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Variants of an Action Oriented Learning Environment for Technical Vocational Training[1]

Learning a trade in Germany usually is done under the dual system of vocational education and training. The system is called 'dual' because vocational training takes place both in the company and in part-time vocational school. In the dual system the primary task of the vocational school is to foster the acquisition of theoretically controlled and reflected vocational competence. One possible means to achieve this is action oriented training. Action oriented technical vocational training requires a complete and rich learning environment. Students are active in realistic or reality referred tasks which are situation and subject-related. The navigation through the learning process is gradually left to student's responsibility allowing them to make their own decisions. Necessary guidelines in an action oriented technical vocational training are often offered as written documents. Students can learn and work with them almost without directive instruction of a teacher. Modern vocational training comprises self-directed learning as well as instructional means conducted by the teacher. Thus, situated learning processes are combined with objectivistic elements. The question however, of how the two different orientations should be combined is yet to be answered. One contribution to answer it is tried to be provided by comparing different variants of lessons in an empirical study. In four different treatments of an action oriented training the student's written documents and the instruction by the teacher are varied. Both the written documents as well as the instruction are in one variant example-based (situated) and in the other systematic oriented (objectivistic). The results of this study should help to enlighten the question which interdependencies of the investigated characteristics in an action oriented learning environment are beneficial for an acquisition of knowledge that leads to vocational competence.

Research Questions

1. How should written documents in self-directed learning processes be designed?
2. How should the acquisition of knowledge in self-directed learning processes be supported by the teacher?

Approach

- empirical study
- standardized questions
- participant observation
- pre-test, final test

2x2 Factorial Design

Instruction by teacher

Student's written documents	systematic oriented	example based
systematic oriented	SS	SE
example based	ES	EE

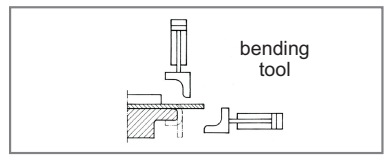
Written Documents

systematic oriented

2. Aufbau von SPS-Programmen
   2.1 Einfache SPS-Programme
      2.1.1 Voraussetzungen
      2.1.2 Die Funktionen FC1 und FC2
   2.2 Umfangreichere SPS-Programme
      ...
3. Befehlsausgabe bei bistabilen Magnet...

The structure of the **written documents** is systematic oriented and features no worked out examples.

example based

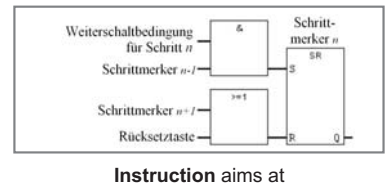


The structure of the **written documents** is action oriented and features worked out examples.

The students work with two types of written documents. A so called 'Leittext' (guiding text) tells them what to do and additional written documents ("Informationsmaterial") provide them with the information they need to solve their tasks. The two variants of "Leittexts" are similar in their structure whereas the structure of the additional written documents differs from each other as described above.

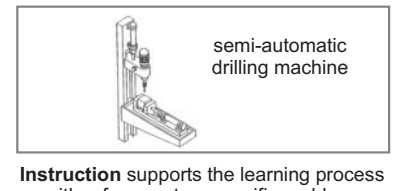
Instruction by Teacher

systematic oriented



Instruction aims at underlying systematic structures.

example based



Instruction supports the learning process with reference to a specific problem.

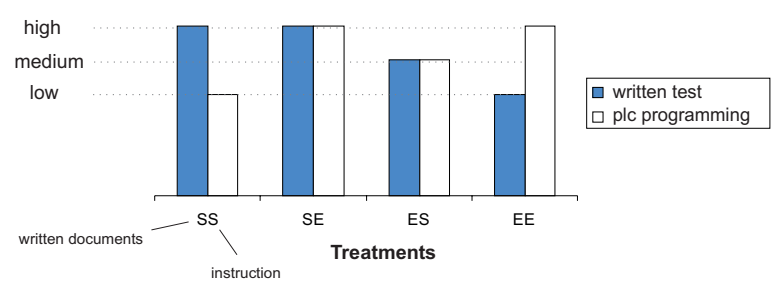
The variation of the teacher's instructions refers both to the few planned instructions in front of the whole class and to the individual instructions and support for the different groups. The students were free to demand support whenever they thought they needed it.

Hypotheses

Hypothesis 1:
The different variants lead to different results. In these results the smallest differences are expected between variants SE and ES. Greater differences are expected between variants SS and EE.

Hypothesis 2:
The expected results are particularly favourable, when systematic orientated and example based written documents and instruction are combined complementarily.

The following diagram tries to visualise the expected results based on the hypotheses.



