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COMPETENCE DEVELOPMENT OF SYNCHRONOUSLY COACHED TRAINEE TEACHERS IN COLLABORATIVE LEARNING

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Abstract: The need to make trainee teachers more prepared to coach collaborative learning effectively is increasing, as collaborative learning is becoming more important. One complication in this training process is that it is hard for the teacher trainer to hear and understand the students' utterances and those of the coaching trainee teacher. Besides, it is essential that the teacher trainer does not intervene with the students directly. This constraint is a strong plea for facilitating the direct whispered suggestions by an earpiece to the trainee teacher. In this study, first of all an instrument for measuring the quality of the teacher behaviour during collaborative learning was developed. Subsequently, it was concluded that the quality of the pedagogical action and the reaction time of the trainee teacher in the synchronous condition (direct interventions via an earpiece) progressed better than in the traditional asynchronous variant (coaching form with a discussion at the end of the lesson). The final request for validation is: to what extent reflects the video recognition task reflects the teacher performance in a full real life setting?

Introduction

Teacher trainers have difficulty in monitoring and coaching trainees as they are guiding collaborative learning sessions (Lockhorst, 2004). The main problem is the difficulty for the teacher trainer to hear what the trainee teacher says to the students in various working groups, as was concluded in an interview with 10 teacher trainers of Dutch teacher training institutes. Normally the teacher trainer takes a remote position in order not to disturb the interaction process between the teacher trainee and the students. It is important to solve this problem considering that collaborative learning still gains more momentum in every-day school life until now (Van der Sanden, 2004). Typically the teacher who guides collaborative group learning needs to develop the associated diagnostic and subsequent coaching skills.

The aim of this study is to investigate whether synchronous (direct) coaching with the help of an earpiece has a more positive effect on the quality of the pedagogical action compared to asynchronous coaching where the teacher trainer can only provide feedback afterwards. The earpiece offers the possibility to directly steer

the pedagogical action at a given moment. Another big advantage is that the earpiece allows the teacher trainer to monitor the verbal interaction during the lesson in more detail. Additionally, feedback can be more focussed and provided more comfortably.

Ideal Teacher Behaviour in Supervisory Collaborative Learning

Collaborative learning has kept the attention of several researchers for a number of years (Dillenbourg, 1999; Slavin, 1996; Dillenbourg, Baker, Blaye, & O'Malley, 1996). In the context of the present study, it is important to identify the expression of the ideal teacher behaviour as a part of the core competencies in the supervision of collaborative learning. Using data, among others, by Ebbens and Ettekenoven (2005); Schmidt and Moust (2000); Schmidt, Van der Arend, Moust, Kokx and Boon (1993) the following theoretical competencies (numbered) should be met at least:

1. formulate adequate learning goals;
2. propagate the importance of social skills;
3. reliable evaluation of product /quality of collaboration;
4. recognize one's own role as a teacher;
5. efficiently searching for functional collaborative interaction structures and
6. being able to separate 'content oriented learning revenues' and 'learn how to collaborate revenues'.

The Role of Personality in being Submitted to Synchronous Coaching for Optimizing one's Ability to Coach Collaborative Learning

According to prior research (Hendriks, 1997; Vermetten, Lodewijks, & Vermunt, 2001; Vermetten, 1999), the "Big Five" personality traits are: extraversion, agreeableness, conscientiousness, emotional stability and autonomy. Trainee teachers who score high on agreeableness are expected to respond positively to synchronous interventions in collaborative learning (Busato, Prins, Elshout, & Hamaker, 1999). Their empathic, flexible, and co-operative attitude (agreeableness) is essential for having discussions with students working in groups. They will regard a synchronous intervention as enriching the learning process of both the student and the teacher. Trainee teachers whose personality is characterised as emotionally stable are also suitable for being exposed to synchronous coaching in collaborative learning. These trainee teachers do not panic when being whispered to; they value the suggestions and may find a suitable moment to integrate it in one's overall learning process. Similarly to the mastery of plenary teaching, a high score on autonomy corresponds to a successful exposure to synchronous coaching. In collaborative learning however, one should consider the fact that being open to new experiences may also have a restraining effect on the quality of the pedagogical action. Undergoing synchronous interventions solely is not ideal as well. Thereby, one can think of the self-correcting capacity of the group process. There is the risk that the intertwined nature of the collaborative group process and its relationship with the coach may be interfered by the external almost immediate interventions. That's why a systematic analysis of its positive and negative effects is needed indeed.

We expect that trainee teachers who have a systematic and careful behaviour (high degree of conscientiousness) benefit relatively little from synchronous coaching. These trainee teachers prefer a well-structured educational surrounding (De Raad,

Hendriks, & Hofstee, 1992). An unexpected sudden intervention conflicts with this ideal. Trainee teachers who have a high score on extraversion are not likely to benefit from being exposed to synchronous interventions during collaborative learning either; They attempt to convert the synchronous whispering into behaviour change in a too energetic manner (Kourilsky, Esfandiari, & Wittrock, 1996). However, in addition to that they fail to see Factor 4 'recognize one's role as a teacher' and Factor 5 'efficiently searching for functional collaborative interaction structures' of the ideal teacher behaviour in collaborative learning. Acting immediately to a synchronous intervention, may lead the trainee teacher to feel placed at the very centre of the collective learning process of the group. The creativity of the group may also be impaired in case the trainee teacher steers the group through external interventions only. Therefore, experimenting with introducing new roles within the group may have its limitations.

