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Evaluating the link between attendance and performance in higher education - the role of classroom engagement dimensions

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Abstract

Does attendance matter? This question is not only the title of several research papers on this topic but has still not been answered conclusively yet. In general, studies find positive but mostly weak correlations between attendance and performance. However, due to technological changes in learning, attendance in higher education seems to lose its importance since students do not have to attend class to get access to course material. The question that arises is whether information on purely descriptive attendance is sufficient to prove positive effects of attendance on performance. This study takes a closer look at the link between attendance and performance, examining classroom engagement dimensions as mediating factors. The results suggest that it does not matter if but rather how students attend class.

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1 Introduction

Students' attendance in college courses is a highly discussed topic in the research of higher education which has been conducted for decades. However, due to several changes in students' learning and thinking as well as technological progress in learning, the perceived value of attendance in lectures or tutorials seems underrated. Massingham and Herrington (2006) report different reasons for how these changes foster absenteeism in college classes. Firstly, they report a growing alternative learning motivation of students. Rather than showing intrinsic motivation in selected courses, students nowadays are interested in formal qualifications which help them find a good job. Secondly, the secondary school teaching changed over the last decades. Particularly in large classes, teaching in higher education still consists of breaking the complex course material down into clear and well-structured explanations of the subject matter. Since the learning in schools has changed to more constructivist methods, students do not accept these old-fashioned learning methods anymore. Thirdly, they state that students have developed an "assessment thinking" which deemphasizes attendance in lectures and tutorials. Therefore, students only attend classes to gather information which might be important for passing assignments and exams. Fourthly, learning technology has change. PowerPoint slides and learning platforms made it partly unnecessary to attend lectures since most information can be accessed otherwise (Moore et al., 2008).

However, these points are not only reasons for students' absenteeism but also possible reasons for students' disengagement in classes (Booth, 2001). Particularly assessment thinking and new technologies are reasonable factors for declining classroom engagement. Since information is provided through several channels (e.g. slides, internet, learning platforms), students do not take notes anymore and it is not as important to show high attention all the time. Additionally, laptops, tablets and mobile phones are responsible for a lower attention span. Rodgers (2002) concludes, that "attendance per se does not ensure that learning takes place" (p. 265). Against this background it is highly necessary to examine the relationship between attendance and performance under the perspective of engagement. Does it really matter whether a student is attending or rather how a student participates in and prepares for class?

This study evaluates the link between attendance and performance by checking for mediation effects of different engagement dimensions. Particularly, the classroom engagement components of behavioral and cognitive engagement are taken into ac-

count. To this end, data of 730 students enrolled in different economics-related study programs at a mid-sized German university has been raised. In addition to different engagement scales, the exam performance in various economic courses and further educational and biographical variables are available to examine the relationship between course attendance, engagement and performance.

2 Theoretical Background

2.1 Attendance and performance

The link between students' attendance and performance is a well-discussed topic in the context of higher education. Several studies investigate and report mostly positive correlations between the students' attendance in lectures or tutorials and their exam performance[1]. However, many of these studies cannot measure causal effects easily or do not control properly for further key variables. Clearly, an experimental design where students are randomized into an experimental group (students who are allowed to attend lectures or tutorials) and a control group (students who are not allowed to attend lectures or tutorials) is neither practical nor feasible. Consequently, with the exception of Chen and Lin (2008), most studies underlie a quasi-experimental design or a comparison of cohorts, where certain courses were held in one but not in other semesters (Rodgers, 2002; Marburger, 2006; Medard et al., 2015). This results in issues of self-selection for quasi-experimental designs (motivated and engaged students are more likely to attend lectures) or in probably non-comparable cohorts for cohort studies (students are not the same in different samples or semesters). Particularly the issues of self-selection are hardly controllable in studies investigating the relationship between attendance and performance. This is crucial, however, remembering that students who do exhibit a higher engagement in their studies or specific classes are more likely to attend lectures and tutorials as well (Devadoss and Foltz, 1996; Friedman et al., 2001; Durden and Ellis, 2003).

Generally, the correlation between attendance in lectures or tutorials and student performance is positive. Surprisingly, many studies just find weak evidence for the impact of attendance. For instance, Rodgers (2001) estimates that showing full instead of the average class attendance leads to an increase in one's exam score of

[1] see e.g. Romer, 1993; Durden and Ellis, 1995; Devadoss and Foltz, 1996; Rodgers, 2001; Marburger, 2001; Kirby and McElroy, 2003; Cohn and Johnson, 2006; Lin and Chen, 2006; Stanca, 2006; Horn and Jansen, 2009

1 to 3 percentage points. Marburger (2001) also states a 2 to 3 percentage points higher exam score if a student shows full attendance. Similar attendance effects are reported by Stanca (2006) who estimates that missing one lecture results in a test score drop of 0.5 percentage points. A meta-analysis by Credé et al. (2010) finds a medium-strong influence of attendance on performance. However, unlike the aforementioned studies, the authors only performed correlation analysis without any control for motivation, engagement or further performance variables like GPA or SAT scores. Furthermore, the authors report that there is only a weak effect of mandatory attendance on performance, which already implies that the attendance effect is mediated by unknown variables. Further studies investigate the effect of mandatory attendance policies rather than measuring the direct effect of attendance on performance (e.g. Marburger, 2006; Allen and Webber, 2010; Dobkin et al., 2010) and also find some positive evidence. Particularly the study of Dobkin et al. (2010) measures the effect of mandatory attendance within an elaborate regression discontinuity design which allows causal interpretations.

2.2 Engagement in higher education

2.2.1 Engagement and performance

Similar to attendance, students' engagement also positively correlates with the students' performance in general[2]. Therefore, one cannot be sure whether the course/tutorial attendance, the course/tutorial engagement or both characteristics contribute to an improved performance in higher education. Research usually considers the links between attendance and performance or engagement and performance separately. Only Spedding et al. (2017) take attendance and engagement into account as mediating variables. However, they do not find any mediating effect of engagement on the link between attendance and performance. This is most likely because the authors measured general engagement rather than individual course engagement.