School and Students

School
- Städtische Berufsschule für Fertigungstechnik, Munich
- Mechatronics apprentices, second year
- 2 classes = 4 groups (62 students)
- "block-teaching" (1 week in vocational school, 2 weeks in company)

Lesson
- action oriented
- high degree of self-directed learning with written documents
- only few planned instruction phases

[1] Presented on a poster session during the final conference of COST Action A 11 in Gothenburg, June 13th – 16th, 2002.
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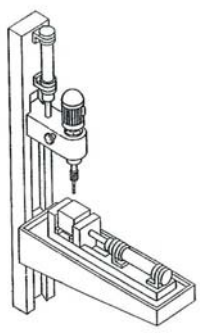
Topic of Lessons

The topic of the lessons - programming sequences of events - stems from the learning field **automation technology**. Within an automated process programmable logic controllers (plc) are used to implement industrial control systems for machines, manufacturing plants and industrial processes. The learning target for the eight lessons (1 lesson = 45 minutes) is to learn **how to program sequences of events**. In previous lessons the students learned how simple binary functions are programmed. Now their task is to use the different functions to program the sequences of events which are necessary to fulfil the assembling tasks of their station. The students work in groups of three on one station.

In the centre of the described vocational training stands an assembly line. Here electrical switches are mounted sequentially through a series of five assembly stations. Having reached the end of the assembly line the mounted switches are taken off it by a robot who puts them into boxes.

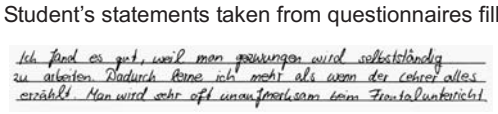
Structure of Lessons



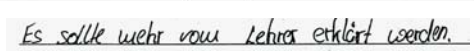
Task 1	Task 2
Programming of a semi-automatic drilling machine	Programming of one station of the assembly line
approx. 3 lessons	approx. 5 lessons

Student's Statements

Student's statements taken from questionnaires filled out after the lessons.



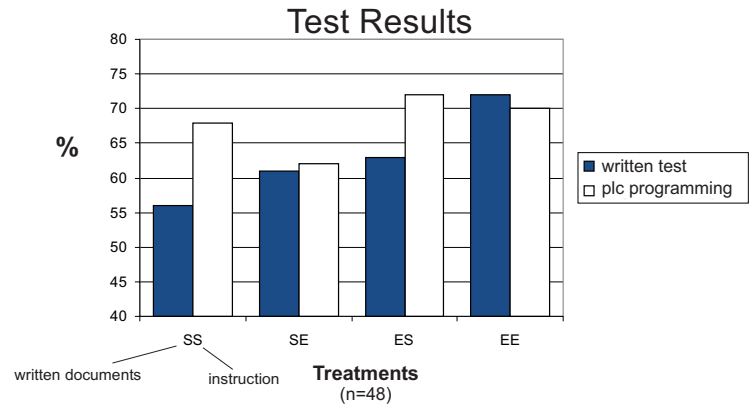
"I liked it because one is forced to work on one's own. This way I learn more than when the teacher is telling things. One often gets inattentive when being taught ex-cathedra."



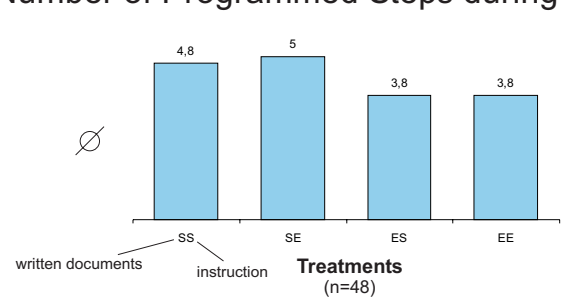
"The teacher should explain more."

Final Test

After the 8 lessons the students had to take a test that lasted about 90 minutes. A written test of about 25 minutes was followed by a programming task of about 65 minutes. The written test focussed on declarative knowledge whereas the focus of the programming task was to test the acquired applicable knowledge.



As a first result the diagram shows that the students with the example oriented variant of the written documents performed better in both parts of the test.



The main part of task 2 was to program the stations as far as possible. The diagram shows the average number of steps that where programmed by the four groups. According to the analysed data the students with the systematic oriented variant of the written documents in average programmed one step more than the groups with the example based material.

Summary of First Results

- The results of both parts of the final test show a better performance of the students with the example oriented variant of the written documents.
- Unlike their performance in the final test the students with the systematic oriented variant of the written documents programmed more steps in task two than the students with the example oriented variant of the written documents.

First Conclusions:

The students with the example oriented variant of the written documents were better prepared for the final test because they had to work through the worked out examples and extract knowledge from them in order to apply it to their task.