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What Influences College Classroom Interaction?

Hermann Kurthen, Grand Valley State University, USA

Abstract: This study analyzed factors that influence classroom interaction based on 320 class observations at a large U.S. Midwestern undergraduate college. Regression analysis of class, student, and instructor characteristics indicated these factors were weak in explaining interaction quality. But class characteristics and interaction quality are important for explaining interaction quantity. An analysis of causes and conditions of observed interactions suggests that aspects such as an instructor's skills, teaching tools, style, method, class topics, student interest, motivation, and other features are most valuable in explaining both interaction quality and quantity.

Keywords: Qualitative and Quantitative Classroom Interaction, Characteristics of Students, Instructors, Teaching

Introduction

In recent decades Western societies went through dramatic changes and innovations pertaining to learning and teaching. Many professors who grew up in the 50s and 60s are witnesses to how classroom interaction has changed since the chalkboard days of their own education and early careers (Astin 1997; Kuh 1999). Changes in pre-college instruction and an increase of student diversity but also improvements in curricula, faculty training, instructional technology, and pedagogical innovation led to measurable modifications in classroom interaction and transformed the types and styles of teaching as well as the learning, skills, and expectations of students (Kuh and Hu 2001, 310).

To understand changes in teaching and learning, a study of interaction is central because it permeates relationships between professors and students or among students themselves (Moore 1993); it exists inside as well as outside the classroom (Alderman 2008, 72); and it is pervasive regardless whether the teaching is face-to-face, blended-hybrid, or fully online (Smith and Kurthen 2007).

Interaction encompasses in its most basic form face-to-face collaboration between students and faculty, interaction between peers as well as the use of different communication styles or types (e.g., frontal lectures, student debates, and online discussion boards), and interaction techniques such as multimedia, hands-on projects, and oral presentations.

In this study, interaction is broadly defined as any form of oral face-to-face communication in the classroom during a circumscribed teaching period. Typically, interaction originates from questions, results in answers or comments, and happens as an exchange between a professor and student(s). It also entails any form of oral engagement of students in class: one-to-many, one-to-one, one-to-some, and some-to-some (Smyth 2005; Shomoossi et al. 2008; Tsui 2010). Interaction may also encompass verbal exchanges related to the instruction method as well as to the classroom management (Folmer-Annevelink 2010, 30). With this broad definition any interaction and its observed 'quantity' is open to investigation whether it happens mostly in the form of lectures, exercises, assignments, discussions, or other situations of collaboration (Fassinger 1996, 27).

The definition of interaction quality is based on the subjective perception that a meaningful educational purpose is fulfilled, that something can be gained, that the level of interest or engagement is high (i.e., few students are bored or sleeping), and that learning is palpable in the form of exchanges, probing, clarifications by way of meta-comments such as "'I still don't get this,' or 'Something is missing; that doesn't seem right'" (Cerbin 2011, 91). According to a survey conducted by Smimou and Dahl (2012), students typically define quality as being related to

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course material understanding and instructor ability to give satisfactory answers and meaningful explanations.

The fact that the quantity and quality of classroom interaction is interrelated and vital for explaining good learning outcomes has been established in dozens of research studies in recent decades (Alderman 2008, 11; Astin 1999, 527; Carrell and West 2010; Cotten and Wilson 2006; Cox et al. 2010; Cundell 2009; Cundell and Pierce 2009; Cuseo 2007; De Paola 2009; Fassinger 1995; Kember and Gow 1994; Kim and Sax 2007, 2; Kuh 2001; Lundberg and Schreiner 2004; McBroom and Reed 1994; Pascarella 2001; Rowan et al. 1997; Umbach and Wawrzynski 2005; Wang and Woo 2007, 272).

For example, Kuh and Hu (2001) conclude their survey of student-faculty interaction research with the statement that "in general, for most students most of the time, the more interaction with faculty the better" (p. 329). And Umbach (2005) summarizes that "students report higher levels of engagement and learning at institutions where faculty members use active and collaborative learning techniques, engage students in experiences, emphasize higher-order cognitive activities in the classroom, interact with students, challenge students academically, and value enriching educational experiences" (p. 153). This is confirmed by Astin (1999), Chickering and Gamson (1987, 4), Fassinger (1995, 82), Picciano (2002, 23), and Terenzini et al. (2001) who show that engaging students in interactive and participatory classroom activities increases student performance, satisfaction, learning motivation, and critical thinking. Cuseo (2007) summarizes this consensus with the statement that "the research support for active involvement (engagement) is so formidable that it has been referred to as the 'grand meta-principle' of student learning" (p. 6).

The literature also supports the idea that students prefer instructors that encourage active class participation and discussion (McClanahan and McClanahan 2002). And those students who engage with the material and answer more questions also perform better on tests and assignments and are less likely to drop out (Alderman 2008, 11; Hoffmann and Oreopoulos 2009, 91). Interactive teaching also benefits student retention, increases graduation rates, and improves the efficiency of higher education. Understanding the characteristics that shape effective classroom interaction is crucial not only for the success of student learning and instructor training but also of interest to academic institutions, parents, taxpayers, communities, and society as a whole. Knowledge of the importance and relative strength of instructor, class, and teaching characteristics that influence interaction will allow for a better distribution of limited financial, technological, administrative, and pedagogical resources.