Engagement in general and particular components like vigor, dedication or absorption are positively correlated with the overall academic performance (see e.g. Vizisi et al., 2018; Bréso et al., 2011; Oriol-Granado et al., 2017). However, for self-efficacy, Bréso et al. (2011) report a positive effect, while Oriol-Granado et al. (2017)

[2]see e.g. Handelsman et al., 2005; G. Kuh et al., 2008; Bréso et al., 2011; Pike et al., 2012; Casuso-Holgado et al., 2012; Serrano and Andreu, 2016; Oriol-Granado et al., 2017; Ayala and Manzano, 2018; Vizisi et al., 2018

cannot confirm that. Generally, all these studies examine engagement and academic achievement on a superior level. Performance is measured with theoverall GPA and the measurement of engagement is realized with common engagement questionnaires. Studies investigating the engagement in higher education, with the exception of Svanum and Bigatti (2009) and Spedding et al. (2017), do not focus on the link between individual classroom engagement and individual course performance. This study tries to fill this gap by particularly focusing on classroom engagement and exam performance in higher education rather than general academic engagement and GPAs.

2.2.2 Measuring engagement on institutional level

The interest in engagement in higher education increased tremendously over the last two decades. Great numbers of both theoretical as well as empirical approaches on this topic were published recently. Starting in the 1980s with work from Astin (1984) or G. D. Kuh et al. (1991), the theoretical approach to student engagement has been examined and reported on continuously. Particularly newer models conceptualized academic engagement in three to five components (e.g. Appleton et al., 2006; E. R. Kahu, 2013; E. Kahu and Nelson, 2018; Zhoc et al., 2019): academic engagement, social engagement with peers and teachers, cognitive engagement, and affective engagement. Furthermore, the factors of vigor, dedication and absorption (Schaufeli et al., 2002) have been highly popular in recent engagement research (see e.g. Bréso et al., 2011; Serrano and Andreu, 2016; Vizisi et al., 2018; Ayala and Manzano, 2018). The measurement of engagement, however, is controversial (Baron and Corbin, 2012; Bryson, 1991; Zepke, 2015). Studies investigating academic engagement mostly fall back on verified questionnaires. This results in students' self-determining their engagement which is considered problematic. The most common questionnaires are the National Survey of Student Engagement (NSSE), the Australian Survey of Student Engagement (AUSSE), and the Utrecht Work Engagement Scale for Students (UWES-S). As mentioned before, this leads to studies examining engagement on an institutional level rather than engagement in classrooms and individual learning behaviors.

2.2.3 Measuring engagement on classroom level

This study focuses on the influence and mediating effect of classroom engagement on the link between course attendance and course performance. Therefore, student

engagement has to be measured for each course individually. Studies dealing with classroom engagement scales are, for instance, Appleton et al. (2006) or Gunuc and Kuzu (2015). Appleton et al. (2006) developed the "Student Engagement Instrument" (SEI) which is built on a four-dimensional model of engagement. Academic engagement (quantitative measures like study time and assignment completion), behavioral engagement (attendance, classroom participation, and extracurricular participation), cognitive engagement (self-regulation, learning value and strategies) and psychological engagement (belonging, identification with school). Gunuc and Kuzu (2015) developed a student engagement scale examining both, campus engagement and class engagement. Class engagement is further divided into behavioral engagement, cognitive engagement, and emotional engagement. However, studies searching for effects of classroom engagement on performance are mainly found in elementary and high school education research rather than in higher education (Martin, 2011; Reeve et al., 2004; Reyes et al., 2012; Reeve and Lee, 2014). The scales for measuring classroom engagement are primarily built for research in schools as well (like Appleton et al., 2006) or are not easily transferable to the German higher education landscape. Particularly the items in the questionnaire of Gunuc and Kuzu (2015), measuring the important dimensions of behavioral and cognitive engagement, cannot be adapted since the structure of higher education courses differs too much.

The most important factor in German higher education courses is the class size. Up to 500 students attend basic courses in economics or business administration. That complicates the measurement of behavioral engagement since participation in these courses by means of asking questions, giving answers or completing exercises, for example, is mostly non-existence. Students usually just listen and at most take notes in classes like that. Therefore, behavioral engagement is hardly measurable in these cases. Since every lecture provides additional tutorials in small groups, the behavioral engagement is measured in the tutorials rather than the main classes. To this end, a behavioural scale developed by Handelsman et al. (2005) has been adapted to measure the behavioral engagement of students in the tutorials. However, cognitive engagement is an important dimension of classroom engagement as well. Reeve and Lee (2014) see the MSLQ (Motivated Strategies for Learning Questionnaire) by Pientrich et al. (1991) as a suitable instrument to measure cognitive engagement.

2.3 Hypotheses

Attendance in classes and tutorials, as well as engagement, show a positive effect on students' performance. Especially the role of behavioral and cognitive engagement is interesting since assessment thinking and technology changes may change attendance and participation in classes. The question that arises, in this case, is whether the students' attendance or the behavioral/cognitive engagement is mainly responsible for their exam performance. Since technology and students' assessment thinking seem to dispense attendance, it is highly necessary to examine the relationship between formal attendance and engagement in classes. Many students attend classes but do not pay full attention because the presentation slides are available online or mobile phones steal their attention. In short, it should not matter if but rather how a student shows attendance in classes and tutorials. Therefore, two hypotheses of the study are formulated:

H1: Cognitive engagement dimensions positively mediate the relationship between attendance in classes/tutorials and exam performance.

H2: Behavioral engagement dimensions positively mediate the relationship between attendance in classes/tutorials and exam performance.

3 Sample and Data

3.1 Data collection

Data has been gathered at the Economics Department of a mid-sized German university over various semesters and in various courses. More precisely, data was raised in three different semesters (summer semester of 2017 and winter semesters of 2017 and 2018) and four different courses (internal accounting (IA), macroeconomics (MAE), descriptive statistics (S) and math (M)). As a result, this study covers different parts of economic education and, because the data was collected at the Economics Department, mainly focuses on students pursuing an economics degree or similar subjects. Every course was accompanied by optional tutorial sessions.

