writing a laboratory report and making an oral presentation.

Didactic: demonstration (day 1) and 'Thinking and Doing' stations (day 2 - 4).

Student group: 18 students, working in pairs.

Teachers: one

Course book: Practical Skills in Biology (Chapters 1 - 10). Jones, A., Reed, R. and Weyers, J. (1994). Longman Scientific and Technical.

Thinking and Doing 1

Take an automatic pipette. What is the accuracy and precision of the pipette ? How would you check it ?

Aims:

* to understand the concepts of accuracy, precision and errors
* to think about how to check accuracy and precision
* to practise pipetting
* to practise using a balance
* to do simple statistics i.e. mean, standard deviation and coefficient of variation

Comment: the students referred to the text book to look up accuracy, precision and errors. Any piece of equipment (e.g. pipette or burette) for volume measurement could have been used.

Thinking and Doing 2

Calculate how much sodium chloride you need in order to make a 0.5 M solution. Make this solution and then do a doubling dilution and then do 2 decimal dilutions. What is the final concentration of the solution ?

Give the final solution to your teacher who will check the sodium concentration of the solution by flame photometry.

Aims:

* to practise calculating molarity and doing dilutions
* to gain practical dexterity
* to give a feeling for the size of volumes
* to understand the difference between tap water and deionised water
* to introduce the method of flame photometry
* to introduce the concept of the standard curve

Comment: By not saying which volume of solution was needed, the students had to decide for themselves how much solution to make based on which glassware was available. The ability of the students to do the task was assessed by measuring the sodium concentration in the final solution by flame photometry- which meant that the students got feedback about how well they had performed practically. It was possible to see who had used tap water from the 'results' obtained.

Thinking and Doing 3

Make a solution of 1M sodium hydroxide

Make a solution of 1M phosphoric acid (from concentrated phosphoric acid)

Aims:

* to practise in handling a strong acid and alkali safely
* to give further practise in calculating molarity
* to develop practical dexterity

Comment: Again no volumes were given, so the students made a pragmatic decision. The first calculation was straight forward. The second calculation (of the required dilution of concentrated phosphoric acid) was more challenging for the students since it required the use 'percent composition' and 'density' too.

Thinking and Doing 4

What is the pH of tap and deioinised water ? What is the hydrogen ion concentration ?

What is the pH of the sodium hydroxide and phosphoric acid solution which you have made ? What are the hydrogen ion concentrations ?

Predict what will happen to the pH when you add sodium hydroxide to phosphoric acid. Draw a theoretical curve (ml sodium hydroxide on the X axis and pH on the Y axis)

Aims:

* to introduce the concept of pH and the pH scale
* to understand the relationship between pH and hydrogen ion concentration

* to learn how pH is measured (dyes, pH paper and pH meter)
* to practice predicting experimental outcome

Comment: the students referred to the course book to get help

Thinking and Doing 5

Pour 100 ml of water in a beaker and add 10 ml of 1M phosphoric acid. Determine the pH with indicator paper. Add 1 ml of 1M sodium hydroxide, mix, and determine the pH. Continue adding sodium hydroxide (1 ml at a time) and determining the pH after each addition until the solution is strongly alkali.

Draw a graph of pH against ml sodium hydroxide added. Point out the pKa values for phosphoric acid. How can pKa values be used in practical laboratory work ?

Aims:
* to gain understanding of buffering capacity
* to understand how to measure pKa
* to understand how pKa values can be used to select a buffer for use in biological experiments.

Comments: 'Thinking and Doing' 3 - 5 are related and build on each other but have different aims. In Thinking and Doing 5, the students followed instructions, but chose their own equipment to do the experiment. To solve the 'problem', the students were forced to read the chapter on pH in the course book.

Thinking and Doing 6

Measure the time taken to dissolve a given tablet at room temperature. At what temperature will the rate of dissolving be doubled ? Find out by experiment.

Aims:

* to design a simple experiment
* to perform an experiment
* to make decisions about what do experimentally
* to practise predicting practical problems in experiments .

Comments: This 'pre-lab' was borrowed from the workshop of Johnstone and Reid (1997). It worked very well and really caught the imagination of the students who continued designing new experiments long after they had 'finished'. They practised writing their first laboratory report based on their experiments.

EXPERIMENT II

'Animal physiology'

Introduction. "Why do we have this as a course book (Asking Questions in Biology - Barnard et al; 1993), it' s so boring !" said one student. "Every time I start to read it, I fall asleep", said another. I was exasperated - how could they not understand the importance of this book - it was about the most important method of all in biology, the Scientific Method !

