

Factors Influencing Seminar Learning and Academic Achievement

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ABSTRACT

Many veterinary curricula use seminars, interactive educational group formats in which some 25 students discuss questions and issues relating to course themes. To get indications on how to optimize the seminar learning process for students, we aimed to investigate relationships between factors that seem to be important for the seminar learning process, and to determine how these seminar factors account for differences in students' achievement scores. A 57-item seminar evaluation (USEME) questionnaire was administered to students right after they attended a seminar. In total, 80 seminars distributed over years 1, 2, and 3 of an undergraduate veterinary medicine curriculum were sampled and 988 questionnaires were handed in. Principal factor analysis (PFA) was conducted on 410 questionnaires to examine which items could be grouped together as indicators of the same factor, and to determine correlations between the derived factors. Multilevel regression analysis was performed to explore the effects of these seminar factors and students' prior achievement scores on students' achievement scores. Within the questionnaire, four factors were identified that influence the seminar learning process: teacher performance, seminar content, student preparation, and opportunities for interaction within seminars. Strong correlations were found between teacher performance, seminar content, and group interaction. Prior achievement scores and, to a much lesser extent, the seminar factor group interaction appeared to account for differences in students' achievement scores. The factors resulting from the present study and their relation to the method of assessment should be examined further, for example, in an experimental setup.

Key words: academic achievement, group interaction, interactive learning, multilevel analysis, small group learning, student preparation, teaching performance

INTRODUCTION

Rapid progression in clinical practice and technological development has raised several challenges for the veterinary profession.¹ Lifelong learning skills, such as critical scientific thinking; problem solving; finding, organizing, and analyzing information; decision making; and communication skills are needed to perform the complex tasks of the modern veterinary profession.² Based on the Pew National Veterinary Education Program, which conducted the "Future Directions for Veterinary Medicine" study,³ and the Royal College of Veterinary Surgeons and the American Veterinary Medical Association Day One Competencies,^{4,5} veterinary schools have focused on implementing appropriate educational strategies to graduate competent veterinarians who meet these requirements. Active instructional methods have been introduced in curricula, allowing students to be more proactively engaged in their own learning through dialogue, discussion, questioning, and collaborating with peers and teachers.^{6,7}

In introducing these methods, the focus of education can be redirected from an excessive emphasis on the accumulation of information toward the acquisition of the above-mentioned skills. Different curricula in the health profession domain have approached this implementation

in several ways, allowing diverse manifestations of active learning strategies in education worldwide.^{8,9} Some have implemented full-fledged small-group curricula (e.g., problem-based learning curricula), while others combine more traditional teacher-centered large-group lectures with different types of small- and medium-sized group learning methods in a hybrid curriculum.⁹⁻¹¹ Worldwide, the terminology and execution of these small- and medium-sized group learning methods differ (e.g., seminars, tutorials, team-based learning sessions, Socratic dialogs, workshops). In this study, we focus on a group learning method that is characterized by interaction between student peers and a teacher, which we refer to as seminars. Dennick and Spencer¹² describe seminars as teaching and learning sessions that are usually midway in size between a small group and a lecture group, and during which there is discussion. Jaarsma¹¹ refined this definition: "a seminar is a learning session facilitated by a content expert during which a group of some 25 students discusses questions and issues emerging from assigned readings, with the underlying idea being that students learn through confrontation with problems of practical relevance."^{11(p.1180)} The idea of seminars is that they are focused on advanced topics and include interactivity, allowing learners to engage in a deep learning approach

and the critical evaluation of evidence.¹² It is postulated that during seminars students move from acquiring and reproducing knowledge to seeking meaning through the application of knowledge in assignments and discussion with peers.^{13,14} By engaging in interactive group work, students elaborate and restructure facts, principles, and concepts, thereby building robust cognitive frameworks^{12,15,16} that are assumed to be helpful to students applying what they have learned in new situations.¹⁷ Another aspect of group learning is that the social interaction in groups might help in acquiring collaborative and communication competencies that are needed for a veterinary and medical professionals.^{2,18,19} In veterinary educational literature, these kinds of sessions are also sometimes defined as “tutorials.”²⁰

Factors that seem to be important for the seminar learning process are teacher performance, group interaction, and the quality of seminar assignments.¹⁰ Other potentially important factors, investigated by qualitative studies,^{21,22} are the amount and quality of the preparatory materials, the extent of student preparation, students’ course schedule, coherence and alignment of different educational methods within a course, group size, and student motivation in the group. The literature does not provide studies on the impact of these seminar learning factors on academic achievement.