Background

The research literature on interaction in the past primarily focused on primary and secondary schools - much less on college and undergraduate students (Fassinger 1995, 82). Often student-instructor interaction was used as a predictor variable to explain student outcomes (Pascarella et al. 1978). Those who treated interaction as a dependent variable, such as the literature on classroom communication, explained interaction from the perspective of student interpersonal contact, cognition, and motivation, or professor personality and related psychological attributes and attitudes (Abrantes et al. 2007; Cotten and Wilson 2006; Schweinle and Helming 2011). A relative large body of research is concerned with student-faculty interaction outside the classroom (Alderman 2008; Comeaux, 2008; Cotten and Wilson 2006; Cox et al. 2010; Cundell and Pierce 2009; Kuh and Hu 2001; Kuh et al. 2010; Pascarella and Terenzini 1977) or has studied the relationship between student-professor interaction inside and outside the classroom (Cuseo 2007, 8). However, studies about the combined effect of class, student, instructor and teaching characteristics on classroom interaction are rare.

Class Characteristics

A review of the literature confirms a long-standing consensus that class size matters for interaction quantity and quality. This is not surprising since smaller classes increase the ability of instructors and the willingness of students to engage in higher quality, positive forms of interaction (Cotten and Wilson 2006; Cundell and Pierce 2009; Englehart 2007; Fassinger 1996; Folmer-Annevelink 2010; Kuh and Hu 2001; Smimou and Dahl 2012). It is thought that the threshold of class size is about 20 to 25 students per class (Folmer-Annevelink 2010, 30), only a few researchers argue that increasing the class size from "30 to 40 or more, up to several hundred, may not radically affect college student achievement" (Williams et al. 1985, 316). In any case, it is still a widespread custom to expose primarily freshmen to larger classes, increasing the probability that professors use lectures instead of class discussions, with unsurprising negative effects on student performance, satisfaction, and eventually, retention (Cuseo 2007, 6-8).

Other factors that have been found to affect interaction are the type of classes, i.e., electives versus required courses (Hoffmann and Oreopoulos 2009, 90-91; Kim and Sax 2007, 2-3), physical classroom design, e.g., lecture halls versus seminar style rooms, access to media and technology (Adams 2010; Tang and Austin 2009; Hallett and Faria 2006), and other environmental conditions such as time, day, length, and semester in which classes are held. Student majors and chosen academic disciplines, i.e., knowledge transmission-driven science versus facilitation-driven non-science classes, are also considered predictors (Kember and Gow 1994).

The review of literature indicates that multimedia instruction, i.e., media that uses a combination of different content forms, is beginning to replace the traditional frontal academic lecture style, the use of print-only text, and handwritten class notes by students. Multimedia addresses different learning styles of students by entertaining multiple senses (e.g., doing, seeing, hearing, reading, and interacting) in combination with multiple media (e.g., text, audio, still images, animation, video, or other interactivity content forms). The use of new media and instructional technology platforms like *Blackboard* ranges from PowerPoint presentations, Wiki blogs, and online quizzes to presentations with the help of music, graphs or visual diagrams, photos, video clips, and cartoons pulled from the Internet. Research about the effect of multimedia use in the classroom is ongoing. Some researchers argue that the new media help to transform the instructor-centered teaching to student-centered collaborative learning (Wang 2007); others are more skeptical about the new media's impact on interaction and learning (Debevec et al. 2006; Koeber 2005; Wegner et al. 1999).

Student Characteristics

The literature discusses numerous explanations for the impact of student demographics and related factors on interaction, in particular gender, race, and ethnicity (Comeaux 2008; Fassinger 1995; Kim and Sax 2007). Other factors studied include social characteristics such as immigration and socioeconomic status, financial situation, non-traditional family background, employment type, amount of work outside of school, types of commuting, residential living and roommates as well as physical and psychological features of students, such as health and disability, mental and emotional status, attentiveness, lack of sleep, motivation, and interest (Abrantes et al 2007; Hardre and Sullivan 2008). Additionally, academic traits like course preparation (Kuh and Huh 2001), class performance and GPA (Wyatt 1992), absenteeism, multitasking, and other distractions during class periods. e.g., texting, surfing the web, have been researched intensively.

For societies like the United States, characterized by structural and cultural racism, segregation, and poverty along ethno-racial and immigration status lines, African American and Hispanic students are treated and often also perform differently in classroom interaction as a

result of prevailing prejudice, stereotyping, discrimination, and social confinement. White students are more likely to grow up in families with higher socio-economic status (with parents who attended college or university previously); and they are more likely to internalize mainstream middle-class values and expectations. Therefore, they tend to be better adjusted to the expected habits and skills of university life and class interaction (Thomas 2004). Although many colleges accept disadvantaged minority students with lower high school grades in order to boost campus diversity, these students have a hard time adjusting given their frequently insufficient preparation. In effect, this often creates a two-tier system of performance and interaction (Lundberg and Schreiner 2004).

Another important division affecting interaction are a student's age and - related - class level (Freshman, Sophomore etc.), not least because students longer exposed to academia tend to adapt to the prevailing mode of learning and communication, and develop more sustainable learning habits as well as higher degrees of confidence to participate in class discussions (Kuh and Hu 2001; Pascarella and Terenzini 1998; Wyatt 1992).

Finally, student attendance, specifically absenteeism has found much attention in the literature. Not surprisingly, non-attendance is related to lower student performance, lower GPA levels, and lower knowledge of class content. Absenteeism also is correlated with class size, discipline, and instruction type (Crede et al. 2010; Gump 2005; Romer 1993, 68; Wyatt 1992). Absences also affect a student's continuous exposure and capability to interact with instructors and peers.

Instructor and Teaching Characteristics

Studies that link demographic instructor characteristics with teaching behavior and class interaction often focus on gender (Crawford and MacLeod 1990; Rashidi and Naderi 2012), age (Arbuckle and Williams 2003; Rashidi and Naderi 2012, 36), a teacher's race and ethnicity (Cox et al. 2010, 768-9; Lundberg and Schreiner 2004; Rubie-Davies et al. 2006), rank, salary, and faculty employment status. Research has not produced uniform results but on the whole these factors show surprisingly little or no influence on a student's class participation and academic performance (Cox et al. 2010; Hoffmann and Oreopoulos 2009, 91).