Quote from Ramsden (1996), when asked ' more that 80 % (of zoology students from third year to graduate level) were baffled by the question on scientific theory (method)'...I could understand why - because they were n't taught it !

So as course leader, I felt that something had to be done. But I had now given myself two tasks. Firstly, to teach the students some of the methods used to study animal physiology and secondly, to teach the Scientific Method. How could this be done ? And in 10 days !

Course design. The main function of the course was not to teach physiology theory (this was 'done' on the earlier theoretical course) but to give practical experience of investigating animal physiology. I took the following approach -

Firstly, to get students to read 'Asking questions in Biology' (Barnard et al.; 1993), test their understanding of the Scientific Method and then discuss difficulties.

Secondly, to give short orientation lectures in five areas of animal physiology.

Thirdly, to get the students to do a 'mini-project' in groups in one of these areas, using the Scientific Method to design and carry out their own experiments.

Fourthly, to write a scientific article based on the results of the 'mini-project'.

Finally, to give an oral presentation of their findings.

Since the students would be working closely with the course book 'Asking questions in biology' but would be asking questions in animal physiology, the course gained the working title of 'Asking questions in animal physiology' (see Experiment II - Course details).

Basic didactic approach: I wanted to encourage self-driven, independent activity by the students.

Student assessment. Again, the students had to be assessed according to the scale - good pass, pass and fail. The students were assessed based on: observed activity, a test and participation in a discussion on the Scientific Method and on the 'use of animals in research', quality of an oral presentation and quality of the written scientific article. There was both individual and group assessment.

Evaluation of the experiment

Observation by me. In general, the independent self-driven approach worked well as judged by the high level of student activity and interest. The students showed a lot of interest in the Scientific Method (and their course book) once they got a chance to apply it in practise.

Comments from students. Some of the students said that they were extremely satisfied with the design of the course, the opportunity to read the course book and their 'mini-projects.

In contrast, one student criticised how the course was designed already during the introduction - thinking that there should be labs everyday since "this was a lab course" (see comment earlier). I was a bit taken a back, but recovered and managed to say something about the idea being to encourage deep learning of the Scientific Method as applicable gaining knowledge in animal physiology (and something that they would remember and have use for later on) and that I felt it of less use for them to do a larger number of more demonstration-like practicals. Whew !, the argument was accepted, but was I right ?

Many of the students thought that writing a scientific article *and* giving an oral presentation was 'too much' - writing took up too much time and energy, leaving nothing left to give in the oral presentations.

Post-course analysis:

'Scientific Method'. Use of the Scientific Method in laboratory teaching seems to me to have a number of advantages: (a) the students get an opportunity to learn the whole process of doing 'science' (is n't that our aim - to make them into scientists ?!); (b) the students get insight into how scientific knowledge is gained and thereby get the opportunity to change how they view the 'knowledge' in their biology text books and (c) perhaps the students gain a sense of security in so much that the same method can be applied to gain knowledge throughout the vast field of Biology. The disadvantages are: (a) the students cover fewer methods and (b) this approach requires more time.

The NT-svux students on the course had earlier studied biology theory using the PBL approach (see Background). The core of this method is based on group work using a formal 7 step learning cycle (Kjellgren et al.; 1993) Although I have summarised the steps in the Scientific Method as a list in Appendix 2, the Scientific Method could also be described as a cyclic process of learning and knowledge accumulation. Thus, it seems that the 7 step PBL learning cycle and the Scientific Method represent similar (complementary ?) learning strategies for theory and practise, respectively.

Economics. The cost of teaching 'Asking questions in animal physiology' was almost half that of other subjects (of equivalent length) on

'Biologiska arbetsmetoder' due to the relatively low contact time between supervisors and students.

Development. A number of improvements could be made. For example, a series of short laboratory stations could be added so that the students can at least try more methods, data simulation could be used for variation (e.g. of action potentials in nerves), the demand for written and oral presentations could be reduced in order to increase laboratory time (as long as they get sufficient practise elsewhere on the course !) and more feedback on individual student learning (written examination ?) could be obtained for better (?) student assessment...but this again will have to wait until the autumn term.

What do I think about the teaching experiment on reflection ?

This was the first time that I had taught the Scientific Method and its application to 'Asking questions in animal physiology', so the experiment was a challenge in terms of my own learning/teaching. In addition, although I knew what I wanted from the students, I think that I did not clearly communicate what I wanted to the other supervisors - so that we could all work towards the same goals. Similar communication problems seem also to arise when teaching teachers the 7 steps of the PBL method. Do we interpret the method in the same way ?! Do we emphasise the same things ?! Perhaps, the course also felt 'heavy' to me because of all this. Despite these 'teething problems', I am excited about the approach since the students get a feeling for 'doing science'. I was also very excited to see just how well some of the 'mini-projects worked !