For problem-based learning (PBL) curricula in health science institutions, the relationship between group learning methods (often referred to as PBL tutorials) and academic achievement has been investigated.^{23–31} In these studies, various variables were tested for their relation with academic achievement, including prior knowledge for tutorial, tutor functioning, group functioning, problem characteristics, time spent on self-study, students’ interest in the subject, and depth and breadth of the reporting in the group. Because of the differences between the learning process in PBL tutorials and seminars (i.e., in PBL tutorials, students are responsible for defining their own learning goals and working in smaller groups with the teacher as facilitator; in seminars, students have assigned preparatory materials and learning goals, work together in larger groups, and have a content expert as teacher), we cannot just assume that these variables are also important for the seminar learning process. A more detailed understanding of the relationships between factors that are important for the seminar learning process and students’ achievement scores is therefore needed. These insights may help teachers in a veterinary curriculum to optimize the seminar learning process for their veterinary students.

We conducted a questionnaire study to address the following research questions:

1. What are the relations between factors that seem to be important for the seminar learning process?
2. How do these seminar factors account for differences in students’ achievement scores?

METHODS

Educational Context

The study was conducted in the first three years of the six-year undergraduate curriculum of the Faculty of Veterinary Medicine, Utrecht University, the Netherlands (FVMU). About 225 new students enroll every academic year. The integrated curriculum of the first three years is organized around organ systems (circulatory system, hepato-biliary system) and focuses on basic science, clinical science, and practical skills. Seminars, lectures, and practicals are the main educational formats. Contact time between students and teachers takes up 30%–40% of total study time and the remaining time is designated for self-study to prepare for sessions and exams. Assessment consists mostly of written end-of-course exams.

Seminars of around 25 students make up 40%–60% of contact time. The system-based courses comprise around eight seminars on different themes (e.g., “Pathophysiology of jaundice and cholestasis”). For each seminar theme, nine seminars are conducted (225 students per year, 25 students per group), facilitated by different teachers. Attendance of seminars is optional. Students prepare for seminars by completing assigned readings with guiding questions. Preparation is compulsory but students are free to work individually or in groups. Except for duration (105 minutes maximum), there is no prescribed facilitating method for seminars. In practice, teachers mainly use two seminar approaches: some teachers ask students to discuss the seminar questions in subgroups of two to six students, followed by plenary discussion. Other teachers ask students to prepare the questions individually before discussing them with the group.¹⁹ Most teachers have attended a two-year faculty development program with personal mentoring. During that program, they learn to promote thinking and to stimulate students to actively participate in discussions. Teachers are expected to have good skills with regard to questioning, listening, reinforcing, reacting, and summarizing. The faculty development program has also focused on designing seminars with questions that provoke discussion and are clinically relevant and academically challenging. A seminar is not a teaching format that can be used by the teacher to give a presentation or explain a specific topic. The task of the teacher is to facilitate student understanding of a topic, helping students to apply their knowledge while working on the seminar questions. In this way, students talk at least as much as their teacher. Students are not given an incentive for participation: the intention is that the instructiveness of participation in the seminar is an incentive in itself and prepares them for the end-of-course exam and their work as veterinarians later on. Seminar student groups remain together for the duration of a semester, but teachers vary depending on the seminar theme. Quality assurance is based on student evaluations of a complete course.

PROCEDURE

Questionnaire Development

We designed a preliminary questionnaire consisting of 58 items, of which 53 related to aspects affecting seminar learning. These were derived from earlier questionnaire and focus group studies on seminar learning.^{11,21,22} The questionnaire was piloted among 15 veterinary students, who were asked to judge whether the items were clear, unambiguous, and pertained to one single aspect. The pilot led to rewording of two items and exclusion of one item. The resulting Utrecht Seminar Evaluation questionnaire (USEME) was divided into five sections each containing related items to be evaluated on five-point Likert scales (from 1 = *strongly disagree* to 5 = *strongly agree*). The five sections were “general characteristics of student and seminar” (5 items), “preparation” (17 items), “content of seminar” (23 items), “teacher performance” (8 items), and “overall scores on aspects of the seminar” (4 items). The full questionnaire can be found in Appendix 1.

