Two Strategies for Competence Oriented Knowledge Transfer

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Improving University Teaching 2012
Statement of the problem

Strategy 1: Written Elaborations
- A (brief) presentation of the strategy
- Methodology of the evaluation
- Findings
- Discussion of possible improvements

Strategy 2: A commented list of errors
- A (brief) presentation of the strategy
- Methodology of the evaluation
- Findings
- Discussion of possible improvements

Outlook
1. **Statement of the problem**

2. **Strategy 1: Written Elaborations**
   - A (brief) presentation of the strategy
   - Methodology of the evaluation
   - Findings
   - Discussion of possible improvements

3. **Strategy 2: A commented list of errors**
   - A (brief) presentation of the strategy
   - Methodology of the evaluation
   - Findings
   - Discussion of possible improvements
Statement of the problem

Deficits in the students’ mathematical communication competence (also in higher semesters).
Statement of the problem

Deficits in the students’ mathematical communication competence (also in higher semesters).

- Difficulties in formulating mathematical assertions in a formally correct way.
Deficits in the students’ mathematical communication competence (also in higher semesters).

- Difficulties in formulating mathematical assertions in a formally correct way.

**Example**

*The equation has a positive solution.*
Statement of the problem

Deficits in the students’ mathematical communication competence (also in higher semesters).

- Difficulties in formulating mathematical assertions in a formally correct way.

Example

*The equation has exactly one positive solution.*
Deficits in the students’ mathematical communication competence (also in higher semesters).

- Difficulties in formulating mathematical assertions in a formally correct way.

Example

*The equation has exactly one solution* and *this solution is positive.*
Statement of the problem

Deficits in the students’ mathematical communication competence (also in higher semesters).

- Difficulties in formulating mathematical assertions in a formally correct way.
- Problems in formulating a proof in a logically correct way.
Statement of the problem

Deficits in the students’ mathematical communication competence (also in higher semesters).

- Difficulties in formulating mathematical assertions in a formally correct way.
- Problems in formulating a proof in a logically correct way.

(vague) explanation ≠ proof
Deficits in the students’ mathematical communication competence (also in higher semesters).

- Difficulties in formulating mathematical assertions in a formally correct way.
- Problems in formulating a proof in a logically correct way.
- Difficulties in presenting mathematical topics (to different audiences) in an appropriate way.
Deficits in the students’ mathematical communication competence (also in higher semesters).

- Difficulties in formulating mathematical assertions in a formally correct way.
- Problems in formulating a proof in a logically correct way.
- Difficulties in presenting mathematical topics (to different audiences) in an appropriate way.

Lack of follow-up of courses by the students.
Usual structure of (our) mathematics tutorials

Weekly:
Usual structure of (our) mathematics tutorials

Weekly:

- Exercises are posed (a week in advance)
Usual structure of (our) mathematics tutorials

Weekly:
- Exercises are posed (a week in advance)
- the students work on the exercises (at home)
Usual structure of (our) mathematics tutorials

Weekly:

- Exercises are posed (a week in advance)
- the students work on the exercises (at home)
- the students mark the solved exercises
Usual structure of (our) mathematics tutorials

Weekly:
- Exercises are posed (a week in advance)
- the students work on the exercises (at home)
- the students mark the solved exercises
- students present their solutions
Usual structure of (our) mathematics tutorials

Weekly:
- Exercises are posed (a week in advance)
- the students work on the exercises (at home)
- the students mark the solved exercises
- students present their solutions

In addition: $n$ examinations
Written Elaborations

1. Statement of the problem

2. Strategy 1: Written Elaborations
   - A (brief) presentation of the strategy
   - Methodology of the evaluation
   - Findings
   - Discussion of possible improvements

3. Strategy 2: A commented list of errors
   - A (brief) presentation of the strategy
   - Methodology of the evaluation
   - Findings
   - Discussion of possible improvements
The students made a written elaboration of an exercise they had presented before.
Written Elaborations and feedback

1. The students made a written elaboration of an exercise they had presented before. **Focus** on formal correctness and comprehensibility for people with the same mathematical level.
### Written Elaborations and feedback

<table>
<thead>
<tr>
<th>Number</th>
<th>Task Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The student had presented an exercise they had worked on before. Focus on formal correctness and comprehensibility for people at the same mathematical level.</td>
</tr>
</tbody>
</table>

**Example:**


![Diagram](image_url)
The students made a written elaboration of an exercise they had presented before. **Focus** on formal correctness and comprehensibility for people with the same mathematical level.
Written Elaborations and feedback

1. The students made a written elaboration of an exercise they had presented before. **Focus** on formal correctness and comprehensibility for people with the same mathematical level.

2. The elaborations were corrected by the teacher.
Written Elaborations and feedback

1. The students made a written elaboration of an exercise they had presented before. **Focus** on formal correctness and comprehensibility for people with the same mathematical level.

2. The elaborations were corrected by the teacher.

3. The students received feedback on a feedback form.
Written Elaborations and feedback

1. The students made a written elaboration of an exercise they had presented before. **Focus** on formal correctness and comprehensibility for people with the same mathematical level.