Summary

A group of mature ('NT-svux') students with some previous theoretical background in animal physiology were given a two week course entitled 'Asking questions in animal physiology'. On the course, the students applied the Scientific Method in order to gain knowledge (through practical experimentation) in animal physiology. The course seemed to be fairly successful in terms of reaching the goals set but less successful in terms of overall balance and was judged as being somewhat 'heavy' (in its present form) by the students and teacher alike.

EXPERIMENT II - COURSE DETAILS

A practically-oriented (two week) course with the working title of 'Asking questions in animal physiology'

Aim: to provide the opportunity to understand the Scientific Method and its application to the gaining of knowledge in animal physiology.

Goals: after the course you should have -
* gained understanding of the Scientific Method
* understood how the application of the Scientific Method can be used to gain knowledge in animal physiology
* gained knowledge in animal physiology
* gained practical skills in physiological measurement
* learned how to analyse results statistically
* learned how to write a scientific article
* practised oral presentation

Contents: Scientific Method, ethics of animal experimentation, temperature regulation, excretion, circulation, respiration/energy metabolism, endocrinology (orientation lectures and 'mini-projects' in four of these areas), how to write a scientific article, oral presentations.

Didactic: emphasis of responsibility for learning on the students; encouragement of independent, self-driven activity by the students.

Student group: 29 students; working in groups of varying size.

Teachers: one supervisor for each 'mini-project' area - contact time with students over the two week period was about 10 hours.

Equipment: sphygmomanometer, Douglas bag, oxygen/carbon dioxide analyser, light microscope and flame photometer.

Course books: *Asking questions in biology - design, analysis and presentation*. (1993). Barnard, C., Gilbert, F. and McGregor, P. Longman Scientific and technical. *Biology*. Campbell. (1996) (the students had this from earlier studies). The Benjamin/Cummings Publishing Company, Inc.

Reference books: *Animal Physiology - adaptation and environment.* (1997). Schmidt-Nielsen, K. Cambridge University Press. *Animal physiology: mechanisms and adaptations*. Eckert, R., Randell, D. and Augustine, G. (1988). Freeman and Company.

'**Asking questions in biology' (Barnard et al.; 1993)**

Comment: The students were given course time to read the book; motivation being provided by the prospect of a test. One problematic area of the book for the students (and perhaps also for a lot of researchers including me) was choosing statistical significance tests (before designing the experiments !).

'Using animals in research' - video and discussion

Comment: The teacher who showed the video and lead the discussion commented that there was a very lively discussion afterwards which could have gone on forever !

'Mini-projects' - laboratory work

Comment: The students were allowed to choose one of four subject areas (circulation, endocrinology, energy metabolism or excretion) to work in. The supervisor showed them the equipment which was available and how to use it. The students made some preliminary observations and then formulated a hypothesis and made predictions. They then tested their predictions using the Scientific Method as outlined in Appendix 2. The students decided to look at the effect of: (a) exercise on pulse rate and blood pressure; (b) smoking on pulse rate and blood pressure; (c) food ingestion on metabolic rate; (d) salt and 'Seltin' intake on urinary sodium and potassium excretion; or (e) hormones on melanophore distribution in fish scales.

Scientific article - the students wrote up the results of the 'mini-project' in the form of a scientific article (as exemplified in Barnard et al.; 1993).

Comment: Some groups wrote one article between them. Other students wrote an individual article. The students put an enormous (disproportionate ?) amount of time into writing their articles which was reflected in the generally high standard. The articles were graded independently by two supervisors using a marking sheet (modelled on examples in Gibbs and Habeshaw; 1994) looking for the following points: (a) understanding and application of the Scientific Method; (b) understanding of the physiological method; (c) quality of the data and statistical analysis; (d) quality of coupling to the physiological theory and (d) 'completeness' of the article.

Oral presentations - the students were asked to present their 'mini-projects' in a way which would exactly describe their working through the Scientific Method (i.e. according to the steps outlined in Appendix 2).

Comment: the oral presentations were OK but it was clear that the students had been exhausted by the task of writing a scientific article the days (and nights) before.

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Other sources of inspiration:

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Bessman, M. (1997). Kurs i Universitets Pedagogik i teori och praktik Autumn term 1997.

Tom Tits Experiment. Södertälje, Stockholm.

Lastly...Ginger, Sporty, Scary, Posh and Baby...the all-conquering...Spice Girls !