Data Collection

During the period from April–June 2012, data were collected from a sample of all seminars in the second semester of years 1–3 of the undergraduate curriculum of the FVMU. Although sampling was guided by logistical considerations, we aimed to collect data from at least two out of nine seminar sessions devoted to the same theme. All selected seminars were designed with clear learning goals, preparation assignments, integrated seminar questions, and clear teacher guidelines, with the goal of encouraging students to be active during the session. Different teachers guided them and mainly two teaching approaches were used: plenary discussion of the seminar questions following either individual reflection or group discussion. This resulted in a sample of 80 seminars dealing with 34 different themes relating to six different courses. The seminars were conducted by 36 different teachers. All students attending these seminars were invited to participate in the study. Students were asked to complete the questionnaire immediately after the given seminar to ensure a proper match between answers and seminar. After the teacher had left the classroom, a student assistant handed out the questionnaire with a letter explaining the aims of the study and informing students that participation was voluntary and would take about 10 minutes of their time. An additional form requested that students consent to the use of their course results for research purposes. Students were assured that the data would be treated confidentially. The student assistant collected the completed questionnaires and consent forms. Questionnaires were only analyzed if the consent form was signed. Due to the procedure that was used, it was possible for students to complete more than one questionnaire, albeit on different themes.

Course exam results (i.e., achievement scores) were obtained at the end of courses in which students had filled out seminar questionnaires. Summative course exams contain multiple-choice questions that corresponded with the content of the course. In the Netherlands, grades

range from 1 (lowest) to 10 (highest). To be able to control for prior achievement, students’ prior achievement scores were calculated by averaging individual scores on all obtained previous course exams weighted for the amount of credits per course. To pass an exam, a score of at least 5.5 is required for each course; therefore, the prior achievement scores of students can range between 5.5 and 10.

DATA ANALYSIS

Research Question 1: What are the Relations between Factors That Seem to be Important for the Seminar Learning Process?

We performed principal factor analysis (PFA) with promax (oblique) rotation to check whether the items grouped together in the questionnaire were congruent with factors that were found to affect seminar learning in earlier qualitative studies^{11,21,22} and to take into account correlations between factors.³²

The number of extracted factors was based on Kaiser’s criterion (retaining factors with associated eigenvalues of 1 or larger) and inspection of the scree plot.³³ Although the factor analysis was based on pair-wise deletion of missing values, list-wise deletion and mean imputation of missing values resulted in highly similar factor loadings and correlations between factors. Because PFA cannot handle repeated-measurement structures, only the first questionnaire that a student handed in was used for PFA. Including multiple responses from one student would violate the assumption of independent observations and could easily lead to artificial factors.³⁴

Items were retained when factor loadings were at least 0.4 and no larger cross loadings were found. While higher factor loadings are generally better, the chosen strategy is defensible from a statistical point of view,³³ especially given the relatively large sample size. Analysis with remaining items was repeated. SPSS 21 software was used for the analyses. The factors were analyzed for their interpretability as a meaningful scale. Internal consistency was determined by calculating Cronbach’s alpha for the matching cluster of items, and values of 0.70 and larger were considered acceptable. Average scores were computed for the items grouped together as factors. Correlations between these derived factors were calculated.

Research Question 2: How Do These Seminar Factors Account for Differences in Students’ Achievement Scores?

Because individual students are part of the seminar groups, multilevel regression was used for the analysis of the questionnaire responses. Multilevel analysis takes interdependence of ratings into account. In the present study, for example, students are nested within seminar groups. Multilevel modeling disentangles these dependencies by quantifying the degree to which variance in student ratings is due to differences between individual students or to the higher level construct that is being evaluated (seminars) and within which ratings are