Since data protection laws are very strict in Germany, the data was raised through a completely anonymous process. Students were asked to generate an individual and anonymous code and answer a questionnaire in the last or second last course session. With the individual code, the students' final exam performance of each course could be matched to the respective questionnaires.

Table 1: Structure of the samples

Semester	Summer 17			Winter 17	Winter 18	
Course	IA	MAE	S	IA	M	MAE
$N_{all\ students}$	160	113	98	121	109	123
$N_{final\ exam}$	111	76	60	78	78	89

3.2 Sample

All in all, 730 students answered the questionnaire. Information on the final exam performance of the respective courses is available for 492 students. Clearly, not every student who attended the course session also took the final exam. This led to two different samples. The sample of the 730 students will be used for measuring and analyzing attendance and different engagement scales, while the sample of the 492 students will be used when issues of final exam performance are concerned. Due to a few missing values, the actual sample size can vary slightly in the upcoming analysis. Table 1 gives an overview of the samples' composition.

Data in internal accounting and macroeconomics was raised in two different semesters while the subjects of math and statistics were considered once each. In internal accounting, this yielded information on 281 students of whom 189 took the final exam; in macroeconomics, those numbers were 236 and 165, respectively. The courses of math contributed data of 109 and 78 students. In statistics these number ar 98 and 60 students. Approximately two thirds of the students reached with the questionnaires could be matched to their final exam result which is the only performance indicator in these subjects.

3.3 Variables

With the questionnaires, data was raised on different biographical and educational variables (see Table 2) as well as engagement, motivation, and learning scales (see appendix). The given biographical and educational variables are comparable to other studies where similar questionnaires were used (Laging and Voßkamp, 2017).

The students' final exam performance is presented in percent so it does not matter whether the different exams have the same maximum score. Nevertheless, this leads to some comparability issues that will be discussed later. Further variables are gender, age, and the year of study which are about equal in both samples. Students are mostly enrolled in study programs of Economics and Business Administration,

Table 2: Variables and descriptive information

Variable	all student sample	final exam matched sample
Final exam performance (mean in %)		
IA summer 17		44.4 %
IA winter 17		48.5 %
MAE summer 17		49.0 %
MAE winter 18		50.4 %
S summer 17		61.5 %
M winter 18		52.5 %
Gender		
male	51.4 %	50.4 %
female	48.6 %	49.6 %
Age (mean)		
18 years - 46 years	23.7	23.4
High school GPA (lower is better)		
1 to 2	22.6 %	25.9 %
2 to 3	66.4 %	64.4 %
3 to 4	11.0 %	9.7 %
Year of study		
first	28.4 %	29.7 %
second	26.7 %	26.6 %
third or higher	44.9 %	43.7 %
Course of study		
Economics and Business Administration	50.5 %	52.4 %
Educational Economics	21.4 %	19.9 %
Industrial Engineering	17.9 %	17.3 %
other	10.1 %	10.4 %
Attended course sessions in percent (mean)		
0 % - 100 %	83.2 %	84.4 %
Attended tutorial sessions in percent (mean)		
0 % - 100 %	77.4 %	79.3 %
Completion of exercises (mean)		
scale from 1 (all) to 7 (none)	2.78	2.56
Final exam attempt		
first	75.1 %	71.9 %
second	19.1 %	21.8 %
third and last	5.8 %	6.3 %
Prior knowledge (mean)		
number of successfully completed relevant courses (0 - 6)	2.42	2.47
Preparation for course session (mean)		
weekly hours 0 - 35	2.69	2.71
Preparation for tutorial session (mean)		
weekly hours 0 - 22	2.35	2.52

Educational Economics, or Industrial Engineering. Only about 10% are enrolled in other degree programs that are not further specified. Important information for further analysis is the attendance rate of the lectures and tutorials. On average, the students attended just above 80% of all course sessions and just below 80% of all tutorials. The individual courses were structured similarly, with nearly the same number of course and tutorial sessions (about 12-14) per semester and the attendance in classes and tutorials was not mandatory. Students had additional exercise sheets in all subjects which they could solve. In some courses, the exercise sheets were also part of the tutorials. At German universities, students usually have three attempts to pass a final exam; otherwise, they will be exmatriculated, which concerns about 6% of the students. The variable "prior knowledge" describes the total number of certain courses that the students have already passed successfully in their previous studies. The courses considered as "prior knowledge" in each questionnaire vary, depending on the subject under examination For example, the questionnaire asked for successfully passed courses like external accounting or controlling as prior knowledge in IA, while the questionnaire in the MAE classes asked for courses like math or microeconomics. The students were also asked how many hours per week they spent on the preparation of each class or tutorial. The students answered in a broad range from 0 to 35 hours for class preparation and 0 to 22 hours for tutorial preparation. The mean value is about 2.5 hours each. The second part of the questionnaire consists of the classroom engagement scales of the MSLQ (Pientrich et al., 1991) and the adapted engagement scales by Handelsman et al. (2005) for tutorial engagement. This leads, at first, to four main and seven subscales. Tutorial engagement is divided into a skill and participation scale (see appendix). A shortened version of the MSLQ (Hilpert et al. 2013) compresses this originally long questionnaire into three main and five subscales, namely self-efficacy for learning and performance, control strategies, task value, metacognitive regulation, and effort regulation (see appendix). These scales are reorganized in the next chapter.

4 Empirical Framework

Within this chapter, some empirical groundwork is done to prepare the given data for further analysis. Firstly, the issue of comparable exam results will be solved. Secondly, since the engagement scales are adapted from different studies and are used for the first time in this specific context, a principal axis factor analysis (PFA) will be performed. Thirdly, since a mediaton analysis only makes sense with initial

correlations between the investigated variables, simple correlation analysis will investigate significant correlations between course and tutorial attendance, performance and mediator variables.