APPENDIX 1

a classification of 'problems' (after Johnstone and Reid; 1997)

Type	**Data**	**Method**	**Goal**
1	Given	Given	Given
2	Given	Unfamiliar	Given
3	Incomplete	Familiar	Given
4	Incomplete	Unfamiliar	Given
5	Given	Familiar	Open
6	Given	Unfamiliar	Open
7	Incomplete	Familiar	Open
8	Incomplete	Unfamiliar	Open

APPENDIX 2

The Scientific Method (based on Barnard et al. 1993)

Preliminary observations

Formulation of a hypothesis

Making predictions and formulating a null hypothesis (Ho)

Choosing a statistical significance test

Experimental design

Experimentation

Statistical analysis of the results

Predication correct or incorrect

Hypothesis holds or not

Interpretation of the results in a broader context

Tidigare utgivna rapporter i denna serie:

1974:1 S Wahlén. Språkfärdighetstermin i engelska. Del I. Engelska institutionen
1974:1 I Carlson - S Hargevik - D Jones - M Knight. Språkfärdighetstermin i engelska. Del II. Lärarerfareheter. Engelska institutionen
1974:1 S Wahlén. Språkfärdighetstermin i engelska. Del III. Andra terminens utbildning. Engelska institutionen
1974:1 M Knight. Språkfärdighetstermin i engelska. Del IV. Uttals- och talkurs. Engelska institutionen
1974:2 Pågående utvecklingsprojekt vid Stockholms universitet 1974/75
1974:3 D T Richard. Postgraduate Education in Geology. Geologiska institutionen
1974:4 I Åkerlund. Muntlig språkfärdighet i franska AB1, första terminen. Institutionen för romanska språk
1975:1 M Jaarma. Grupparbete i teoriundervisningen i biokemi. Avdelningen för biokemi
1975:2 A Hjort. Pedagogisk försöksverksamhet med arbetsgruppper. Socialantropologiska institutionen
1975:3 Pågående institutionsprojekt vid Stockholms universitet 1975/76
1975:4 M Bergström - N Bickham. Deltagarstyrd projektorienterad undervisning. Pedagogiska institutionen
1975:5 B. Söderberg. Arbets- och examinationsformer. Institutionsgruppen för svenska
1975:6 B Rönnbäck. Tillämpning av Kellerplanen på en kurs inom psykologut bildningen. Utbildningsavdelningen
1975:7 L Brandell. Kvällsstudier. I. Vid kursens början. Utbildningsavdelningen
1975:8 B Rönnbäck. A Personalized System of Instruction - PSI - eller Keller planen. Litteraturgenomgång och teoretisk analys. Utbildningsavdelningen
1975:9 U Boëthius - B. Söderberg. Problemorienterade studier i svenska.
1976:1 E. Ems - Å Sohlman. Pu-arbete vid en universitetsinstitution. En uppföljningsstudie. Nationalekonomiska institutionen
1976:2 K Gylling - B Wadell. Vad är det vi håller på med? Försök med gruppundervisning. Företagsekonomiska institutionen
1976:3 S Köpniwsky - G Edsbäcker. Matrisen. Ett förslag till ny utbildnings struktur för företagsekonomiska institutionen.
1976:4 Förteckning över pågående projekt läsåret 1976/77
1977:1 M Knight. Final Report on Four Laboratory Programmes "Tell the Story". Engelska institutionen
1977:2 U Boëthius. Ett försök med problmeorienterade studier i svenska. Litteraturvetenskapliga institutionen
1977:3 I Åkerlund. Muntlig språkbehandling i franska. Institutionen för romanska språk
1977:4 J L Serrano. Kontrastiva övningar i spansk morfosyntax. Institutionen för romanska språk
1977:5 Förteckning över pågående och avslutade projekt läsåren 1976/77 och 1977/78. Stockholms universitet
1977:6 B Rönnbäck. Tre studiedagar kring pedagogiska frågor i samband med läromedelsutveckling.

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1978:5 M Jaarma. Ny metod för teoriundervisning på grundkurser i biokemi. Institutionen för biokemi
1978:6 M Ohné - K Winblad. Projektarbeten på biologlinjen. Biologiska övningslaboratoriet
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1981:2 J Heizlar - P LUndström. Kvällsundervisningens pedagogik. Samhällsvetenskapliga linjenämnden.

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1982:1 G Hansson - G Skoog. Fältkurs i ekologi - en undervisningsmodell. Biologiska övningslaboratoriet
1982:2 L-J Norrby. Kemiämnenas pedagogik: Kunskaper och begreppsbildning vid kemistudiernas början. Kemiska övningslaboratoriet
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ISSN0349-0955