nested. The multilevel method also allows the inclusion of explanatory variables (e.g., seminar group characteristics like group size) that may explain differences between students or between seminar groups. Another attractive feature of multilevel analysis is that the effects of explanatory variables can be estimated not only as a fixed effect (as in multiple regression analysis) but also as a random effect. This means that it is possible to estimate not only the average effect of, for example, student's prior achievement scores on students' academic achievement scores but also the degree to which this effect differs across seminars (random slopes). By choosing multilevel regression instead of multiple regression, we are able to deal with the violation of the assumption of independence of observations (students nested in groups, multiple responses of a part of the students) and with deviations from the classical assumption of homogeneity of variances (by specifying random effects). We used students' academic achievement scores as the dependent variable and the factors revealed by factor analysis together with prior achievement scores and group size as explanatory (i.e., predictive) variables. The predictive variables will form the fixed effects of the model. To account for intra-student and intra-seminar correlation in the data (i.e., multiple responses from the same students who participated in different seminars), we performed multilevel regression analysis using seminar-level and student-level intercepts and seminar-level random slope as random effects of our model. *P* values of $<.05$ were considered significant. SPSS 21 software was used for the analyses.

ETHICAL CONSIDERATIONS

Written informed consent was obtained from all participants and the study was approved by the Ethical Review Board of the Dutch Society for Medical Education (NVMO-ERB; dossier number 46).

RESULTS

Data Collection

Of the possible 1,582 questionnaires that could have been handed in after the seminars, 988 (62.5%) completed questionnaires with signed consent forms were returned. It turned out that the 988 questionnaires were completed by 410 different students (median number of questionnaires per student = 2, range 1–6). Of the students who completed questionnaires, 79.4% were female, which adequately reflects the gender distribution in the student population. Academic achievement of the final sample was largely comparable to the full groups of students taking each of the exams. Prior achievement scores ranged between 6.17 and 8.96, $M = 6.97$, $SD = 0.53$.

Research Question 1: What Are the Relations between Factors That Seem to Be Important for the Seminar Learning Process?

PFA was conducted on the data from 410 questionnaires. The Kaiser–Meyer–Olkin measure verified the sampling adequacy for the analysis (KMO 0.890 is “meritorious” according to Hutcheson and Sofroniou³⁵). Bartlett's test

of sphericity, $\chi^2 (171) = 3351.159$, $p < .001$, indicated that the inter-item correlations were sufficiently large for PFA. Four factors had eigenvalues above Kaiser's criterion of 1. The scree plot indicated an inflection point (elbow) at the fifth factor, indicating that extracting four factors was acceptable. Table 1 shows factors, items, and factor loadings after rotation. PFA revealed four factors: teacher performance (factor 1), seminar content (factor 2), extent of a student's preparation for the seminar (factor 3), and opportunities for interaction in the seminar (factor 4). Cronbach's alpha was larger than .70 for all four factors, which is considered satisfactory. Because of unacceptable loadings or cross loadings, 33 items were deleted. Item 47 (“The teacher stimulated group interaction”) had a cross loading of 0.47 on the factor “teacher performance” and 0.48 on the factor “group interaction.” We included this item in the factor “group interaction” based on item content and because Cronbach's alpha of the scales supported this decision.

Table 2 presents the correlations between factors.

The results demonstrate strong and significant correlations between teacher performance, seminar content, and group interaction. No substantial correlations were found between extent of preparation and the other factors.

A zero-order correlations table with all variables and an explanation of how to interpret these correlations can be found in Appendix 2.

Research Question 2: How Do These Seminar Factors Account for Differences in Students' Achievement Scores?

Table 3 presents the full main effects model with the factors that relate to the seminar learning process, group size, and prior achievement scores as predictor variables.

The contribution of significant predictors can only be properly estimated if we delete the non-significant predictors step by step. Multilevel regression analysis with a backward procedure that deleted the least significant variables one by one resulted in the end model presented in Table 4. For interpretation purposes, all predictors were standardized (i.e., yielding variables with an average score of 0 and standard deviation of 1).

Following Lipsey and Wilson's³⁶ definition of values of 0.10, 0.25, and 0.40 as indicating small, medium, and large effects, respectively, Table 4 indicates that prior achievement scores appeared to have a large effect on students' achievement on course tests. Group interaction appeared to have a very small negative effect.

DISCUSSION

We conducted a questionnaire study to investigate relationships between factors that seem to be important for the seminar learning process and we wanted to determine how these seminar factors account for the differences in students' academic achievement scores.