Synchronous Coaching of Trainee Teachers while Supervising Collaborative Learning

We start from the hypothesis that the coach has a better insight in the interaction between the trainee teacher and the students in collaborative learning while monitoring via an earpiece. After all, the coach is able to hear the conversations much better without his/her presence being felt. Veenman, Gerrits and Kenter (1999) stressed that novice trainee teachers rely on the coach for solving problems. We expect that the synchronous whispering can serve at this point as well. Kulik & Kulik (1988) reported that immediate feedback is preferred to delayed feedback. The principle of synchronous coaching fits in with this. The less-competent action of a trainee teacher can immediately be corrected during supervision of a group of students. At that moment, the trainee teacher becomes aware of the less-competent behaviour and gets used to the instantaneously felt need for changing situations through interventions. As a consequence, the demanded reaction time required for evaluation and intervention will decrease. Hooreman, Kommers and Jochems (in press a) stated hereby as a condition that "cognitive overload" should be avoided (Sweller, 1999;2003; Sweller, Van Merriënboer, & Paas, 1998).

The mentioned advantages of synchronous coaching of the trainee teacher in collaborative learning will become stronger as the number of coaching moments increase. Changes in the coaching structure may initially result in a shock reaction. However its negative effects will decrease in time (Koetsier & Wubbels, 1995).

These notions entail to the following hypotheses:

- Hypothesis 1: Synchronous coaching has a significant greater effect on collaborative teacher skills as compared to asynchronous coaching.
- Hypothesis 2: The future reaction time of the trainee teacher would be influenced more positively through synchronous intervention than through asynchronous coaching as the trainee teacher gets used to responding directly to problematic situations.
- Hypothesis 3: Trainee teachers who have a high score on agreeableness and emotional stability are more apt to synchronous coaching during collaborative

learning compared to those with personality traits of autonomy, conscientiousness and extraversion.

- Hypothesis 4: The difference in the quality of pedagogical actions between trainee teachers coached synchronously versus asynchronously increases in collaborative learning situations as the intensity of the coaching interventions increases.

Method

Participants

Video recordings of two secondary vocational training classes were made in order to obtain an insight into the behaviour of students when they are exposed to collaborative learning. The first class had seventeen students and the second class had sixteen students.

Four senior teachers assisted in the development of an instrument for measuring the quality of teacher behaviour. They were regarded as experts as they had extensive experience in coaching trainee teachers. They also had an understanding of the teaching material used for this experiment.

A total of forty bachelor of education students from Dutch teacher training institutes (second and third year) were randomly assigned as test subjects to two groups. The twenty students in the first group were exposed to synchronous coaching, whereas the remaining twenty students in the second group were exposed to the asynchronous condition. It is possible to follow a bachelor of education course in three disciplines: science, language and social sciences. Each group consisted of different subgroups; for example “language” can be divided into French, English etc. Graduates are allowed to teach appropriate subjects at high schools and institutions of vocational education.

An observer evaluated the quality of the teacher behaviour of the test subjects. The same observer was also involved in compiling the video material.

Materials

The competence assessment is an instrument for measuring the quality of critical elements in teacher behaviour. The reliability expressed on an average Cronbach’s alpha\scale of 0.88, is according to Field (2005) more than adequate. This instrument was modified in order to measure the quality of the pedagogical action as the trainee teacher supervises collaborative learning. The instrument consists of external behaviour indicators associated with underlying competencies. The teacher behaviour was scored for each criterion using a Likert scale ranging from (1) to (5).

Video recordings of students in a simulated collaborative learning task were observed in order to gain insight into all the possible flaws by the students. The group simulation emulated a fictitious enterprise. The students were supposed to perform common tasks in an office setting in the sales and administration department. This type of corporate simulation is a part of the curriculum in many curricula for business administration and thus represents a vital element in the school practices.

A film script with twenty written fragments was another integrated instrument in this study. Only one single mistake per student per fragment was described. The

twenty fragments were recorded on video in two ways. For the sake of fair repeated measures the two versions differed in terms of 1) episode sequence and 2) in terms of slight situation variation such as the acting persons. Besides the instruments described above, the trainee teacher in this study also had an earpiece for whispering by the coach during synchronous coaching sessions.

Design and Procedure

Part 1: Convert 'Competence Assessment (Plenary)' into 'Competence Assessment Collaborative

Video recordings of two classes in secondary vocational education (second grade) participating in the described commercial-economic simulation were made. The observer selected fragments of the videos in which students appeared to make mistakes.

One point of attention was that the complete spectrum of mistakes by the students had to be clearly visible in the whole assortment of the fragments. This overview of mistakes (visual material) was discussed with the four senior teachers in a group interview.

1. The experts had to reach consensus for each of the mistakes in the appropriate action by the teacher in a given situation. In this way an overview of behaviour indicators for the “desired reactions of the beginning teacher in a given situation” was produced.
2. The experts labelled the detected factors under the six formulated theoretical competencies after a factor analysis (Tab. 2). The result of the above procedure was an overview of behaviour indicators per competence which had to be satisfied by an ideal teacher supervising collaborative learning: “the competence assessment collaborative learning”.

Part 2: Development of Competencies of Trainee Teachers Coached in Collaborative Learning Pre-test

Each of the 40 bachelor students (both in the synchronous- and asynchronous condition) received a film script consisting of twenty fragments on paper. A typical inferior teacher reaction to a certain event in collaborative learning was expressed in each of the fragments.

The trainee teachers had to indicate how they would either correct the mistake or help the student per each fragment. The observer checked the explanation against the behaviour indicators described in the ‘competence assessment collaborative learning’. The mistakes by the students were already assigned to the behaviour indicators of the ideal teacher during the construction of the competence assessment in the context of collaborative learning (Part 1). The observer scored the quality of the explanation in the competence assessment collaborative learning on a scale ranging from (1) to (5). The reaction time per fragment of each trainee teacher was registered as well.

The observations of the observer mentioned were initially compared with those of a second observer in order to arrive at an estimate of the interrater reliability. This provided an acceptable Cohen’s kappa of 0.67 according to Field (2005), so that in the rest of the investigations a single observer was sufficient.