While there is some evidence that male and female professors behave differently in the classroom (reflecting the continuous relevance of gender roles), the empirical effect of an instructor's gender on student outcomes is questionable (Fassinger 1995, 83-84, 92-93; Shomoossi et al. 2008, 180). Hardre and Sullivan (2008, 473) argue that if such effects exist, they have to be seen in the context of a teaching environment.

Instructor personality, interpersonal skills (e.g., humor and communication styles), preparation and organization (Alderman 2008; Chowdhury 2012; Rowan et al. 1997), knowledge and experience (Carrell and West 2010; Wright et al. 1997) as well as instructor enthusiasm, approachability, and expectations (Rubie-Davies et al. 2006) are also relevant, but they are difficult to measure and not easily generalizable.

Teaching styles also should be considered an integral part of an instructor's characteristics since style and method are a personal choice and rely on personal experience and knowledge. However, it could be argued that teaching style and method also relates to the subject matter taught and student knowledge (Holley and Jenkins 1993). Cerbin (2011, 49), for example, points out that the choices made by instructors, like the mode of instruction, disciplinary preferences, repertoire of methods, techniques, media, situational factors, and knowledge of student learning, are dependent on the topic, audience, and level of education of students.

Altogether, interactive teaching styles are considered more successful and learning oriented. McBroom and Reed (1994) point out that it is much more beneficial to have focused discussions compared to lectures, not least because preparing discussion questions or providing answers makes each student explain, analyze and defend their answers or help other struggling students.

In Boyle's (2003, 43) words "this results in more robust and elaborate mental constructions of concepts than would occur in more traditional lecture classrooms." Chen and Cheng (2009), Emmelman (2007), Kember and Gow (1994), and Terregrossa et al. (2012) have made similar arguments.

Theoretical Framework and Purpose

The purpose of this study is to revisit previous findings and test the importance and relative strength of class, student, instructor, and teaching characteristics that influence classroom interaction. The hypothesis is that these factors, regardless of the dramatic changes and technological innovations in learning and teaching, remain important in explaining interaction quantity and quality. Before we modify the objective and subjective components of the college teaching and learning environment, we need to better understand if and how much they impact student interaction. The best universities and colleges of the future will be those that know what matters and how those factors can be arranged so that they can achieve "the most effective gains in learning and learning skills among their students" (Umbach and Wawrzynski 2005, 175).

Previous research about classroom interaction illustrates the importance of above three major contextual sets of characteristics (Fink 2004, 7; Cotten and Wilson 2006). However, the importance of each factor, interrelationships, and changes over time remains inconclusive and need further investigation. Unfortunately not much has changed with regard to our knowledge of the determinants of classroom interaction since Jansen et al. (1972, 537) wrote: "Not many investigations are available of factors which affect the educational situation and determine specific activities and interactions."

The restrictions placed on the researcher do not allow to address all possible aspects and components of the three inter- and independent sets of characteristics listed above. Therefore, this study focuses only on a limited number of variables hypothesized in the literature as influencing undergraduate classroom interaction. Because the literature is inconclusive about each variables causality status, the exploratory study presented here uses a simple cause-effect framework between factor sets (predictors) and interaction quantity and quality (both defined as outcome or criterion variables). This approach does not deny the possibility that future studies using more complex models (with moderating, intervening, or mediating effects) could explain this complex interrelationship better.

Furthermore, by focusing on interaction as the central anchor of learning and education and by measuring input and output, this analysis follows the theoretical tradition of models advanced by Tinto (1993) and Astin (1993, 1999), which posit that students' "successful academic and social integration [is] dependent upon the favorable daily interactions between faculty and students" (Umbach and Wawrzynski 2005, 156). Likewise, this study supports assumptions of constructivism, namely, that "the learner is an active processor of information" (Nisbet 2004, 123). Ideally, it would be desirable to back up the study of interaction with a detailed interaction analysis (Flanders 1970). Given limited resources and data collection constraints the design of this study used instead a short observation questionnaire that also included two open-ended questions about the reasons for an increase or decrease of class interaction quantity and quality in comparison to previous class sessions.

Research Instruments and Sampling

This study is based on 320 classroom observations at Grand Valley State University between 2006 and 2013. GVSU is a large public Midwestern college in the United States. In 2012/13 GVSU had 24,654 students enrolled and offered 3,982 courses in 200+ areas of study for 81 undergraduate and 31 graduate degrees.

A class observation questionnaire (see Appendix A) was developed by the author in the context of previous research about hybrid face-to-face teaching (see Kurthen and Smith 2006). Because the observations had to be completed in one class session without interrupting class instruction, the observation used very broadly defined measures.

Observations were performed by trained and supervised student volunteers from the author's Sociology Research Methods class during the last three weeks of a term. Classes used for observations were randomly selected by the student observers themselves. To increase reliability it was required that observers had to be enrolled in the observed class and that they had to do only one class observation per term, and they received extra credit after completing the observation. The fact that all student observers were upperclassmen and that they had to be enrolled in the classes they observed, led to an overrepresentation of upper-level, non-General education classes in the Social and Behavioral Sciences, representing a data limitation.

Class registration and GPA data were added from the university's statistical records. Incomplete and multiple observations of identical classes as well as observations containing extreme outliers or contradictory claims were excluded from further evaluation. Altogether, 71 cases (18%) were excluded from the original 391 observations.