The analysis revealed four factors that are important for the seminar learning process according to students: teacher performance, seminar content, extent of student preparation, and opportunities for group interaction. The strong correlation found between teacher performance

Table 1: Principal factor analysis structure

Factors	Items	Rotated factor loadings				Eigen values	% of variance	Cronbach's α
		F1	F2	F3	F4			
F1) Teacher	The teacher explained the topics clearly	.81	.13	.01	-.10	6.76	35.6	.90
	The teacher had sufficient expertise on the seminar topic to facilitate the seminar group	.69	.06	-.06	-.11			
	The teacher gave useful feedback on my activities	.66	-.06	.05	.14			
	The teacher guided us through the questions in an adequate manner	.82	.06	.00	-.10			
	The teacher adapted the seminar to students' knowledge levels	.69	-.02	.00	.11			
	The teacher stimulated us to use our prior knowledge to answer the questions	.68	.04	-.02	.05			
	The teacher created a safe learning environment during the seminar	.66	-.11	.01	.02			
	My overall rating of teacher performance is	.80	.00	-.00	-.04			
F2) Seminar content	The relevance of the questions for the field of veterinary medicine is sufficiently clear to me	-.16	.73	-.08	.06	2.42	12.8	.80
	This seminar was well structured	.17	.44	.02	.00			
	This seminar stimulated my interest in the subject matter	.05	.66	.01	.05			
	This seminar has increased my understanding of the subject	.14	.64	.03	-.05			
	In this seminar it has become clear to me that the content of this seminar is important within the field of veterinary medicine	-.01	.74	.04	.04			
F3) Student preparation	To what extent did you prepare for this seminar	-.01	-.04	.75	-.04	1.68	8.9	.84
	Before the seminar, I thought I was prepared sufficiently to be able to participate actively	.01	-.01	.95	.02			
	After the seminar, I thought I had prepared sufficiently to be able to participate actively	-.02	.04	.72	.02			
F4) Group interaction	The questions stimulated group discussion sufficiently	-.07	.20	-.00	.69	1.28	6.7	.79
	The structure of the seminar encouraged interaction between students	-.01	-.01	.01	.82			
	The teacher stimulated group discussion	.47	-.14	-.04	.48			

and seminar content replicated the relation that was found in an earlier study on seminar learning.¹¹ The strong correlation between teacher performance and group interaction may suggest that the seminars were less teacher centered than the seminars in the study of Jaarsma et al.,¹¹ where this relationship was non-significant and weak. This may be explained by the fact that most of the teachers in the present study had completed the faculty development program focused on interactive teaching, and the fact that students and teachers were aware of the educational philosophy of the cur-

riculum, that is, to promote active participation and group interaction. The strong positive correlation between seminar content and group interaction suggests that group interaction might be enhanced by improving seminar content. However, a questionnaire study such as the present one does not allow for inferences of causal relationships between factors, and it is equally possible that improving group interaction might raise students' perceptions of seminar content.

In comparison with Jaarsma's study on seminars, the factor analysis of this study revealed a new factor (extent

Table 2: Correlations between factors

Factor (<i>p</i> value)	F1	F2	F3
F1: Teacher performance			
F2: Seminar content	0.61 [†]		
F3: Extent of preparation	-0.02	0.15*	
F4: Group interaction	0.57 [†]	0.58 [†]	0.07

* *p* < .005

[†] *p* < .001

of preparation) that was hypothesized based on earlier qualitative studies on seminar learning.^{21,22} Surprisingly, however, the new factor showed no statistically significant important relationship with the other factors, which implies that the results of the present study do not support the importance of good preparation for group interaction, as was assumed by teachers in an earlier study.²² This study suggest that while some teachers may think that preparation is a prerequisite for group interaction, students do not consider or experience that doing the preparatory assignments has a positive effect on group interaction. In this study, we have relied on students' general report of their own preparation. In a follow-up study, we suggest adding different measurements of "the extent of student preparation," for example, by asking students to keep a log of time spent on preparing, or by measuring the extent of preparation with a pre-seminar test like those used in team-based learning curricula (readiness assurance process test³⁷). In addition, an observational study could provide us more insight in the way students use the knowledge that they have acquired through preparing the materials in their group discussions. This may offer useful insights to help improve the seminar learning process.