4.1 Standardization of Exam Results

The exams in different subjects or even the exams of the same subject in different semesters cannot be compared easily. Firstly, since the tests in one subject are not the same every semester, they can slightly vary in their level of difficulty. Secondly, the exam results in math cannot be easily compared with the results in e.g. internal accounting or descriptive statistics. Many students have their difficulty with math which means that, for example, a student scoring 80% in math cannot be compared to a student with the same score in statistics. To solve this issue of comparability, the exam results of each subject have been z-standardized before the data was pooled together. Therefore, a student's score is a standardized value and can always be considered in comparison with the exam results of students who took another exam. For example, a student with an 80% score in math gets a standardized value of 1.5, while a student with an 80% score in statistics only gets a value of about 1.4. This is because, on average, students performed better in statistics and, therefore, an 80% score in math seems "worth more".

4.2 Principal Axis Factor Analysis (PFA)

Since two scale formats from different questionnaires are compiled, it seems reasonable to run a factor analysis first. In total, the questionnaire include 46 items on a scale from one (lowest value) to six (highest value). With these items, a factor analysis using principal axis factoring was performed. The Kaiser-Meyer-Olkin measure of sample adequacy (value of .90) as well as the Bartlett test of sphericity (significant with $p < .001$) shows that the data set is adequate for a PFA. Figure 1 shows the eigenvalues of the resulting factors.

The PFA indicates that five factors should be considered which can either be seen graphically "elbow shape", or in consideration of the eigenvalue criteria (above one). This leads to five factors with eigenvalues of 10.04, 5.23, 2.49, 2.24 and 2.02. The factors six to ten also have eigenvalues above one but are extremely close to one (1.67 or lower), and are not considered any further.

Table 3 shows the rotated results using the varimax rotation method. Only items with a factor loading above .30 were considered. The five factors consist of

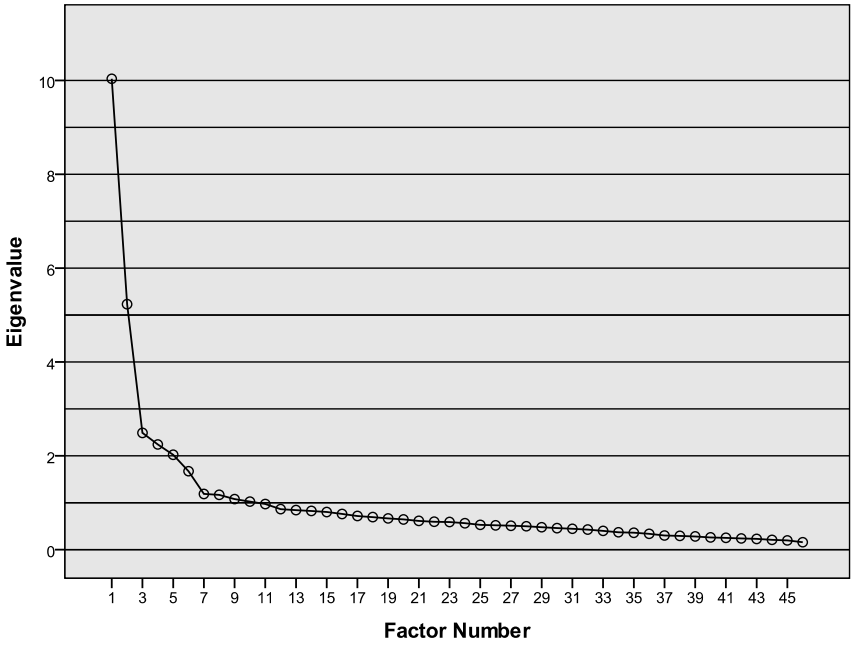

Figure 1: PFA scree plot

35 remaining items. The items SK4, SK2, CONT3, CONT4, ER1, ER2, ER3, ER4, MR5, MR7, and MR9 were discarded.

The PFA rotated matrix gives an overview of the factors and their loadings. Four of the five factors can easily be named and are clear so far. The items loading on the first factor are organized as well in the MSLQ structure and can be seen as expectancy components (EC). The same applies to factors three (task value - TV), four (metacognitive regulation - MR), and five (self-efficacy for Performance - SEP), which are MSLQ scales as well.

Some changes are necessary for the tutorial engagement section. While Handelsman et al. (2005) use two different engagement scales (skill and participation), it appears that items of both scales primarily load on factor two. These scales will be restructured and combined into one tutorial engagement scale (TE).

4.3 Correlation analysis

Table 4 gives information on correlations, mean values, and standard deviations as well as on the reliability of the restructured scales. So far, the scales show good or satisfying reliability. The Cronbach's alpha (CA) values range from .74 (task value) to .91 (expectancy components).

Table 3: PFA rotated matrix (varimax)

Item	EC^a	TE^b	TV^c	MR^d	SEP^e	Item description
CONT2	,766					It is my own fault if I don't learn the material in this course.
CONT1	,761					If I study in appropriate ways, then I will be able to learn the material in this course.
SE4	,751					I'm confident I can understand the most complex material presented by the instructor in this course.
SE3	,732					I'm confident I can understand the basic concepts taught in this course.
SE2	,732					I'm certain I can understand the most difficult material presented in the readings for this course.
SE5	,689					I'm confident I can do an excellent job on the assignments and tests in this course.
SE1	,573					I believe I will receive an excellent grade in this class.
PART1		,840				I raise my hands often in the tutorials.
PART2		,707				I participate actively in small-group discussions.
SK1		,672				I put forth effort in the tutorials.
SK5		,636				I make sure to prepare the tutorials on a regular basis.
PART3		,562				I help my fellow students, if necessary.
PART5		,531				I ask questions, if I don't understand something.
SK7		,490				I do all the exercises.
SK3		,443				I am looking over the tutorial notes on a regular basis, to make sure I understand the material.
SK6		,442				I am well organized in the tutorials.
PART4		,409				I have fun in the tutorials.
TV5			,733			I like the subject matter of this course.
TV1			,654			I think I will be able to use what I learn in this course in other courses.
TV4			,649			I think the course material in this class is useful for me to learn.
TV6			,612			Understanding the subject matter of this course is very important to me.
TV3			,585			I am very interested in the content area of this course.
TV2			,517			It is important for me to learn the course material in this class.
MR6				,570		I ask myself questions to make sure I understand the material I have been studying in this class.
MR11				,547		When I study for this class, I set goals for myself in order to direct my activities in each study period.
MR1				,508		During class time I often miss important points because I'm thinking of other things. (Reversed)
MR8				,477		I often find that I have been reading for class but don't know what it was all about. (Reversed)
MR10				,477		When studying for this course I try to determine which concepts I don't understand well.
MR4				,456		If course materials are difficult to understand, I change the way I read the material.
MR3				,437		When I become confused about something I'm reading for this class, I go back and try to figure it out.
MR12				,335		If I get confused taking notes in class, I make sure I sort it out afterwards.
MR2				,320		When reading for this course, I make up questions to help focus my reading.
SE7					,748	I'm certain I can master the skills being taught in this class.
SE8					,708	Considering the difficulty of this course, the teacher, and my skills, I think I will do well in this class.
SE6					,696	I expect to do well in this class.