Experiment

The experimental subjects (both under the synchronous and asynchronous condition) were shown the Version 1 of the video. There was a student mistake in each fragment (with a total of twenty). After each fragment, the screen went blank and the trainee teacher had to show the observer and an arbitrary second observer what his supervision of the student who had made the mistake would look like. The observer scored the quality of the manifested teacher behaviour. If in the observer's opinion the quality of the behaviour deserved a score of less than (5), then the keywords of the appropriate behaviour indicator were whispered in the synchronous condition. In the asynchronous variant there was a discussion at the end of the experiment. This discussion was focussed on the fragments based on which the trainee's teacher behaviour had received a score of less than the maximum of (5) from the observer. The used procedure was further completely identical to that used for the synchronous coaching.

Post-test

The test subjects were shown video fragments again. However, this time they were shown Version 2 instead of Version 1 (see materials). Once again, each fragment showed a student mistake. Once more, the trainee teacher had to show the observer and an arbitrary second observer what his supervision of the student who had made the mistake would look like.

Similar to the pre-test, the quality of the manifested teacher behaviour was scored on the competence assessment collaborative learning and the reaction time registered. The trainee teacher received neither synchronous- nor asynchronous coaching in contrast to the experiment.

Subsequent longitudinal experiment

The test subjects were subsequently confronted four times with the experiment and once with the post-test. All participants remained assigned to the same synchronous- or asynchronous coaching. In contrast to the previous experiment, the participants were not shown all video fragments. They were presented fragments with mistakes that concerned the third (reliable evaluation of product and quality of collaboration) and the fourth (recognize one's own role as a teacher) competencies on paper. This choice is clarified in the discussion of the results. The observer took care that the five (inclusive post-test) versions of the script differed sufficiently from each other.

Data Analyses

The validity of the 'competence assessment collaborative learning' was established by the use of a principal component analysis with varimax rotation (Tab. 2) and the number of factors was determined by including components with an eigenvalue larger than one (Kaiser's criterion) (Kim & Mueller, 1978). Next we determined the Cronbach's alpha for the resulting factors (Tab. 1).

A post hoc ANOVA was used to map the difference between the synchronous and the asynchronous condition. This examined difference concerned two variables: ‘quality of the pedagogical action of the trainee teacher’ and ‘reaction time reduction’. Subsequently, Pearson correlations between the Big Five personality traits and the mentioned variable were calculated. A longitudinal trend analysis was finally utilised to investigate the long-term effects of the synchronous whispering.

Results

Part 1: Convert ‘Competence Assessment (Plenary)’ into ‘Competence Assessment Collaborative Learning’

It can be seen in Table 1 that the proportion of explained variance by the five factors is 70.1%. The reliability of the scales is more than adequate according to Field (2005). However, the latter is invalid for the fifth scale. An explanation for this is that the calculation of the alpha-values is based on the individual scores of students. The range of the individual scores is larger than the averages of the groups. However, to guarantee a complete picture of possible teacher behaviour this less-reliable scale will be used.

Component/Scale	Eigenvalue	% of Variance	Cumulative %	Cronbach's Alpha	Number of Fragments (items)
1 (formulate adequate learning goals/separate content oriented learning revenues)	4.0	20.0	20.0	.89	6
2 (propagate importance of social skills)	3.1	15.7	35.8	.83	5
3 (reliable evaluation of product/ quality of collaboration)	2.9	14.4	50.2	.79	4
4 (recognize one's own role as teacher)	2.7	13.5	63.7	.74	3
5 (efficiently searching for functional collaborative structures)	1.3	6.4	70.1	.46	2

Table 1: Total variance explained and reliability competence assessment collaborative learning

An overview of factor loadings (≥ 0.4) per factor is shown in Table 2. The five factors are assigned by the experts to the theoretical competencies and are referred to as follows:

- Factor 1. formulate adequate learning goals/being able to separate ‘content oriented learning revenues’ and ‘learn how to collaborate revenues’
- Factor 2. propagate the importance of social skills
- Factor 3. reliable evaluation product/quality of collaboration
- Factor 4. recognize one's own role as a teacher
- Factor 5. efficiently searching for functional collaborative interaction structures.

It should be remarked that Competence 1 ‘formulate adequate learning goals’ and Competence 6 ‘being able to separate ‘content oriented learning revenues’ and ‘learn how to collaborate revenues’ are combined in Factor 1.

Factor structure "Competence Assessment Collaborative Learning"					
Video Fragment	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
11	.83				
13	.75				
3	.66				
8	.64				
5	.59				
14	.55		.54		
12		.80			
19		.77			
20		.66			
6		.63			
9		.45			
18			.80		
10			.73		
15			.49	.47	
17			.41		
1				.87	
4				.69	
7				.51	
16					.83
2					.49

Table 2: Results of principal component analysis after varimax rotation, factor loadings ≥ 0.4

Part 2: Development of Competencies in Trainee Teachers Coached in Collaborative Learning
Hypothesis 1

Table 3 shows that the progression in the quality of the pedagogical action in the synchronous condition on average was significantly higher than in the asynchronous condition. This result may be distinguished per factor and is shown in Table 4. The progression per factor in all cases in the synchronous condition was higher than that in the asynchronous variant. This difference was significant for the first factor ‘formulate adequate learning goals/being able to separate ‘content oriented learning revenues’ and ‘learn how to collaborate revenues’ and the fourth factor ‘recognize one’s own role as a teacher’.