A look at the results of the second research question shows that prior achievement scores appear to account most for the difference between students' achievement scores. We were quite surprised by the small effect sizes of the association between teacher performance, group interaction, and seminar content, on the one hand, and achievement scores, on the other hand. However, these findings are supported by Hattie's statement³⁸ that in explaining academic achievement, variables of the learning environment are less important than variables at the student level. Also, compared with other quantitative studies on academic achievement in other contexts, the relatively strong influence of prior achievement scores should not come as a surprise.^{39,40} However, given the findings of the qualitative studies on seminar learning,^{21,22} a greater impact of the factor "extent of preparation" on academic achievement was expected. In the general educational literature, the impact of the extent of preparation on academic achievement is a topic of debate. In a review of homework in secondary education,⁴¹ homework was assumed to be associated with improved academic achievement while research in higher education reports equivocal results for this relationship.⁴² In line with the results of the present study, research in medical education in PBL curricula on "time spent on self-study" showed no effect on unit test scores,³¹ while "time spent on individual study" also correlated poorly with scores on tests measuring short- and long-term knowledge retention.²⁴ In contrast to the study by Webb et al.⁴³ where group interaction was identified as a strong predictor of student achievement, group interaction in our study seem to be a very small negative predictor for achievement scores. A possible reason for not finding a strong relationship between these two variables might be a mismatch between the objective of seminar learning (active learning and promoting a deep learning approach through group interaction) and the type of assessment or exam questions. To be able to answer the course exam

Table 3: Full main effects model

Parameter	B (SE)	df	t	<i>p</i>
Fixed effects				
Intercept	0.003 (0.058)	87.848	-0.0482	.962
Teacher performance	0.000 (0.036)	399.063	0.000	1.000
Group interaction	-0.045 (0.032)	385.929	-1.387	.166
Seminar content	-0.012 (0.031)	408.174	-0.384	.701
Student preparation	0.038 (0.023)	369.617	1.626	.105
Group size	-0.002 (0.056)	49.921	-0.044	.965
Prior achievement scores	0.639 (0.035)	364.142	18.236	<.001
	VAR (SE)	df	Wald Z	<i>p</i>
Random effects				
Seminar group intercept	0.158 (0.039)	1	4.048	<.001
Student intercept	0.394 (0.036)	1	11.042	<.001
Residual	0.084 (0.009)	1	9.264	<.001

The table shows regression coefficients (B) for fixed effects and variance estimates (VAR) with their associated standard errors (SE) along with *t*-tests (*N* = 620)

Table 4: Multilevel linear model for the prediction of academic achievement

Parameter	B (SE)	df	t	p	Lower	Upper
Fixed effects						
Intercept	0.041 (0.056)	107.799	0.732	.466	-0.070	0.151
Group interaction*	-0.041 (0.020)	610.879	-2.077	.038	-0.081	-0.002
Prior achievement scores*	0.587 (0.034)	217.130	17.339	<.001	0.520	0.653
	VAR (SE)	df	Wald Z	p	Lower	Upper
Random effects						
Seminar group intercept	0.166 (0.033)	1	5.012	<.001	0.113	0.246
Slope seminar group: PAS	0.012 (0.006)	1	2.012	.044	0.004	0.030
Student intercept	0.378 (0.030)	1	12.493	<.001	0.323	0.442
Residual	0.099 (0.008)	1	12.546	<.001	0.085	0.116

PAS = prior achievement scores

* Academic achievement, group interaction, and prior achievement scores were standardized (i.e., mean 0 and standard deviation 1) for interpretation purposes

The table shows regression coefficients (B) for fixed effects and variance estimates (VAR) with their associated standard errors (SE) along with t-tests and 95% CIs (lower bound and upper bound) (N = 925)

questions correctly, group interaction and a deep learning approach during seminars may not be necessary.⁴⁴ Besides this argument, the items we used in the factor group interaction give no indication of the breadth and depth of group interaction. So it might be that group interactions encouraged during a seminar are not the kinds of interactions needed to get high scores on end-of-course exams.