2. The elaborations were corrected by the teacher.

3. The students received feedback on a feedback form. Feedback was itemised with respect to competences.
Statement of the problem

Strategy 1: Written Elaborations

1. The students made a written elaboration of an exercise they had presented before.
   Focus on formal correctness and comprehensibility for people with the same mathematical level.

2. The elaborations were corrected by the teacher.

3. The students received feedback on a feedback form.
   Feedback was itemised with respect to competences.

Strategy 2: A commented list of errors

Written Elaborations and feedback

1. The students had presented an exercise with the focus on...

2. The elaboration was corrected by the teacher...

3. The students received feedback on their elaboration....
Written Elaborations and feedback

1. The students made a written elaboration of an exercise they had presented before. **Focus** on formal correctness and comprehensibility for people with the same mathematical level.

2. The elaborations were corrected by the teacher.

3. The students received feedback on a feedback form. Feedback was itemised with respect to competences.
Written Elaborations and feedback

1. The students made a written elaboration of an exercise they had presented before. **Focus** on formal correctness and comprehensibility for people with the same mathematical level.

2. The elaborations were corrected by the teacher.

3. The students received feedback on a feedback form. Feedback was itemised with respect to competences.

4. Finally there was a discussion of the elaboration and the feedback.
Written Elaborations

1 Statement of the problem

2 Strategy 1: Written Elaborations
   - A (brief) presentation of the strategy
   - Methodology of the evaluation
   - Findings
   - Discussion of possible improvements

3 Strategy 2: A commented list of errors
   - A (brief) presentation of the strategy
   - Methodology of the evaluation
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   - Discussion of possible improvements
The project aim was:

“Improving the students’ competence to communicate mathematical topics in a correct and understandable way.”
The project aim was:

“Improving the students’ competence to communicate mathematical topics in a correct and understandable way.”

The research question for the strategies’ evaluation was:

“Does the strategy of written elaborations improve the students’ mathematical communication competence?”
Methodology I

Data collected after each meeting
Data collected after each meeting

- *The students’ perspective:* A questionnaire containing the questions:
  1. Feedback form and discussion were useless – very helpful to me. (four-point scale)
  2. How do you judge your own mathematical communication competence? (open question)
Methodology I

Data collected after each meeting

- **The students’ perspective:** A questionnaire containing the questions:
  1. Feedback form and discussion were useless – very helpful to me. (four-point scale)
  2. How do you judge your own mathematical communication competence? (open question)

- **The teacher’s perspective:** Feedback form and observations during the discussion
Data collected after each meeting

- **The students’ perspective:** A questionnaire containing the questions:
  1. Feedback form and discussion were useless – very helpful to me. (four-point scale)
  2. How do you judge your own mathematical communication competence? (open question)

- **The teacher’s perspective:** Feedback form and observations during the discussion

- **External perspective** (only in some of the meetings): Observations of an office colleague
Methodology II

Data collected at the end of the term
Methodology II

Data collected at the end of the term

- **The students’ perspective**: A questionnaire containing the questions:
  1. How helpful were the written elaborations and the feedback? (four-point scale)
  2. What did I thereby learn the most? (open question)
Data collected at the end of the term

- **The students’ perspective**: A questionnaire containing the questions:
  1. How helpful were the written elaborations and the feedback? (four-point scale)
  2. What did I thereby learn the most? (open question)

- **The teacher’s perspective**: Reflections and observations on the strategy.
Methodology II

Data collected at the end of the term

- **The students’ perspective:** A questionnaire containing the questions:
  1. How helpful were the written elaborations and the feedback? (four-point scale)
  2. What did I thereby learn the most? (open question)

- **The teacher’s perspective:** Reflections and observations on the strategy.

- **External perspective:** Reflections on the strategy by a colleague teaching another group.
Written Elaborations

1. Statement of the problem

2. Strategy 1: Written Elaborations
   - A (brief) presentation of the strategy
   - Methodology of the evaluation
   - Findings
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3. Strategy 2: A commented list of errors
   - A (brief) presentation of the strategy
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   - Findings
   - Discussion of possible improvements
(Some) findings - students’ perspective

Rating of the mathematical communication competence
(First written elaboration)

Depending on the difficulty of the topic
oral good, written problems
very good
problems with rigorous formulations

Frequent answers

Frequency
(Some) findings - students’ perspective

Rating of the mathematical communication competence
(Second written elaboration)

Remarks on the improvement since the first written elaboration
Problems with rigorous formulations

depending on insight and preparation

Frequency

0 2 4 6...
(Some) findings - students’ perspective

How helpful were the written elaborations and the corresponding feedback to me?

Frequency of answer
- Useless
- Of a little use
- Helpful
- Very helpful

0 2 4 6 8
(Some) findings - teacher’s perspective

- Very interesting (mathematical) discussions during the meetings.
(Some) findings - teacher’s perspective

- Very interesting (mathematical) discussions during the meetings.
- The students are highly interested in feedback.
(Some) findings - teacher’s perspective

- Very interesting (mathematical) discussions during the meetings.
- The students are highly interested in feedback.
- A lot of elaborations, therefore some less suitable exercises.
(Some) findings - teacher’s perspective

- Very interesting (mathematical) discussions during the meetings.
- The students are highly interested in feedback.
- A lot of elaborations, therefore some less suitable exercises.
- Discuss more than one elaboration at the same time?
Very interesting (mathematical) discussions during the meetings.