[a] Expectancy components
[b] Tutorial engagement
[c] Task value
[d] Metacognitive regulation
[e] Self-efficacy for performance

Table 4: Means (SD), correlations and Cronbach's alpha for the variables

Variable	M (SD)	alpha	CA^a	TA^b	EC	TE	TV	MR	SEP	P^c
CA^a	83.18 (21.57)			.27**	-.01	.18**	.14**	.08*	.05	.09*
TA^b	77.39 (29.61)				-.05	.29**	.06	.10**	.00	.15**
EC	4.22 (.93)	.91				.23**	.50**	.28**	.58**	.10*
TE	4.05 (.98)	.88					.33**	.37**	.21**	.23**
TV	3.79 (1.00)	.85						.39**	.43**	.12**
MR	3.89 (.74)	.74							.28**	.13**
SEP	3.00 (1.16)	.89								.05

[a]Class attendance in %
[b]Tutorial attendance in %
[c]Performance

A mediation analysis examines the path between two correlated variables through a third mediator variable. Consequently, the first step of such an analysis has to be the search for correlations between the independent and dependent variables. Table 4 shows the bivariate correlations between the attendance in lecture and tutorials (independent variables), standardized performance (dependent variable) and engagement scales (possible mediation variables). First of all, attendance in lectures as well as tutorials is correlates significantly with the final exam performance. Furthermore, there are significant correlations of attendance with some of the engagement scales. It seems quite clear that the search for mediating variables only makes sense with initial correlations between the independent and mediating variables as well. Therefore, a mediation analysis will be done with lecture attendance as an independent variable and TE, TV and MR as the mediating variables as well as tutorial attendance as the independent variable and TE as well as MR as the mediating variables.

5 Results

5.1 Mediation Analysis

Mediation analysis was undertaken in SPSS with "Process 3.3 by Hayes". Figure 2 shows the paths between the variables with significant mediation effects. Non-significant effects are not reported.

Figure 2 presents the mediating effects of different variables on the correlations between class or tutorial attendance and exam performance. There is an initial correlation between attendance and performance (c paths). The mediating role of metacognitive regulation between class attendance and performance is significant (see Table 5; bootstrapped confidence interval is different from zero). Class atten-