A strength of this study is that the questionnaires were collected in the authentic context of many different seminars. Even though we knew that the trade-off was a loss of richness in specificity, we felt that measuring what happens in many actual real-life seminars would provide us rich insights into this educational method in general. We must be aware that it is possible that another effect could have been lost due to the variability among the seminar approaches. The insights we gained can be used for future, more systematic studies on seminar learning, for example, by conceptualizing interventions that can be implemented iteratively in seminars. Even though this study has provided rich information about the relations between factors influencing seminar learning and their association with student's academic achievement, there are some limitations. The study was restricted to the perceptions of students at one university. However, since our main focus was on seminar groups, we sampled a broad variety of seminars relating to different disciplines and themes, and facilitated by different teachers. Consequently, we believe that the results may be of value to other institutions that use seminars in their curriculum. Another limitation is that the number of times students responded to questionnaires varied. A stronger sampling design could result in a larger proportion of students responding to the questionnaire in multiple seminars. This could enable researchers to further study factors within and between students that contribute to seminar perception and academic achievement. After factor analysis, we lost 33 questionnaire items, which could not be

included in the results. This does not mean, however, that the answers to those items are not useful. They can provide rich information to course coordinators and teachers, for example, for use in quality assurance.

One practical implication of this study is that attention should be paid to the connection between seminars and the type of assessment. Another practical implication of this study is that the USEME questionnaire can be used for identifying the significance of teacher performance, seminar content, preparation by students, and interaction within seminars.

The suggestion for future research is that the four factors resulting from the present study be examined further, for example, in an experimental setup, using different instructional manipulations in different seminars dealing with the same content in the same curricular year. We also recommend further studies on the connection between the aim of the seminar and the method of assessment of seminar learning.

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CONFLICT OF INTEREST

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

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APPENDIX I: UTRECHT SEMINAR EVALUATION QUESTIONNAIRE



Universiteit Utrecht

Utrecht Seminar Evaluation questionnaire (USEME)

Mark only one box per question. If you make a mistake, cross the box as following and mark the proper box.



Starting from item 7 you will be asked to indicate to what extent you agree with the statements.

- = Strongly disagree
- = Disagree
- /+ = No disagree/no agree
- + = Agree
- ++ = Strongly agree

General information

1. Seminar code

0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

2. What is your student ID?

0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3. Gender: m f

4. Did you participate in your assigned seminar group?

yes no

5. How many students attended this seminar?

0-5 6-10 11-15 16-20 21-25 >25

Preparation

- | | 1 | 2 | 3 | 4 | 5 | N.A |
|---|--------------------------------|--------------------------------|--------------------------------|--------------------------------|----------------------------------|-----------------------|
| 6. To what extent did you prepare for this seminar? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 7. It was clear to me that preparation (self-study) materials were assigned for this seminar | --
<input type="radio"/> | -
<input type="radio"/> | -/+
<input type="radio"/> | +
<input type="radio"/> | ++
<input type="radio"/> | <input type="radio"/> |
| 8. The preparation materials aligned well with my preknowledge | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 9. The amount of assigned preparation (self-study) materials for this seminar was feasible | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 10. The guiding questions in the preparation materials helped me to obtain a better understanding of the preparation materials | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 11. I have studied the seminar questions in advance | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 12. I use the learning goals of the seminar as starting point for the preparation of the seminar | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 13. The preparation materials motivated me for the seminar | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 14. The preparation materials aligned well with the seminar content | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 15. Preparing this seminar was essential to be able to participate actively during the seminar | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 16. Before the seminar I thought I was prepared sufficiently to be able to participate actively | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 17. After the seminar I thought I had prepared sufficiently to be able to participate actively | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 18. During this seminar I learned more because I was well prepared | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 19. I have spent hours on preparing this seminar | 0-0,5
<input type="radio"/> | 0,5-1
<input type="radio"/> | 1-1,5
<input type="radio"/> | 1,5-2
<input type="radio"/> | >2hours
<input type="radio"/> | <input type="radio"/> |
| 20. There was sufficient time in my time schedule to be able to prepare this seminar well. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 21. The content of the previous educational methods (eg. lectures, seminars, practicals) enabled me to prepare optimally for this seminar | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 22. The upcoming end-of-course exam (assessment) hindered me to prepare myself well for this seminar | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