Average Quality of the Pedagogical Action/Video Fragment		
Moment/condition	Synchronous	Asynchronous
Before Intervention (Pre-test)	2.63	2.47
After Intervention (Post-test)	3.90	3.23

Table 3: Comparison of quality (average/video fragment) of the pedagogical action of trainee teachers/video fragment/test subject

Factor	Synchronous progression/Factor/Video-fragment	Asynchronous progression/Factor/Video fragment	Δ Progression	Sig. (Δ between groups)
1	28.8	14.3	14.5	0.01*
2	20.2	10.0	10.2	0.09
3	30.0	27.3	2.7	0.55
4	29.7	13.7	16	0.02*
5	13.0	10.0	3	0.62

*Significant at the $\alpha=0.05$ level (ANOVA)

Table 4: Progression/factor/video fragment

Figure 1 shows that Factor 4 ‘recognize one’s own role as a teacher’ benefited most from the synchronous interventions via the earpiece. This is hardly the case for Factor 3 ‘reliable evaluation of product and quality of collaboration’. An explanation for this is that a synchronous intervention (whispering), which is directed at a change in attitude/role (Factor 4) can be easily whispered in keywords without causing cognitive overload (Sweller, 1999; 2003; Sweller, Van Merriënboer, & Paas, 1998).

However, an extensive explanation instead of several keywords is essential to make it clear to the trainee teacher through whispering that his manner of evaluation (Factor 3) should be changed. In this experiment extensive whispering was explicitly avoided. ‘Cognitive overload’, after all, has a negative influence on the development of the quality of the pedagogical action of the trainee teacher. Thus, the test subjects do not exactly know how to change his/her behaviour with regard to Factor 3 ‘reliable evaluation of product and quality of collaboration’ because of cryptic (only keywords) whispering by the coach. Its direct result is a relatively low synchronous progression for Factor 3. Nevertheless, it is interesting to be aware of the fact that although Factor 3 ‘reliable evaluation of product /quality of collaboration’ presents the worst in the synchronous coaching via the earpiece, the relative increase is still higher than that in the asynchronous condition, in which a discussion with the coach at the end of the experiment is central (synchronous: 0.52 versus asynchronous: 0.48). An explanation for this is that through whispering, the trainee teacher at the certain moment knows that his/her competence under Factor 3 is insufficient. As already mentioned, the whispering is too short for exactly clarifying where the problem is. However, the experimental subject knows that something is wrong when whispered to and attempts on his/her own to find out what it is. Subsequently, a behaviour change occurs, possibly leading to an increase in the quality of the pedagogical action. This process of becoming aware and reacting does not manifest in the asynchronous condition because it becomes clear to the trainee teacher that he/she underachieved at this aspect. Therefore, synchronous interventions stimulate a creative/problem solving thinking, whereas the traditional asynchronous ignores it. The required reaction time will decrease on its own as the trainee teacher gets used to solving the problems ad hoc.

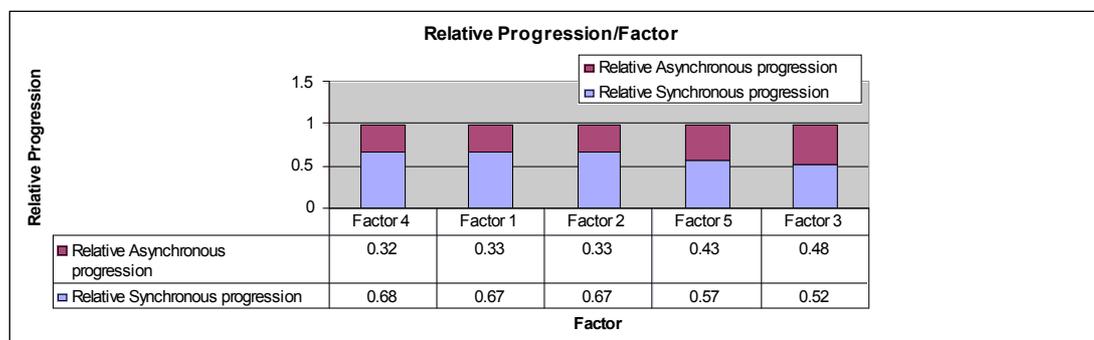


Figure 1: Relative progression/factor

Test subjects who were found to be less-competent in the pre-test (Tab.5) reached a higher progression in the synchronous condition compared to the asynchronous variant. Less-competent trainee teachers developed much better after being coached than the average trainee teacher in a comparable condition. In contrast to the less-competent trainee teachers, more-competent trainee teachers (Tab. 5) benefited more from the asynchronous- than from the synchronous coaching. The talented trainee teachers developed themselves more than the average through the asynchronous discussion. This cannot be claimed for the more-competent trainee teachers in the synchronous coaching. An explanation for this phenomenon is the ceiling effect: The potential learning gain in less-competent trainee teachers is higher than that in more-competent trainee teachers. A synchronous intervention guides a trainee teacher directly in the right direction.

More-competent trainee teachers made fewer mistakes than less-competent trainee teachers (Tab. 5). They have the basic skills so that we expect that the superficial synchronous interventions are subordinate to an in-depth asynchronous discussion. They use their talents to efficiently integrate newly acquired insights from asynchronous discussion so that they develop themselves more positively than the average trainee teacher who has a higher potential learning gain at his/her disposal.

	Average synchronous progression	Average asynchronous progression	μ synchronous progression of all participants	μ asynchronous progression of all participants
Less-competent teachers	32	19	25.5	15.3
More-competent teachers	16	27.5		

Table 5: Progression of the quality of the pedagogical action of less- and more-competent trainee teachers

Hypothesis 2

The needed reaction times on the average for all fragments decreased more in the synchronous- than in the asynchronous condition (Tab. 6). This difference is significant for Factor 3 ‘reliable evaluation of product/quality of collaboration’ (Tab. 7). Factor 2 ‘propagate the importance of social skills’ finds itself in a unique position taking into account that the reaction time decreased more in the asynchronous than in the synchronous coaching. This was a remarkable result because one would expect that a trainee teacher can evaluate the rapidly changing social problems within a group faster than the evaluation of the overall process.