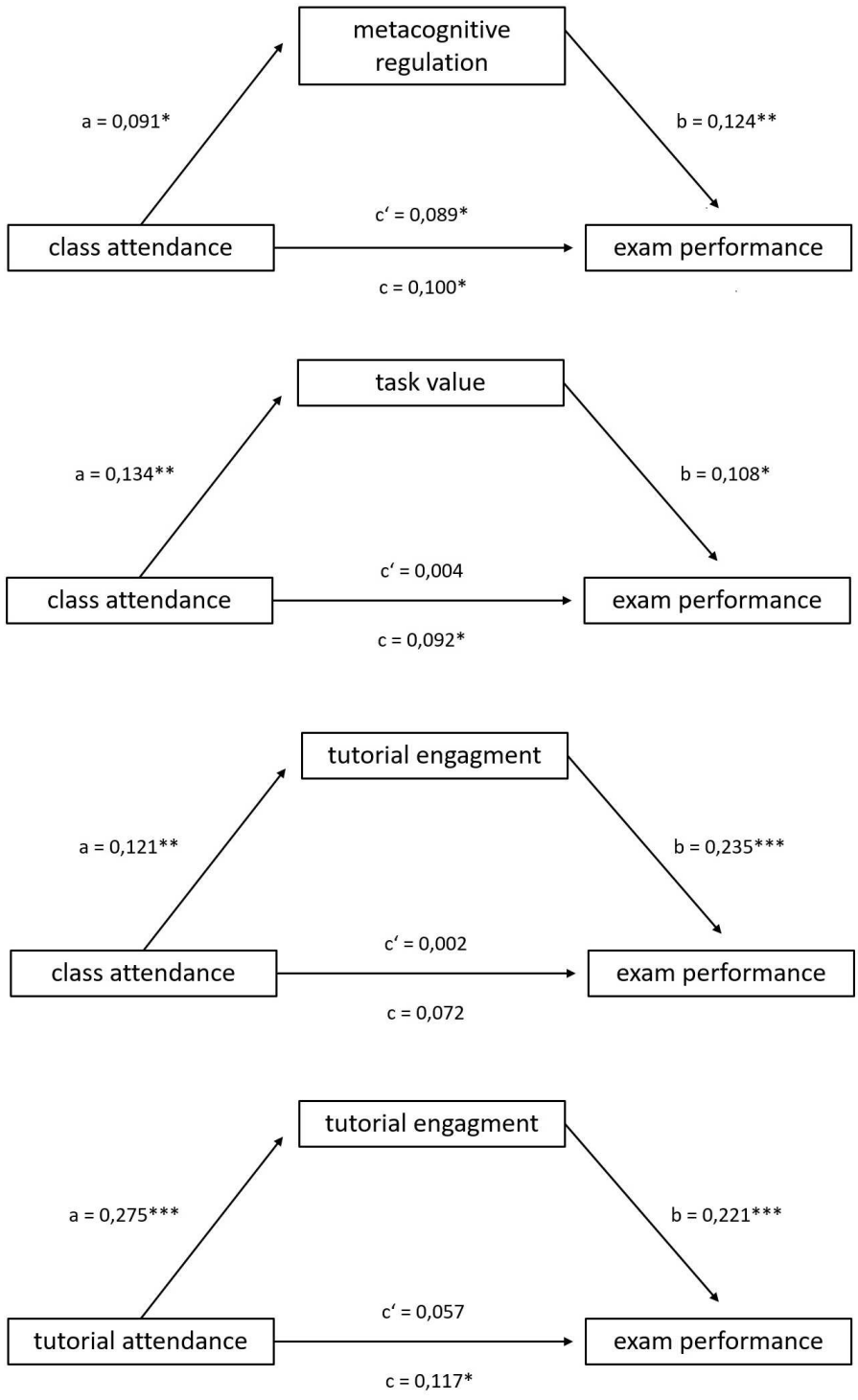

Figure 2: Mediation models of engagement factors

dance also correlates significantly with metacognitive regulation (a path), as does exam performance (b path). Controlling for this additional correlation, the effect of attendance on performance is smaller but still significant (c' path), which indicates a partial mediation. The mediating role of task value between class attendance and exam performance is significant as well (see Table 5). When controlling for task value, the initial correlation (c path) decreases to a non-significant effect between class attendance and exam performance (c' path). This suggests a full mediation.

The mediating role of tutorial engagement is particularly significant. Tutorial engagement mediates the effect of class attendance on performance as well as the effect of tutorial attendance on performance. The correlation of class attendance with performance was not significant at first (c path). This information does not match with Table 4, where the c path (correlation between CA and P) is significant. The sample is slightly changed by the fact that there are students who did not attend tutorials at all. These students cannot show any engagement in tutorials, and therefore get missing values. But since the total indirect mediation effect is significant (bootstrapped 95% confidence interval from .003 to .057) it can be considered here. Including tutorial engagement as mediating variable between class attendance and performance (a path and b path), results in a weaker direct effect (c') which suggests that tutorial engagement is a mediating variable for this relationship. Tutorial engagement shows the strongest mediating effect when considering it as a mediator on the effect of tutorial attendance on exam performance. The total effect (c path) is completely mediated by the a and b paths. The significant indirect effect indicates a full mediation.

Table 5: Significant mediation effect of class and tutorial attendance

Mediation path	Indirect effect size	SE	Boot LCI (95 %)	Boot RCI (95 %)	N
CA → MR → P	.011	.007	.001	.027	485
CA → TV → P	.015	.008	.002	.033	482
CA → TE → P	.028	.014	.003	.057	461
TA → TE → P	.061	.016	.032	.095	462

5.2 Regression Analysis

Particularly the tutorial engagement as part of students' behavioral engagement showed a substantial mediation effect for tutorial attendance as well as class attendance. Therefore, it is worth having a closer look at these mediation paths.

A major problem with mediation analysis is that a causal interpretation of the

Table 6: Standardized regression coefficients

	Path a		Path a		Path b	
Dependent variable	Tutorial engagement		Tutorial engagement		Exam performance	
Model	A.1	A.2	A.3	A.4	B.1	B.2
Class attendance	**.189*** **	**.168*** **			.021	.025
Tutorial attendance			**.277*** **	**.257*** **	.049	.041
Tutorial engagement					**.235*** **	**.249*** **
Gender		.009		-.017		.055
Age		.028		.052		-.194***
HS GPA		-.138***		-.137***		-.261***
Year of study		.094		.085		-.132*
Course of study		.110**		.125**		-.093
Final exam attempt		.104**		.082*		.180***
Prior knowledge		-.139**		-.144**		.279***
Hours lecture preparation		.081		.090*		-.064
Hours tutorial preparation		.240***		.235***		.020
Adj. R^2	.036	.159	.075	.194	.057	.236
N	621	621	627	627	442	442

***p<.001; **p<.01; *p<.05

results is not easy (Hayes, 2018). To at least check for the robustness of the mediating a and b paths, a regression analysis is performed. The analysis is performed for both relevant a paths (class attendance → tutorial engagement; tutorial attendance → tutorial engagement) as well as for the relevant b path (tutorial engagement → exam performance). Certain educational variables (see Table 2) were included as moderating variables.

Table 6 reports the correlations of class and tutorial attendance with tutorial engagement when not (models A.1 and A.3) and when controlling (models A.2 and A.4) for further variables which might affect the mediation path. One can see that the correlations in both cases of the a path are quite stable since the coefficients of class attendance and tutorial engagement were hardly affected. The regression coefficients of class attendance and tutorial engagement just declined slightly from .189 to .168 and .277 to .257, respectively, when controlling for the given variables. This means that the a paths are quite unlikely to be affected by further bias. In addition to the robustness of the investigated mediation paths, the regression analysis provides further insight into the relationship of tutorial engagement and the educational variables. One can see that students with worse preconditions (higher High school GPA) show less tutorial engagement. Also, students with more prior knowledge are not as engaged in tutorials. A certain course of study (EBA), being in the final exam attempt, and investigating much time in the preparation of lectures and tutorials, all positively correlates with tutorial engagement.

The analysis of the b path (tutorial engagement → exam performance) is stable as well. Including the educational variables do not affect the correlation between

tutorial engagement and exam performance significantly. The regression coefficient of tutorial engagement increased slightly from .235 to .249 which indicates a quite robust b path. Furthermore, the result of the regression analysis of the b path supports the mediation effect of tutorial engagement. In model B.1, as the only factor showing significance anymore, it totally mediated the class attendance as well as tutorial attendance. Model B.2 provides further information on some determinants of final exam performance which are of general interest. The variables prior knowledge and final exam attempt correlate positive with the exam performance. This seems reasonable, expecting that those students have to pass the exam in order not to get exmatriculated. The high school GPA shows a negative correlation which indicates that students with a better (lower) GPA performed better in the final exams. Some negative influence was found for the variables age and year of study, indicating that older students performed worse.

Furthermore, the standardized regression coefficients suggest that the influence of tutorial engagement on performance is not only highly significant but also comparable with prior knowledge or the prior GPA in high school. This means that students' engagement in tutorials can be considered as important as students' prior skills when it comes to determining students' performance in these classes.