The students are highly interested in feedback.

A lot of elaborations, therefore some less suitable exercises.

Discuss more than one elaboration at the same time?

The second elaboration was better than the first one.
(Some) findings - teacher’s perspective

- Very interesting (mathematical) discussions during the meetings.
- The students are highly interested in feedback.
- A lot of elaborations, therefore some less suitable exercises.
- Discuss more than one elaboration at the same time?
- The second elaboration was better than the first one.
- From my point of view the strategy was successful.
(Some) findings - external perspective

- Positive climate during the meetings.
(Some) findings - external perspective

- Positive climate during the meetings.
- Students’ did not hesitate to ask in case of comprehension problems.
(Some) findings - external perspective

- Positive climate during the meetings.
- Students’ did not hesitate to ask in case of comprehension problems.
- Very interesting mathematical discussions.
(Some) findings - external perspective

- Positive climate during the meetings.
- Students’ did not hesitate to ask in case of comprehension problems.
- Very interesting mathematical discussions.
- Students learned a lot.
(Some) findings - external perspective

- Positive climate during the meetings.
- Students’ did not hesitate to ask in case of comprehension problems.
- Very interesting mathematical discussions.
- Students learned a lot.
- In the beginning probably some students thought of it as an annoyance.
Written Elaborations

1. Statement of the problem

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3. Strategy 2: A commented list of errors
   - A (brief) presentation of the strategy
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Commented List of Errors

1. Statement of the problem

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3. Strategy 2: A commented list of errors
   - A (brief) presentation of the strategy
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Commented List of Errors

The students make a commented list of probably occurring errors in the treated exercises.
Commented List of Errors

1. The students make a commented list of probably occurring errors in the treated exercises.
   
   **Idea:** promotion of identification of conceptual difficulties
Commented List of Errors

1. The students make a commented list of probably occurring errors in the treated exercises.
   Idea: promotion of identification of conceptual difficulties

2. After the exams frequent errors are added to the list together with a comment/explanation.
Commented List of Errors

1. Statement of the problem

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3. Strategy 2: A commented list of errors
   - A (brief) presentation of the strategy
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   - Findings
   - Discussion of possible improvements
The project aim was

“Improving the follow-up of both the exercises and the examination”.
The project aim was

“If improving the follow-up of both the exercises and the examination”.

The research question for the strategies’ evaluation was

“Does the commented list of errors foster the avoidance of errors?”
Methodology

Data collected at the end of the term:
Data collected at the end of the term:

- **The students’ perspective**: A questionnaire with the following questions:
  3. How helpful was the commented list of errors in avoiding errors? (four-point scale)
  4. How did the commented list of errors influence my process of learning? (open question)
Methodology

Data collected at the end of the term:

- **The students’ perspective:** A questionnaire with the following questions:
  
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- **The teacher’s perspective:** Reflections on the strategy at the end of the term; Collection of observations during the term.
Methodology

Data collected at the end of the term:

- **The students’ perspective**: A questionnaire with the following questions:
  1. How helpful was the commented list of errors in avoiding errors? (four-point scale)
  2. How did the commented list of errors influence my process of learning? (open question)

- **The teacher’s perspective**: Reflections on the strategy at the end of the term; Collection of observations during the term.

- **External perspective**: Observations of two colleagues, who read the list in regular time intervals.
Commented List of Errors

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   - Discussion of possible improvements
(Some) findings - students’ perspective

How helpful was the commented list of errors in avoiding errors?

- Useless
- Of a little use
- Helpful
- Very helpful

Rating

Frequency
(Some) findings - students’ perspective

How did the commented list of errors influence my process of learning?

- efficient preparation of the exams
- knowledge check and comparison
- analysis of errors
- did not use it

Frequent answers
<table>
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<th>(Some) findings - teacher’s perspective</th>
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(Some) findings - teacher’s perspective

- Not many students participated — afraid of “stupid errors”?
- “Technical” problems — entering formulas in OLAT.
(Some) findings - teacher’s perspective

- Not many students participated — afraid of “stupid errors”?
- “Technical” problems — entering formulas in OLAT.
- High workload for the students and the teacher.
Not many students participated — afraid of “stupid errors”?

“Technical” problems — entering formulas in OLAT.

High workload for the students and the teacher.

Did not reach its potential.
(Some) findings - external perspective

- It seems that the students did not use the full potential of this strategy.
(Some) findings - external perspective

- It seems that the students did not use the full potential of this strategy.
- Potentially useful, as the variety of different (typical) errors is not too wide.
(Some) findings - external perspective

- It seems that the students did not use the full potential of this strategy.
- Potentially useful, as the variety of different (typical) errors is not too wide.
- The commented list of errors could reduce the number of times the same error is made.
Commented List of Errors

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