Obviously, the trainee teacher experiences Factor 3 ‘reliable evaluation of product/quality of collaboration’ as an important focus of attention and therefore gives all efforts to react quickly. This line of thought is justified by the fact that students are result-oriented. If students notice that the trainee teacher is serious about this highest goal, coming to an instructive end product that leads to a successful conclusion of a part of the curriculum, the nuances in teacher behaviour are no longer perceived by the students. This is an ideal situation for both the trainee teacher and the student. The students can work towards the end of the module without any distraction, whereas the trainee teacher can concentrate entirely on the evaluation and optimisation of the end product. It appeared in practice that a trainee teacher besides this third factor must also master the remaining factors (1,2,4 and 5) as in the dynamics of teaching, there are moments when the trainee teacher cannot only concentrate on the evaluation of the output like the application of Factor 2: ‘propagate the importance of social skills’ is possible). It is up to the trainee teacher to rely upon his/her other competencies (Factors 1, 2, 4 and 5) for making the students concentrate on the main task: ‘the construction and optimisation of the end product’.

Moment/condition	Reaction time	
	Synchronous	Asynchronous
Before Intervention (Pre-test)	2.70	2.85
	$\Delta = -0.3$	$\Delta = -0.23$
After Intervention (Post-test)	2.40	2.62

Table 6: Average reaction time/video fragment/participant

Factor	Synchronous Reaction time reduction//Factor/Video fragment	Asynchronous Reaction time reduction/ Factor/Video fragment	Δ Progression	Sig. (Δ between groups)
1	-2.13	-0.68	-1.45	0.83
2	-0.7	-1.7	1	0.48
3	-1.9	-1.25	-0.65	0.04*
4	-2.1	-0.35	-1.75	0.35
5	-0.45	-0.1	-0.35	0.17

*Significant at the $\alpha=0.05$ level (ANOVA)

Table 7: Reaction time reduction/factor/video fragment

The relative reaction time reduction/factor in Figure 2 shows that considering the reduction in reaction time goes very well together with Factor 4 ‘recognize one’s own role as a teacher’ and Factor 5 ‘efficiently searching for functional collaborative interaction structures’ in synchronous coaching. The difference in favour of the synchronous coaching is smaller for Factor 1 in formulating adequate learning goals/ able to separate ‘content oriented learning revenues’ and ‘learn how to collaborate revenues’. Given that the difference is not significant, it is questionable whether synchronous whispering is practical in all situations. This decision should be taken per situation. If a group of students demands to ‘undertake an investigation’ it takes much more time for a trainee teacher to evaluate its relevance compared to a group of students who questions the importance of a certain assignment. As mentioned, it appeared from the results that the synchronous coaching is preferred for Factor 5 ‘efficiently searching for functional collaborative interaction structures’ considering the variable ‘reaction time reduction’. This result is desirable considering that it is important for a trainee teacher to respond quickly to signals that indicate that the collaboration between the members of the group is progressing hardly. Nonetheless, such a complication leads to the complete learning process of all the members that are under pressure. The trainee teacher is immediately made aware of this big drawback in the condition of synchronous interventions. Asynchronous discussions also help in this awareness process, but to a lesser extent only.

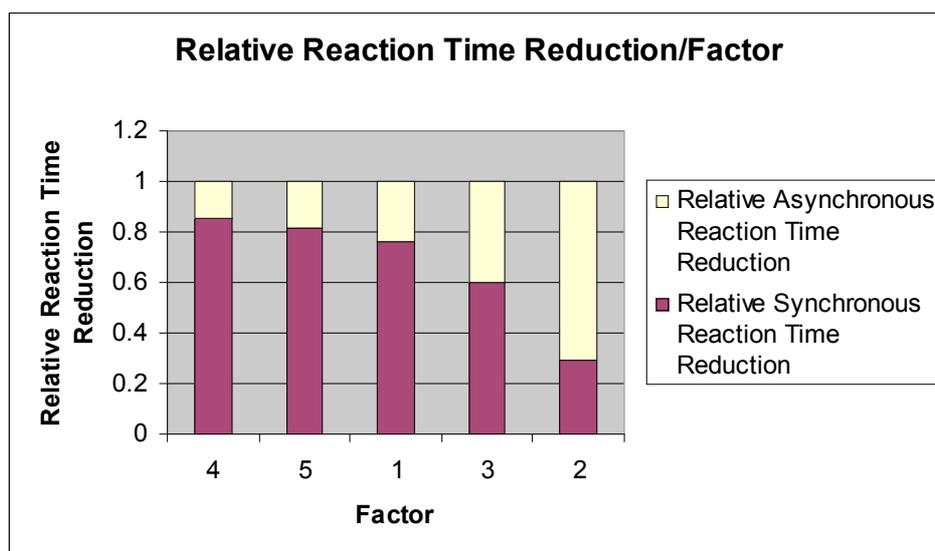


Figure 2: Relative reaction time reduction/factor

Table 8 shows that an increase in the relative synchronous progression in the quality of the pedagogical action in all cases, except Factor 2 ‘propagate the importance of social skills’ and Factor 5 ‘efficiently searching for functional

collaborative interaction structures’, is accompanied by a higher synchronous relative reaction time reduction. It follows from here that the Factors 4 and 1 benefit most in terms of reaction time in the synchronous condition. The relative increase in the quality of the pedagogical action was similar to the synchronous condition.

Condition\Factors ranked by decreasing relative synchronous progression of quality pedagogical action	Factor 4	Factor 1	Factor 2	Factor 5	Factor 3
Synchronous	-0.86	-0.76	-0.29	-0.82	-0.60
Asynchronous	-0.14	-0.24	-0.71	-0.18	-0.40

Table 8: Condition\Factors ranked by decreasing relative synchronous progression of quality of pedagogical action. In the cells is the relative reaction time reduction/factor displayed in seconds

The reaction time decreased by more than average in less-competent trainee teachers in the synchronous condition during the experiment (Tab. 9). This was not the case for the asynchronous coaching. The reaction time of more-competent teachers decreased almost equally in both the synchronous- and asynchronous condition (Tab. 9). Therefore, there is no preference for intervention strategy where this personality trait is at stake.