6 Discussion

This paper examined the link between class attendance and exam performance in higher education by including cognitive and behavioral engagement dimensions. To this end, data was gathered in different classes of the basic studies in economics and related study programs.

6.1 Discussion of results

First of all, attendance in lectures and tutorials as well as expectancy components (EC), tutorial engagement (TE), task value (TV), and metacognitive regulations (MR) were positively correlated with the final exam performance (see Table 4). This matches up with the common literature in this field. However, the correlations between attendance and performance were significant but quite weak (see also: van Walbeek, 2004; Rodgers, 2001; Marburger, 2001; Stanca, 2006). This indicates that purely descriptive attendance is not as important when it comes to determining students' exam performance. This leads to further questions on the relevance of

attendance in general. Students' assessment thinking and new learning technologies have changed the value of attendance (Massingham and Herrington, 2006; Moore et al., 2008). Two hypotheses were formulated:

H1: Cognitive engagement dimensions positively mediate the relationship between attendance in classes/tutorials and exam performance.

This hypothesis could be confirmed in part. The cognitive engagement dimensions of metacognitive regulation partially mediated the effect of attendance on performance, while task value completely mediated this effect. Valuing the course content and having particular learning strategies are important for investigating attendance and performance. However, the engagement dimensions expectancy components and self-efficacy for performance did not show any significant mediation effect.

H2: Behavioral engagement dimensions positively mediate the relationship between attendance in classes/tutorials and exam performance.

This hypothesis could be confirmed. Particularly tutorial engagement, as a dimension of behavioral class engagement, fully mediated the relationship between class attendance and performance as well as tutorial attendance and performance. Furthermore, tutorial engagement also showed a tremendous effect on performance and is comparable with the influence of high school GPA and prior knowledge. This indicates the importance of behavioral engagement in classrooms and underpin that it is not only about students' attendance. Even more, it is hard to believe that attendance would show any positive effect on performance, if the attending student is disengaged. These results show, that behavioral engagement in class should be encouraged. Furthermore, future research investigating predictors of exam performance should also include behavioral engagement as a predictor.

In a second analysis, the mediation paths were controlled for moderated mediation. Checking for several educational variables did not change the initial correlation of the mediating paths (see Table 6). All in all, the paths seem quite robust and were not affected by the variables.

The results showed that, with regards to exam performance, tutorial attendance and engagement seem more important than lecture attendance. Firstly, the descriptive correlation (Table 4) between tutorial attendance and performance is higher than the correlation of class attendance and performance. Secondly, the tutorial engagement totally mediated the correlation between class attendance and performance. How can this be explained rationally? One problem with large classes is that they do not encourage students' behavioral engagement. In fact, the standard

case is that these classes even disengage students, considering that a lecturer just presents PowerPoint slides in a class of up to 500 students. In contrast, small group tutorials provide room for discussion, practice, exercises, and questions. Furthermore, students usually have to take notes in tutorials. All this encourages behavioral engagement and is not common in large scale classes.

6.2 Implications

The findings of this study emphasizes classroom engagement, particularly behavioral engagement. Even though only behavioral engagement in tutorials could be examined in this study, one can conclude that higher behavioral classroom engagement is an important factor for determining students' exam performance. Furthermore, not attendance itself but rather than the in-class engagement is responsible for students' success. Consequently, the question that arises is how engagement, particularly in large classes with hundreds of students, can be enhanced. However, while new learning technologies negatively impact class attendance, they also open doors to new opportunities of fostering behavioral engagement in classrooms. Different studies have already examined new methods and active learning techniques in the context of classroom learning, engagement, and performance.

6.2.1 Flipped classroom

"Flipping the classroom" can be seen as one way to increase students' classroom engagement and attention by replacing the old-fashioned teacher-learner approach, which is most common in higher education classrooms, particularly in large classes. In this context, teachers provide learning materials, lectures, and accompanying measures like exercises or papers online and can the classroom as a stage for debates, case studies or further exercises as well as questions from students.

McLaughlin et al. (2013) evaluated a flipped classroom concept and stated that students particularly praised the quality of engagement encountered. Especially in-class activities and active learning exercises helped to enhance in-class engagement. McNally et al. (2017) also found positive effects of a flipped classroom on in-class activities and attention. Furthermore, most studies report that flipped classrooms increase attendance and grades of students (see e.g. O'Flaherty and Craig, 2015; Mason et al., 2013; Ferreri and O'Conner, 2013; Kurup and Hersey, 2013; McLaughlin et al., 2014; Albert and Beatty, 2014).

However, while most students prefer the flipped classroom design over traditional

lectures (e.g. McLaughlin et al., 2013; Clark, 2015), McNally et al. (2017) defined two types of students, flip endorsers and flip resisters, who show major differences in involvement, attitudes (in- and pre-class) and age (younger students are more likely to resist). This leads to the assumption that the flipped classroom is not a perfect solution for everybody but can, in general, enhance classroom engagement and students' performance.

6.2.2 Classroom response systems

Classroom response systems (CRS), formerly known as "clicker systems", have evolved during the last decade. Particularly web-based formats with mobile phones as students' terminal devices have made the use of these systems much easier. Lecturers are able to get real-time feedback on the students learning progress, either by giving room for individual questions or by evaluating students' responses to short tasks (mostly single or multiple choice). Therefore, CRS are particularly convenient in larger classes where students are anonymous (responses cannot be traced back to individuals) and many answers or questions are generated. Furthermore, Brown et al. (2014) report, that students seem to have a desire for the use of technology in class and especially shy students benefit from CRS. With regards to classroom engagement and performance, different studies show positive effects[3]. Most empirical studies suggest that CRS have a positive influence on the classroom participation and attention span (see e.g. Blasci-Arcas et al., 2013; Heaslip et al., 2014; Beekes, 2006; Addison et al., 2009; Lincoln, 2008) or performance (see e.g. Blasci-Arcas et al., 2013; Mayerich et al., 2011; Mayer et al., 2009; McFarlin, 2008). Even though lecturers might be concerned that employing CRS would mean excluding certain students, they have no reason to worry as CRS are highly accepted by students and participation is possible with any web-based device (Brown et al., 2014).