Although the sample is not representative and, therefore, the findings have to be interpreted with caution, the observations are useful to revisit previous findings reported in the literature and to detect correlations and trends. In fact, in education research it is not unheard of to relax assumptions of random sampling by introducing the idea of an unspecified population of students "like those observed" (Feldman 1978, 201).

Results

Descriptive Statistics

To assess the representativity of the observation sample in comparison with the GVSU population, means and t-tests were calculated for ten variables with 2006 to 2013 semester data. Testing the null-hypothesis that there is no difference between the observation sample and the GVSU population, it was found that six of the ten variable means of the sample were significantly different from the university parameters, except for the variables *Class Level*, *Discipline Cluster*, *Class Time*, and *Class Size*. This confirms the notion that the sample is not representative.

Class Characteristics (see Table 1): One third of the observed 320 classes were lower-level undergraduate courses (GVSU: 34%, t-statistic: -.4567, not statistically different); 29% of the observed classes belonged to disciplinary clusters with strong science or business components (GVSU: 25.7%, t-statistic: 1.2950, not statistically different); two out of five were General Education courses (GVSU: 18.4%, t-statistic: 7.8965***, i.e., statistically different, where * stands for a p-value at the .05 level, ** at the .01 level, and *** at the.001 level.); 44% of observed classes were taught in the morning or around noon (GVSU: 49%, t-statistic: 1.8676, not statistically different); 39% were short 50-minutes classes (GVSU: 32.4%, t-statistic: 2.4058*, i.e., statistically different); and the average class size was 26.14 students (GVSU: 21.40 students, t-statistic: 0.4291, not statistically different).

Table 1: Class Observation Sample Variables, 2006 to 2013 (N=320)

VARIABLES	***VARIABLE DEFINITIONS***	***MEAN***	***StdDev***
	Characteristics of Observed Classes		
Class Level	1=100 or 200-level classes, 0=300 or 400-level classes	.33	.47
Discipline Cluster	1=Natural science, Business, Finance, Marketing, and Psychology classes, 0=All other classes	.29	.46
Class Gen. Ed.	1=General Education, 0=Non-General Education classes	.40	.49
Class Time	1=Morning and noon, 0=Afternoon and evening classes	.44	.50
Class Length	1=50 minutes, 0=75 to 170 minutes classes	.39	.49
Class Size	Minimum: 7 students, Maximum: 95 students	26.14	10.84
	Characteristics of Observed Students		
Students Absent	1= No student absent, 0= Students absent	.11	.32
Students Sleeping	1= No student sleeping, 0=Students are sleeping in class	.72	.45
Class GPA Score	Minimum: 1.60, Maximum: 4.00	3.05	.44
	Characteristics of Observed Instructors and Teaching		
Instructor Sex	1=Male, 0=Female	.64	.48
Instructor Age	Minimum: 26, Maximum 70	47.71	11.09
Instructor Rank	1=Tenure track, 0=Non-tenure track instructors	.66	.78
Multimedia Use	1=Use of "a lot of untypical media, teaching tools, and examples compared to previous sessions," 0=Use of "a few," "same," or "less media etc. than usual"	.09	.29
Observed Interaction Quantity	Composite index average of four class observation questions estimating the percentages of student-faculty interactions per class "at instructor request," "without instructor request," of students "involved in interaction," and of students "involved multiple times." All four measures were confirmed with a principal component analysis with varimax rotations of related sets of items and reliability analysis (Cronbach's alpha 0.804). Minimum: 1 percent, Maximum: 98 percent	31.40	20.73
Observed Interaction Quality	Composite index of four Likert-item ordinal-level class observation questions (2=much better, 1=somewhat better, 0=same or not much difference, -1=somewhat worse, -2=much worse) about the "general quality of the class session compared to previous sessions," the "quality of student-teacher interactions compared to previous sessions," the "quality of student contributions compared to previous sessions," and the "quantity of student contributions compared to previous sessions" (Cronbach's alpha 0.783). Minimum score: -8 (lowest), Maximum score: +8 (highest)	1.27	2.65

Student Characteristics: About one out of ten observers reported no students absent from class; seven out of ten observers did not report students sleeping in the classroom; and the mean GPA of the sample was 3.05 (GVSU: 3.25, t-statistic: 8,1312***, i.e., statistically different).

Instructor and Teaching Characteristics: With regard to instructor demographic characteristics, almost 2 out of 3 instructors in the sample were male (GVSU: 54.7%, t-statistic: 3.4734***, i.e., statistically different); the average instructor's age in the sample was 47.7 years (GVSU: 46.3 years, t-statistic: 2.2905*, i.e., statistically different); and two thirds of the instructors were tenured or tenure-track professors (GVSU: 51%, t-statistic: 3.4378***, i.e., statistically different); about one in ten observed classes used a great deal of untypical media, teaching tools, and examples compared to previous session. The variable *Interaction Quantity* was measured using a composite index of four different interaction observation counts in relation to the number of students attending class. The mean percentage of students involved in interaction during the observed class period was 31.4%. Similarly, *Interaction Quality* was measured transforming four Likert-item ordinal-level observation questions about interaction quality and quantity in comparison to previous sessions into an index ranging from '+2' = 'much better' to '-2' = 'much worse.' The index average was 1.27, indicating an overall positive assessment of teaching quality.

Correlations

Zero-order Pearson r-correlations were conducted between both the three sets of characteristics and the dependent variables *Interaction Quantity* and *Interaction Quality* to discover association strength and directions (Table 2).