	Average synchronous reaction time reduction	Average asynchronous reaction time reduction	μ synchronous reaction time reduction of all participants	μ asynchronous reaction time reduction of all participants
Less- competent teachers	-7.0	-3.0	-6.6	-4.5
More-competent teachers	-5.25	-5.0		

Table 9: Reaction time reduction of less-and more-competent teachers

Hypothesis 3

As predicted by Hypothesis 3, the quality of pedagogical action indeed correlates with the personality traits agreeableness and emotional stability in the synchronous condition (Tab. 10). In contrast, it is shown in Table 11 that in the asynchronous variant extraversion and conscientiousness correlate with the quality of pedagogical action of the trainee teachers. This cannot be said with certainty for autonomy as correlations were only observed in two of the five factors. It is noteworthy that Factor 3 ‘reliable evaluation of product/quality of collaboration’ did not correlate with one of the five personality traits. Therefore, a trainee teacher who is open to new experiences (autonomy) will not develop positively through the synchronous intervention taking into account the competence of arriving at an adequate evaluation.

	Synchronous coaching effect (Quality pedagogical action)				
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Agreeableness	0.78*	0.76**		0.6*	0.54*
Stability	0.66*	0.80*		0.65*	0.53*
Autonomy		0.77*		0.74*	
Extraversion		0.66**			
Conscientiousness					

*Significant at the $\alpha=0.05$ level **Significant at the $\alpha=0.01$ (Pearson correlation)

Factors: 1. formulate adequate learning goals/being able to separate ‘content oriented learning revenues’ and ‘learn how to collaborate revenues’; 2. propagate importance of social skills; 3. reliable evaluation of product/quality of collaboration; 4. recognize one’s own role as a teacher; 5. efficiently searching for functional collaborative interaction structures.

Table 10: Correlations between the synchronous coaching effect (quality pedagogical action) and the Big Five personality traits

Asynchronous coaching effect (Quality pedagogical action)					
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Extraversion	0.88*		0.78*		0.66*
Conscientiousness		0.58*		0.68*	0.72*
Autonomy		0.40**	0.28*		
Stability			0.52*		
Agreeableness					

*Significant at the $\alpha=0.05$ level **Significant at the $\alpha=0.01$ (Pearson correlation)

Table 11: Correlations between the asynchronous coaching effect (quality pedagogical action) and the Big Five personality traits

It is shown in Table 12 that considering the reaction time reduction, there is a relationship between extraversion and autonomy in the synchronous condition. However, as shown in Table 13, there is only a weak relationship between conscientiousness, agreeableness and the reaction time reduction in the asynchronous variant. The mentioned relationships are expressed as negative numbers in order to emphasize that an increase in the correlating personality trait leads to a decrease of the reaction time. An example is; A teacher with systematic and careful behaviour (high score on conscientiousness) reacts faster via an asynchronous discussion in situations in which Factor 2 ‘propagate the importance of social skills’ and Factor 4 ‘recognize own role as a teacher’ are at stake.

Synchronous reaction time reduction					
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Extraversion	-0.66*			-0.8*	-0.72*
Autonomy	-0.78**		-0.65*	-0.62*	
Stability		-0.68*		-0.64*	
Agreeableness					-0.55*
Conscientiousness					

*Significant at the $\alpha=0.05$ level **Significant at the $\alpha=0.01$ (Pearson correlation)

Factors: 1. formulate adequate learning goals/being able to separate ‘content oriented learning revenues’ and ‘learn how to collaborate revenues’; 2. propagate importance of social skills; 3. reliable evaluation of product/quality of collaboration; 4. recognize one’s own role as a teacher; 5. efficiently searching for functional collaborative interaction structures.

Table 12: Correlations between the reduction of synchronous reaction time and the Big Five personality traits

Asynchronous reaction time reduction					
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Conscientiousness		-0.66*		-0.78*	
Agreeableness			-0.70*		-0.72*
Stability		-0.62*			
Autonomy				-0.59*	
Extraversion					

*Significant at the $\alpha=0.05$ level **Significant at the $\alpha=0.01$ (Pearson correlation)

Table 13: Correlations between the asynchronous reaction time reduction and the Big Five personality traits

Hypothesis 4

Figure 3 shows that the development of the quality of the pedagogical action with regard to Factor 3 ‘reliable evaluation of product/quality of collaboration’ progresses more favourably in the synchronous than in the asynchronous condition. The overall progression in the synchronous variant is also higher. It is interesting to get acquainted with the fact that the difference between the two coaching variants becomes higher as the number of coaching moments increases. A test subject added the following to this: ‘A mistake is immediately intervened through the earpiece. You as a teacher immediately know that you are evaluating someone incorrectly. The first

time you are shocked if someone whispers something in your ear. You get used to it and it helps a lot to keep things on track’.

Factor 3 ‘reliable evaluation of product/quality of collaboration’ was selected for this analysis because this component responds relatively poorly to synchronous coaching. This in contrast to the selected Factor 4 ‘recognize one’s own role as a teacher’ that is particularly suitable for exposure to synchronous coaching, as was observed in the initial experiment (Fig. 1).