Another highly interesting approach using new media to generate student responses is suggested by Junco et al. (2011). They use the social networking service Twitter to enhance students' engagement and performance by promoting co-curricular discussions. Even if primarily general student engagement rather than in-class engagement was examined, it shows that new media can help increase students' attendance, organization, and performance.

[3]for a review, see Keough (2012)

6.2.3 Faculty

Almarghani and Mijatovic (2017) report that the engagement of faculty staff leads to student engagement as well. Empirical evidence is given by Steele and Fullagar (2009) or Wimpenny and Savin-Baden (2009), who examined the link between faculty characteristics and student engagement. Lecturers are especially effective in raising students' engagement if they have an activating influence on students. Therefore, it is in the teachers' responsibility to integrate active learning in their classes (Umbach and Wawrzynski, 2005; Stoner and Fincham, 2012). Students can be activated during lectures with different approaches. Besides the aforementioned techniques of flipped classroom or CRS, there are, among others, case study designs, discussions, presentations, debates, and independent study (Tsui, 1999). Furthermore, higher student autonomy can increase student engagement as well (Garcia and Pintrich, 1996). However, these active learning approaches, with the exception of flipped classroom and CRS, seem reasonable in small classes only.

6.3 Limitations

There are limitations that have to be addressed. Firstly, this study only examined students enrolled in economics or similar study programs. Therefore, one should be careful in generalizing these results. For instance, Leach (2016) finds engagement differences of students enrolled in different study programs. Secondly, the examined classes were part of the students' basic studies with up to 400 students. The lectures' designs do not consider students' behavioral engagement since they are structured the old-fashioned way, with the teacher explaining PowerPoint slides. Therefore, behavioral engagement was measured in small group tutorials. However, if behavioral engagement in tutorials mediates the link between attendance and performance, this effect can be assumed to exist in the context of lectures as well. Thirdly, the behavioral and cognitive engagement was measured by scales. Even though the scales seem reliable, there is general criticism of self determination on engagement measures (see e.g. Baron and Corbin (2012)).

7 Conclusion

This study evaluated the link between attendance in lectures and tutorials, classroom engagement, and performance in higher education by using a mediation analysis. However, most studies do either have a look on attendance and performance

or engagement and performance. This study filled this gap and the results showed that cognitive engagement partly and behavioral engagement fully mediated the link between attendance and performance. This paper provides results that should be considered theoretically and practically. Firstly, future research investigating students' attendance should control for classroom engagement as well as further motivational variables. Secondly, lecturers should focus on teaching methods fostering active learning and behavioral engagement.

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Appendix

Table 7: Original items asked in the questionnaire

Item	Reference
Expectancy components	MSLQ (Hilpert et al. 2013; Pintrich et al. 1991)
Self-efficacy for learning and performance	
SE1 I believe I will receive an excellent grade in this class.	
SE2 I'm certain I can understand the most difficult material presented in the readings for this course.	
SE3 I'm confident I can understand the basic concepts taught in this course.	
SE4 I'm confident I can understand the most complex material presented by the instructor in this course.	
SE5 I'm confident I can do an excellent job on the assignments and tests in this course.	
SE6 I expect to do well in this class.	
SE7 I'm certain I can master the skills being taught in this class.	
SE8 Considering the difficulty of this course, the teacher, and my skills, I think I will do well in this class.	
Control strategies	
CONT1 If I study in appropriate ways, then I will be able to learn the material in this course.	
CONT2 It is my own fault if I don't learn the material in this course.	
CONT3 If I try hard enough, then I will understand the course material.	
CONT4 If I don't understand the course material, it is because I didn't try hard enough.	
Value components	MSLQ (Hilpert et al. 2013; Pintrich et al. 1991)
Task value	
TV1 I think I will be able to use what I learn in this course in other courses.	
TV2 It is important for me to learn the course material in this class.	
TV3 I am very interested in the content area of this course.	
TV4 I think the course material in this class is useful for me to learn.	
TV5 I like the subject matter of this course.	
TV6 Understanding the subject matter of this course is very important to me.	
Self-regulation components	MSLQ (Hilpert et al. 2013; Pintrich et al. 1991)
Metacognitive regulation	
MR1 During class time I often miss important points because I'm thinking of other things. (Reversed)	
MR2 When reading for this course, I make up questions to help focus my reading.	
MR3 When I become confused about something I'm reading for this class, I go back and try to figure it out.	
MR4 If course materials are difficult to understand, I change the way I read the material.	
MR5 Before I study new course material thoroughly, I often skim it to see how it is organized.	
MR6 I ask myself questions to make sure I understand the material I have been studying in this class.	
MR7 I try to change the way I study in order to fit the course requirements and instructor's teaching style.	
MR8 I often find that I have been reading for class but don't know what it was all about. (Reversed)	
MR9 I try to think through a topic and decide what I am supposed to learn from it rather than just reading it over when studying.	
MR10 When studying for this course I try to determine which concepts I don't understand well.	
MR11 When I study for this class, I set goals for myself in order to direct my activities in each study period.	
MR12 If I get confused taking notes in class, I make sure I sort it out afterwards.	
Effort regulation	
ER1 I often feel so lazy or bored when I study for this class that I quit before I finish what I planned to do. (Reversed)	
ER2 I work hard to do well in this class even if I don't like what we are doing.	
ER3 When course work is difficult, I give up or only study the easy parts. (Reversed)	
ER4 Even when course materials are dull and uninteresting, I manage to keep working until I finish.	
Tutorial Engagement	Adapted from Handelsman et al. (2005)
Skill	
SK1 I put forth effort in the tutorials.	
SK2 I take good notes in the tutorials.	
SK3 I am looking over the tutorial notes on a regular basis, to make sure I understand the material.	
SK4 I am listening carefully in the tutorials.	
SK5 I make sure to prepare the tutorials on a regular basis.	
SK6 I am well organized in the tutorials.	
SK7 I do all the exercises.	
Participation	
PART1 I raise my hands often in the tutorials.	
PART2 I participate actively in small-group discussions.	
PART3 I help my fellow students, if necessary.	
PART4 I have fun in the tutorials.	
PART5 I ask questions, if I don't understand something.	