Table 2: Zero-Order Correlations of Class Observation Sample 2006 to 2013 (N=320)

	Dependent Variable Interaction Quantity		***Dependent Variable Interaction Quality***	
Independent Variables	*Pearson Correlation*	*Sig (1-tailed)*	*Pearson Correlation*	*Sig (1-tailed)*
Characteristics of Observed Classes				
Class Level	-.109*	.025	-.046	.207
Discipline Cluster	-.214***	.000	-.055	.163
Class Gen. Ed.	-.136**	.008	.001	.494
Class Time	-.185***	.000	-.112*	.023
Class Length	-.219***	.000	-.103*	.033
Class Size	-.340***	.000	-.067	.117
Characteristics of Observed Students				
Students Absent	.006	.454	.110*	.025
Students Sleeping	.108*	.027	.061	.137
Class GPA Score	.144**	.005	.123*	.014
Characteristics of Observed Instructors and Teaching				
Instructor Sex	.070	.106	-.002	.486
Instructor Age	.063	.132	.009	.438
Instructor Rank	*-.022*	.349	-.004	.470
Multimedia Use	.099*	.039	.182**	.001
Observed Interaction Quality	.397***	.000	X	X
Observed Interaction Quantity	X	X	.397***	.000

*P-value significance * at .05 level, ** at .01 level, and *** at .001 level.*

First, a statistically significant, positive, and very strong relationship was detected ($p<.0001$) between both the quantity and quality interaction variables. In this study the relationship was treated as bi-directional but one could also consider it as uni-directional, where interaction quality is a causal (or perhaps intervening) variable of *Interaction Quantity*.

Second, if one compares correlations between the dependent variable *Interaction Quantity* and the three sets of independent characteristics it is remarkable that demographic instructor characteristics and student absence are not significantly associated with quantity, while eight out of eleven variables representing class and teaching characteristics are statistically correlated with interaction quantity. The latter is higher in upper-division classes and in non-science, non-business, non-psychology, and non-General Education courses. More classroom interaction also happens in afternoon and evening classes, in larger classes, and in classes that meet for a longer time period. Not surprisingly, classes with no students absent or sleeping and with higher average GPA scores display more students involved in interaction compared to classes with opposite characteristics. Higher (but statistically not significant) interaction quantity levels were observed in classes with male and older instructors, and in classes taught by non-tenure track instructors. Finally, the use of untypical media and teaching tools also is significantly correlated with interaction quantity.

Third, the fourteen characteristic variables are to a much lesser degree associated with *Interaction Quality*. Only afternoon and evening class time, classes longer than 50 minutes in length, classes with student absent, classes with above average GPA levels, and classes using untypical multimedia were significantly correlated with high classroom interaction quality, but this trend was much weaker in comparison with interaction quantity. The direction of correlations is similar with the following two exceptions: interaction quality is associated with female instructors and General Education classes, though both associations are weak and not significant.

OLS Regressions

To test the importance, interrelation, and change of different sets of classroom characteristics, eight Ordinary Least Squares (OLS) regression estimations were performed comparing the explained variance of the dependent variables (adjusted R-square) on three separate model sets of characteristics: class, student, instructor and teaching, and a fourth complete model which combined the first three sets.

In a first step the assumptions of linear regression were tested: histograms of all non-Dummy variables (class size, GPA, instructor age, interaction quantity and interaction quality) revealed approximate normal distributions, though skewed in most cases. Also, low bivariate correlations with the exception of the interaction quality and quantity variables ($r = 0.34$) suggests the predictor variables were independent of each other. Scatterplots of the standardized residuals against both dependent variables exposed heteroscedastic residuals, particularly for *Interaction Quantity*. For lack of better alternatives, this problematic variable had to be retained though the predictive power of the regression model is limited because not all regression assumptions were met. To avoid giving a wrong impression of precision and to focus on the main purpose of this study, only standardized Beta weights and affiliated significance coefficients were reported.

1. Regressions on the dependent variable *Interaction Quantity* (Table 3): From the variances across the four models, one can easily recognize that demographic characteristics of instructors and students are not helpful compared to class characteristic variables. Following the fourth, complete model, high interaction quantity is, besides interaction quality (Beta .34), statistically associated with small class size (Beta -.25), non-science discipline clusters (Beta -.17), longer classes (Beta -.15), non-General Education class affiliation (Beta -.12), and afternoon/evening classes (Beta -.11). Compared to zero-order correlations in Table 2, the significant association with

class level, student sleeping, class GPA, and multimedia disappears. The direction of relationships changes for two variables: interaction quantity increases when more students are absent and when instructors are younger. Altogether, the fourteen variables included in the fourth, complete set of characteristics explain 31% of the variance of interaction quantity, and most of it is explained by interaction quality and small class size. These findings indicate that future research ought to include additional independent characteristics to increase the explained variance of the dependent variable interaction quantity.

Table 3: OLS Regression of Interaction Quantity Comparing Three Sets of Characteristics

Dependent Variable	**Interaction Quantity**			
Class Observation Sample 2006 to 2013 *(N=320)*	***Model 1***	***Model 2***	***Model 3***	***Model 4***
Independent Variables				
Characteristics of Observed Classes				
Class Level	-.036			-.031
Discipline Cluster	-.190***			-.169**
Class Gen. Ed.	-.120*			-.122*
Class Time	-.149*			-.112*
Class Length	-.170*			-.147*
Class Size	-.275***			-.250***
Characteristics of Observed Students				
Students Absent		-.012		-.060
Students Sleeping		.095		.029
Class GPA Score		.134*		.024
Characteristics of Observed Instructors and Teaching				
Instructor Sex			.063	.010
Instructor Age			.056	-.004
Instructor Rank			-.033	-.030
Multimedia Use			.036	.027
Observed Interaction Quality			.390***	.340***
Adjusted R-square with ANOVA sig.	***.204******	***.020****	***.154******	***.308******

Listed are only OLS standardized Coefficient Beta values.
*P-value significance * at .05 level, ** at .01 level, and *** at .001 level.*

2. Regressions on the dependent variable *Interaction Quality* (Table 4): In this case one can easily see from model 4 that neither classroom nor student nor instructor characteristics matter. Compared to the zero-order correlations (Table 2), the significant associations with class time, class length, student sleeping and class GPA disappear and only those with interaction quantity (Beta .41) and multimedia use (Beta .12) remain. The relationship direction changes for five variables: interaction quality is judged to be higher in natural sciences, business, and psychology classes, in larger classes, and in classes taught by younger, tenure (track), male instructors. The overall explained variance of interaction quality by fourteen characteristics is 16%, and most of that percentage has to be attributed to interaction quantity. We can conclude that the variable sets chosen are not very helpful in explaining the dependent variable.