Seminar content	--	-	-/+	+	++	N.A				
23. The seminar questions were clearly formulated	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
24. The questions stimulated group discussion sufficiently	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
25. The relevance of the questions for the field of veterinary medicine is sufficiently clear to me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
26. The amount of questions in this seminar was appropriate	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
27. The questions had the appropriate level of difficulty	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
28. The questions aligned with my preknowledge level	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
29. The learning goals of this seminar were clear to me	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
30. The content of this seminar aligned well with the learning goals of this seminar	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
31. This seminar was well structured	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
32. This seminar stimulated my interest in the subject matter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
33. This seminar has increased my understanding of the subject	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
34. During this seminar it has become clear to me that the content of this seminar is important within the field of veterinary medicine	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
35. A seminar is the best educational method to handle this subject	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
36. The content of this seminar aligned well with the previous educational methods in this course	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
37. During this seminar I was actively engaged in the subject matter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
38. The structure of this seminar encouraged interaction between students	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
39. During this seminar there was enough space for asking questions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
40. During this seminar I learned a lot from my fellow students	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
41. Because of this seminar this subject attained depth	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
42. This seminar has increased my understanding of the subject	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
43. Because of this seminar I now know the hiates in my knowledge	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
44. I think this seminar is important in the preparation for the end-of-course exam	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
45. This seminar added value comparing it with studying this subject by myself	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
Teacher	--	-	-/+	+	++	N.A				
46. The teacher stimulated group discussion sufficiently	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
47. The teacher explained the topics clearly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
48. The teacher had sufficient expertise on the seminar topic to facilitate the seminar group	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
49. The teacher gave useful feedback on my activities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
50. The teacher guided us through the questions in an adequate manner	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
51. The teacher adapted the seminar to students' knowledge levels	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
52. The teacher stimulated us to use our prior knowledge to answer the questions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
53. The teacher created a safe learning environment during the seminar	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
Quality different seminar aspects	1	2	3	4	5	6	7	8	9	10
54. My overall rating of the quality of the preparation materials of this seminar is ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
55. My overall rating of the quality of the seminar questions of this seminar is ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
56. My overall rating of teacher performance during this seminar is ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
57. My overall rating of this seminar is ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

APPENDIX 2: ZERO-ORDER CORRELATIONS TABLE WITH ALL VARIABLES (N = 616)

	Teacher performance	Group interaction	Seminar content	Student preparation	Group size	Prior achievement scores	Academic achievement scores
Teacher performance							
Group interaction	0.66 [†]						
Seminar content	0.55 [†]	0.55 [†]					
Student preparation	0.02	0.12 [†]	0.15 [†]				
Group size	-0.34 [†]	-0.25 [†]	-0.25 [†]	-0.09*			
Prior achievement scores	-0.03	-0.01	0.01	0.18 [†]	0.01		
Academic achievement scores	-0.09*	-0.06	-0.08*	0.20 [†]	0.02	0.64 [†]	
Gender	0.02	0.02	0.06	0.03	-0.04	0.08*	0.06

* $p < .05$

† $p < .01$

Zero-order correlations are bivariate correlations. That is, the correlation between, say, academic achievement scores and group interaction is not corrected for overlap that these two variables have with other variables in the zero-order correlations table. When running a regression with academic achievement scores as a dependent variable and group interaction as an independent variable, the standardized regression coefficient (beta) equals that zero-order correlation coefficient and the latter equals the semi-partial and partial correlation coefficient. However, once we include other variables from the zero-order table in the aforementioned regression model—variables that have non-zero correlations with academic achievement scores and with group interaction—semi-partial and partial correlation coefficients will be different. Many researchers believe that semi-partial and partial correlation coefficients always get smaller once you include other independent variables, and hence they reason that if a zero-order correlation coefficient is close to zero and not statistically significant, the semi-partial or partial coefficient of that variable in a multiple regression model will be even closer to zero and even less significant. However, Tacc³⁴ provides some very good examples of how semi-partial and partial correlation coefficients may get smaller as well as larger when including other independent variables. Further, zero-order correlations do not correct for hierarchical levels in the data; like classical simple and multiple regression analysis, they are built on the assumption that all observations in a study are statistically independent. In our study, we have multiple responses from the same students—which are by definition correlated and thus not statistically independent—who are nested within seminar groups, tending to create an intra-seminar-group correlation. Snijders and Bosker⁴⁵ among others provide examples of how in some cases not accounting for such multilevel structures zero-order correlations can go negative while coefficients in appropriate multilevel models are positive and vice versa. We have therefore chosen to present and interpret the multilevel end model presented in Table 4.