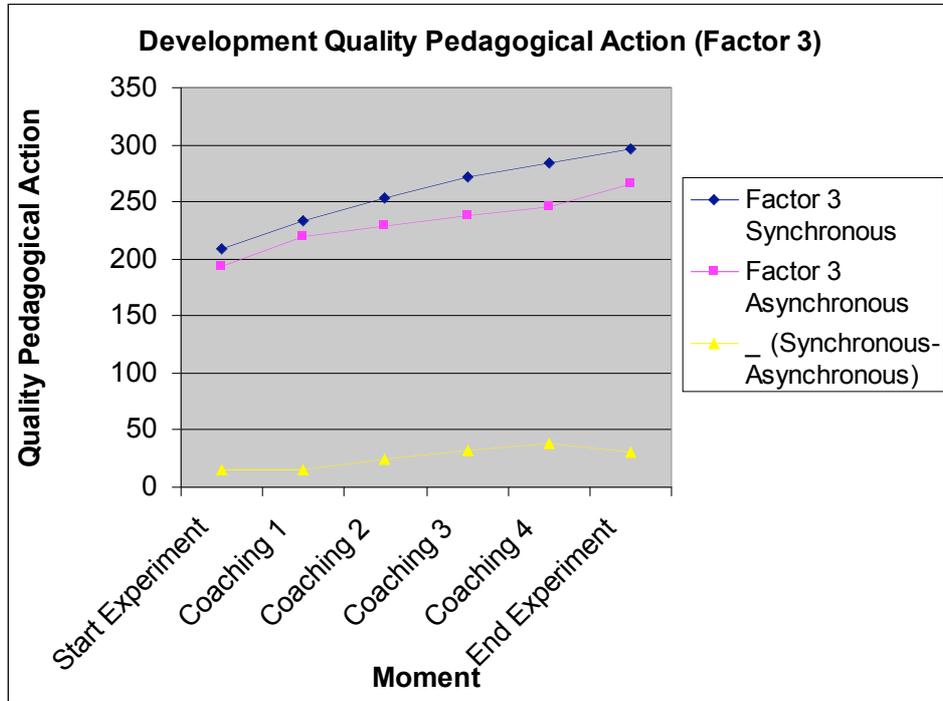


Figure 3: Development quality pedagogical action Factor 3

Factor 4 ‘recognize one’s own role as a teacher’ responded more positively to synchronous than asynchronous coaching during all measurement moments as shown in Figure 4. The difference between the two intervention strategies increased when more than one coaching moment was integrated into the experiment. An explanation for this is that the trainee teacher gets used to the whispering and as such benefits optimally from the tips that reach him/her via the earpiece. A test subject added the following concerning this factor after the experiment: *‘I did not know what was exactly meant when my behaviour was corrected first time via the earpiece. It became clearer to me after the second and the third time and the whispering made me take action*’.

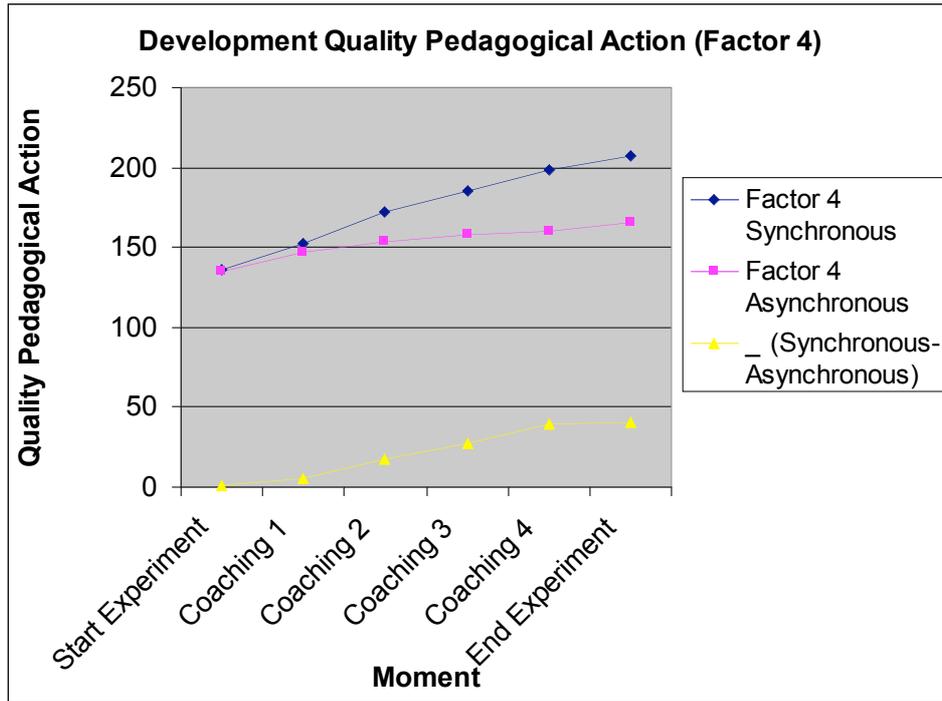


Figure 4: Development quality pedagogical action Factor 4

As already mentioned, it appeared from the initial experiment that Factor 3 ‘reliable evaluation of product/quality of collaboration’ responded relatively poorly and Factor 4 ‘recognize own role as a teacher’ responds relatively the best to synchronous coaching. As the coaching moments increased, it appeared that after 4 coaching moments, Factor 4 ‘recognize one’s own role as a teacher’ differed more (synchronous-asynchronous) than Factor 3. Thus, Factor 4 ‘recognize one’s own role as a teacher’ benefited more from synchronous interventions on the long-term than Factor 3 ‘reliable evaluation of product/quality of collaboration’. It is plausible that this trend continued because during the whole experiment the slope of the ‘progression line Factor 4’ was higher than that of Factor 3, as shown in Figure 5.