Table 4: OLS Regression of Interaction Quality Comparing Three Sets of Characteristics

Dependent Variable	**Interaction Quality**			
Class Observation Sample 2006 to 2013 *(N=320)*	***Model 1***	***Model 2***	***Model 3***	***Model 4***
Independent Variables				
Characteristics of Observed Classes				
Class Level	-.037			-.012
Discipline Cluster	-.053			.052
Class Gen. Ed.	.003			.069
Class Time	-.091			-.021
Class Length	-.073			-.003
Class Size	-.049			.066
Characteristics of Observed Students				
Students Absent		.098		.087
Students Sleeping		.041		.019
Class GPA Score		.112*		.073
Characteristics of Observed Instructors and Teaching				
Instructor Sex			-.018	.004
Instructor Age			-.003	-.008
Instructor Rank			.001	.036
Multimedia Use			.143*	.122*
Observed Interaction Quantity			.385***	.410***
Adjusted R-square with ANOVA sig.	***.007***	***.018****	***.166*****	***.164*****

Listed are only OLS standardized Coefficient Beta values.
*P-value significance * at .05 level, ** at .01 level, and *** at .001 level.*

3. To test whether over the course of the observation time period from 2006 to 2013 changes had occurred that affected interaction quality and quantity as well as the set of characteristics used in the study, a separate correlation analysis was conducted (not shown here). Since no statistical effects were discovered, it was concluded that no changes over time had occurred which affected the above results about the importance and interrelation of different sets of classroom characteristics.
4. It is notable that in both Model 4 of *Interaction Quantity* as well as *Interaction Quality* the characteristics of instructors and students do not matter statistically. Knowing these variables does not seem to be of great importance in understanding interaction, a finding that is similar to what Lundberg and Schreiner (2004, 562) reported. In addition, the finding that class GPA score does not significantly affect interaction puts into question the notion discussed in the literature (Cox et al. 2010, 776) that interaction and student outcomes or performance (often measured using GPA scores) are reciprocal.
5. Overall, the OLS regression results challenge the original assumptions of this study derived from the literature about the importance of the three sets of characteristics, with the exception of a strong interrelation between interaction quality and quantity, and the importance of classroom factors for explaining interaction quantity. When explaining interaction quality the independent multimedia variable is statistically significant but weak in comparison to the dependent interaction quantity variable. Unfortunately the multimedia variable is very broad and untested, making its interpretation difficult.

Qualitative Analysis of Classroom Interaction

The statistical analysis of correlations captures relationships quantitatively using numeric measures but is less rich in detail and depth compared to qualitative analysis. Two open-ended questions on the observation questionnaire about the "reasons why quantity and quality of interaction patterns in this session was different compared to previous sessions" allow us to determine in more detail the causes and conditions of interaction differences. First, observer comments were coded and grouped according to the sets of characteristics used in this study. Second, comments were checked for consistency with other questions from the observation worksheet and found to be highly dependable. Third, an interrater test conducted on comments of 24 classes that were observed multiple times by 60 observers confirmed high reliability levels (alpha >.80).

From the student observation testimonies (Tables 5 and 6) it was learned that an exciting topic related to the personal experiences of students, a class presentation by students, or a review for an upcoming test as well as the use of a sophisticated teaching method or collaborative assignment enhanced interaction quantity and quality. On the other hand, boring lectures, high absentee rates, an early morning Monday class, or the first meeting after the Spring break invited more yawns, less enthusiasm, and was perceived by students as being of lesser learning 'entertainment' quality.

Table 5: Explanations for an increase or decrease of class interaction quantity

Class Observation Sample 2006 to 2013 *(Multiple Responses included)*	***Increase 100%*** *(N=383)*	***Decrease 100%*** *(N=217)*	***Total 100%*** *(N=600)*
Class Characteristics	**8.3%** *(N=32)*	**29.0%** *(N=63)*	**15.8%** *(N=95)*
Class size has an effect on interaction quantity	*21*	*24*	*45*
Effect of time of class, time of day, weekday, or semester	*10*	*35*	*45*
Factors like room temperature, weather, and light conditions	*1*	*4*	*5*
Class Topics	**35.8%** *(N=137)*	**18.9%** *(N=41)*	**29.7%** *(N=178)*
Effect of a particular topic considered interesting, boring, controversial, sensitive, or provocative	*65*	*26*	*91*
Exam review or exam return, directions for finals or projects	*31*	*6*	*37*
Students are (un)familiar with a particular topic	*24*	*8*	*32*
A topic is related to student experience and open to opinion, regardless of student preparation	*17*	*1*	*18*
Student Characteristics	**15.9%** *(N=61)*	**19.4%** *(N=42)*	**17.2%** *(N=103)*
Presence or absence of dominant student 'talkers'	*15*	*19*	*34*
Students give presentations in class	*18*	*13*	*31*
Students are prepared, knowledgeable, did the reading	*17*	*1*	*18*
Students feel comfortable in class, attentive, or awake	*9*	*0*	*9*
Students are stressed, tired, bored, burned out, or distracted	*0*	*8*	*8*
Other specific factors, such as class composition or class level	*2*	*1*	*3*

Instructor and Teaching Characteristics	**40.0%** *(N=153)*	**32.7%** *(N=71)*	**37.3%** *(N=224)*
Use of particular teaching tools, tasks, assignments, exercises (group work, multimedia, video, PPT, YouTube, etc.)	*68*	*40*	*108*
Use of particular teaching styles and methods (lectures, discussions, simulations, role plays, etc.)	*52*	*25*	*77*
Instructor personality (enthusiasm, energy, humor, clarity)	*21*	*6*	*27*
Teaching that rewards class interaction and participation	*12*	*0*	*12*

Table 6: Explanations for an increase or decrease of class interaction quality

Class Observation Sample 2006 to 2013 *(Multiple Responses included)*	***Increase 100%*** *(N=324)*	***Decrease 100%*** *(N=142)*	***Total 100%*** *(N=466)*
Class Characteristics	**3.4%** *(N=11)*	**7.0%** *(N=10)*	**4.5%** *(N=21)*
Effect of time of class, time of day, weekday, or semester	*5*	*9*	*14*
Small class size promotes interaction quality, closeness, personal relationships among students	*6*	*0*	*6*
Factors like light conditions and windowless rooms	*0*	*1*	*1*
Class Topics	**41.4%** *(N=134)*	**26.8%** *(N=38)*	**37.0%** *(N=172)*
Class topic is about an upcoming exam, review, or final essay	*44*	*13*	*57*
Class topic is related to student experiences, the 'real world,' is easy to grasp, allows to have an opinion without reading	*47*	*1*	*48*
Topic is or is (not) interesting, important, redundant, etc.	*32*	*9*	*41*
Topic is new, complex, controversial, interesting, challenging	*11*	*15*	*26*
Student Characteristics	**20.0%** *(N=65)*	**28.2%** *(N=40)*	**22.5%** *(N=105)*
Students are motivated to engage in class by asking questions, defending answers, making contributions, etc.	*26*	*14*	*40*
Students are prepared, knowledgeable, are learning	*21*	*1*	*22*
Students do (not) pay attention, are awake or tired, distracted, pre-occupied with other classes, burned-out, etc.	*5*	*15*	*20*
Students give presentations in class	*8*	*2*	*10*
Presence or absence of dominant student 'talkers'	*3*	*6*	*9*
Other factors, such class heterogeneity and motivation	*2*	*2*	*4*
Instructor and Teaching Characteristics	**35.2%** *(N=114)*	**38.0%** *(N=54)*	**36.0%** *(N=168)*
Instructor professional skill to motivate, ask the right questions, provide educating answers, setting the right interaction environment, reward participation, care for students, have high expectations, etc.	*32*	*20*	*52*
Use of particular teaching tools, tasks, assignments, exercises (multimedia, games, movies, quizzes, etc.)	*33*	*8*	*41*
Use of particular teaching styles and methods (presentation	*29*	*1*	*30*

and communication skills, encouraging discussions, etc.)			
Instructor personality (enthusiasm, mood, humor, clarity, preparation, knowledge, feedback, easygoing way, etc.)	*17*	*3*	*20*
Traditional lectures stifle interaction quality	*0*	*15*	*15*
Class organization, structure, requirements, timing, etc.	*3*	*7*	*10*

When explaining interaction quantity, student observers saw the following factors as being important: instructor and teaching-related factors (37%), class topics (30%), student related factors (17%), and class characteristics (16%). With regard to interaction quality observers mentioned as being most prominent: class topics (37%), instructor and teaching characteristics (36%), followed by student characteristics (23%), and only 4% related to class characteristics, i.e., time, day, semester, size, and room conditions. The causes and conditions responsible for an increase or decrease of class interaction quantity and quality complement the findings from the OLS regression analysis (Tables 3 and 4) about the relative unimportance of instructor demographic characteristics - though it also challenges the prominent role of class characteristics. In fact, the comment analysis qualifies and specifies in much more detail which qualitative factors matter when analyzing classroom interaction.

In the case of *instructor characteristics*, the personality of faculty, their particular teaching style, experience, preparation and skills in using teaching tools, organizing tasks, and stimulating interaction matter more than simple demographics. In the case of *student characteristics* their behavior, preparation, interest, motivation, physical and mental presence as well as peer influence matter more strongly than abstract demographics like gender, age, race, and ethnicity. In the case of *class characteristics* predominantly the class size was mentioned, but also time, day, and semester. Last but not least, an often overlooked factor crucial for explaining quality and also quantity of interaction is *class topics*, i.e., quantity as well as quality of content, and how it challenges, provokes, and connects to student experience, interest, and motivation. In practice, these factors are not mutually exclusive as it is the 'art' of teaching that stimulates, for example, the curiosity of students with available tools and methods to such a degree that seemingly boring topics (even in larger classes with unfavorable classroom conditions) become desired material of learning, leading to a reduction of absent and sleeping students.

An instructor’s passion for a topic and the ability to connect a particular topic with students' knowledge, preparation, experience and motivation, using a broad range of tools available to them (ranging from multimedia to class discussions, group exercises and the like), seem to be important ingredients for learning success. Contrary to those who point to external factors and dismiss the role of a professor's interpersonal style (Fassinger 1995, 94), this study agrees with Cox et al. (2010, 776), that "faculty beliefs about teaching and advising, or about their role in the system of higher education, may affect the frequency with which they interact with students outside of class." In other words, faculty can make a difference in student learning, particularly student-faculty interaction in the classroom (Kuh and Hu 2001, 329).