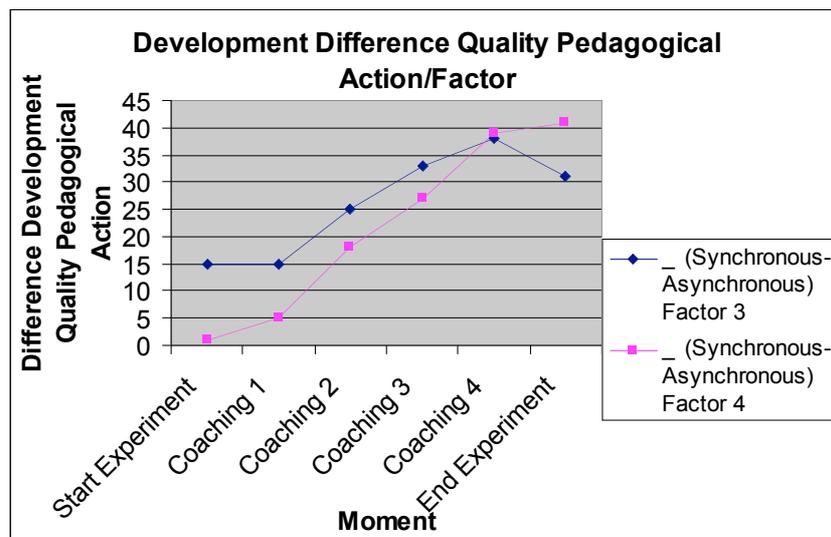


Figure 5: Development difference quality pedagogical action/factor

4. Conclusions and discussion

The study shows that it would be a missed opportunity not to integrate synchronous coaching in teacher training. It is even incomprehensible that this successful coaching technique fails to receive the attention it deserves. This study confirms that the synchronous intervention technique clearly has more value in collaborative learning compared to the traditional asynchronous coaching method. Previous research by these authors (Hooreman, Kommers, & Jochems, in press a, in press b) also emphasized the positive experiences with this new coaching opportunity. An overview of the points given below serve as a summary of the conclusions of this study and as a short manual 'how to coach the trainee teacher in collaborative learning; synchronous versus asynchronous'.

A. The five factors concerning ideal teacher behaviour in collaborative learning, which may be subject for synchronous coaching are: 1. formulate adequate learning goals/being able to separate 'content oriented learning revenues' and 'learn how to collaborate revenues'; 2. propagate the importance of social skills; 3. reliable evaluation of product/quality of collaboration; 4. recognize one's own role as a teacher; 5. efficiently searching for functional collaborative interaction structures.

B. Hypothesis 1: Synchronous coaching indeed has a significant greater effect on the quality of pedagogical action of trainee teachers than the asynchronous condition if collaborative learning is used. The synchronous condition is preferred above the asynchronous variant for all the named factors. One achieves the best results if whispered for Factor 4 'recognize one's own role as a teacher'. However, Factor 3 'reliable evaluation of product/quality of collaboration' should be exposed to a combination of synchronous- and asynchronous coaching. A method for this is to record the whispering session on video and discuss it in an asynchronous discussion with the trainee teacher.

Considering the quality of the pedagogical action, less-competent trainee teachers should be subjected to synchronous whispering, whereas more-competent teachers must be involved in an asynchronous discussion, because skills that are above the basic level are often of a more complex nature. In that case, only a keyword is not sufficient for triggering the improvement of the trainee teacher's advanced skills. Asynchronous discourse offers the opportunity for addressing the issue much better.

C. Hypothesis 2: The reaction time of the trainee teacher decreased more in the synchronous- than in the asynchronous condition indeed. This remark particularly concerned less-competent trainee teachers. Considering the reaction time reduction, more-competent trainee teachers responded indifferently to both intervention strategies. The manner in which each individual factor should be coached can be determined from the results of this study:

- Factor 1 'formulate adequate learning goals/being able to separate 'content oriented learning revenues' and 'learn how to collaborate revenues', Factor 4 'recognize one's own role as a teacher' and Factor 5 'efficiently searching for functional collaborative interaction structures' should all be coached synchronously. The reaction time decreases and the quality of the pedagogical action of the trainee teacher increases.
- Factor 2 'propagate the importance of social skills'. The quality of the pedagogical action concerning this factor is improved by synchronous coaching. However, the trainee teacher should be involved in the asynchronous condition to bring about reaction time reduction.

- Factor 3 'reliable evaluation of product/quality of collaboration'. A combination of synchronous- and asynchronous coaching should be set in. Especially the development of the quality of the pedagogical action is doubtful.

D. Hypothesis 3: Personality traits and synchronous coaching in collaborative learning.

- Trainee teachers who score high on agreeableness and emotional stability should be coached synchronously to improve the quality of the pedagogical action. However, trainee teachers who score high on the personality traits extraversion and conscientious should be involved in an asynchronous discussion to improve the quality of the pedagogical action. Individuals in whom autonomy is dominant should be exposed to a combination of synchronous and asynchronous coaching.

- Trainee teachers who score high on extraversion and autonomy should be subjected to synchronous whispering to bring about reaction time reduction. However, trainee teachers who score high on conscientiousness should be involved in an asynchronous discussion. A combination of synchronous and asynchronous coaching is desirable for trainee teachers who are autonomous and/or emotionally stable.

E. Hypothesis 4: The advantages of synchronous coaching increase in collaborative learning situations as the number of coaching moments increase. Therefore, factors that initially benefit from synchronous coaching (see hypotheses 1, 2 and 3) should also be involved in the synchronous condition as the number of coaching moments increase. However, factors that initially benefited less from the synchronous intervention should be ultimately subjected to a combination of synchronous- and asynchronous coaching.

In summary it can be stated that synchronous coaching is desirable in collaborative learning. The quality of pedagogical action increases and the reaction time of the trainee teacher decreases. In other words, it is likely that through synchronous interventions teachers arrive at a higher level of competence for conveying groups of students in collaborative learning situations. And indeed collaborative learning practices still gain more momentum nowadays (Van der Sanden, 2004). However, longitudinal investigations are required to verify the longer term positive effects of synchronous coaching in teacher training in collaborative learning situations. The chosen experimental approach with video fragments can after all deviate from the dynamics that accompany actual lesson situations.

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