It is important to note that an instructor's ability to change and improve student learning through interaction is more than adapting to or meeting existing student expectations or providing feedback on topics. The agency of education rests primarily with the instructor: student learning happens when an instructor artfully combines students' curiosity, interests, and skills with contextual, topical, and situational factors of particular courses and classrooms - and molds them with an instructor's personal motivation, teaching style, and methods. The goal is to influence and change student expectations, perceptions, knowledge, and behaviors (similar to Rowan et al. 1997, 256). This finding is important for making decisions about faculty selection and training as well as the staffing of particular lower-division introductory and General Education classes.

Discussion

Limitations

First, a major limitation of this study is the non-randomness of the observation sample. Most of the class, faculty, and student characteristics were not representative of their respective GVSU population. Therefore, the results of this study cannot be easily generalized. The focus of the investigation on one institution in the Midwest also restricts the findings geographically and culturally (see also Gudykunst et al. 1996; Wang 2007).

Second, the interaction measures were very broad. Research by Folmer-Annevelink (2010) suggests that interaction research ought to use refined types of verbal and nonverbal classroom interaction measures between student and instructors as well as between students themselves, including measures about the context of interactions, such as focused discussions or group discussions. Other research stresses that attention should be given to "how and why students were actively engaged in the learning process, the extent and nature of student interactions with faculty, the focus and intensity of academic experiences, and the overall level of student engagement" (Umbach and Wawrzynski 2005, 154). For that purpose, methods like Flanders' (1970) interaction analysis should be employed more often, including videotaping of observations, counting and analyzing verbal interaction and related mental and physical behaviors, such as listening, taking notes, giving feedback, inattention, body language, and eye contact (Crede et al. 2010, 288).

Third, the models used in the OLS regression are simple causal ones ignoring the possibility that relationships between independent and dependent variables are more complex and context-specific by nature (Cox et al. 2010, 776). Feldman (1978) stated that the "exact place of course characteristics in a causal network of variables" (199) is difficult to determine, since they could be mediated, bi-directional, or intervening, as in the case of interaction quantity and quality (Crede et al. 2010, 275-276). Furthermore, it cannot be ruled out that some of the discovered relationships are spurious and reflect "the impact of omitted factors rather than a true effect" (Romer 1993, 76).

Fourth, from an even more critical epistemological point of view it is problematic to infer causality from the correlational nature of positivist research (Pascarella et al. 1978, 462). It could be argued that observations of frequency and other quantifiable indicators are reductionist and superficial because they ignore that "perceptions and interpretations guide human conduct" (Fassinger 1995, 85). This would require conducting case studies and matching students with observed classes and faculty, then inquiring in-depth "students' perceptions of one class and one instructor at a time" (Fassinger 1995, 85), and then finally corroborating this with faculty reports (Cox et al. 2010, 776).

Fifth, this research did not include and control for characteristics students bring to college (Pascarella and Terenzini 1977, 541) or interactions that happen outside the classroom (Kim and Sax 2007, 14), although previous studies indicate student-faculty interaction outside the classroom may be important too. Other important factors and measures identified by the literature but not used in this study include student pre-college classroom interaction experiences, skills, and aptitudes; SES; student interaction expectations, student attitudes toward and comprehension of a subject taught, student learning ability, and the influence of peer interaction norms and behaviors (Fassinger1995, 85). In addition there are numerous class, student, faculty, and teaching characteristics that this study did not cover, such as class requirements, course format and design, type of class content requiring by its nature instructor feedback (e.g., problem solving or learning simulations) and pedagogy (Fassinger 1995, 93). It is very likely that if some of these additional variables and characteristics had been added to the analysis, a different picture of the factors determining student-faculty interaction may have emerged.

Because of the above limitations and the complex and interconnected nature of the sets of characteristics analyzed, one can draw only cautious conclusions from this study. Although not intended as excuse, critics ought to be aware that the conceptual, methodological, contextual, and situational limitations inherent in any research about student-faculty interaction make it difficult for anyone to "parse out the reciprocal influences of faculty members and students" (Cox et al. 2010, 783).

Conclusion

The purpose of this study was to revisit previous findings and test them to improve our understanding of the importance and relative strength of sets of characteristics that affect classroom interaction in the context of changes in pedagogy, student diversity, and technology. The underlying goal was to strengthen the interactivity of undergraduate education and learning. The implications of these findings are potentially wide-ranging not only for faculty and students but also for parents, communities, institutions of higher learning, and society as a whole.

This study started out with the premise derived from the literature review that any analysis of classroom interaction divorced from recognizing the impact of contextual sets of characteristics will fail to yield a meaningful understanding of learning. To investigate some of these characteristics and their relative importance, class observations between 2006 and 2013 conducted at a large Midwestern American college were analyzed using a simple causal model containing fourteen independent variables. It was found that quantity and quality of interaction strongly correlate, with quality more likely influencing interaction quantity than vice versa. Explaining the variance of quantity, only class characteristics were statistically significant. In the case of quality, none of the above three sets were helpful explanatory criteria, except for interaction quantity and - to a much lesser degree - the use of multimedia and other teaching tools.

An additional content analysis of causes and conditions of observed classroom interactions revealed that quantity is strongly influenced by an instructor's teaching styles, methods and tools, class topics, and student behavior. Quality of interaction is very much dependent on topics, teaching tools and methods, instructor skills and student interest and motivation. Class characteristics are relative unimportant, particularly for explaining interaction quality. These findings challenge some of the hypotheses derived from the literature review about the importance of certain class, student, and faculty characteristics.

We can draw the conclusion that perhaps future research should not focus on investigating contextual class and demographic student and instructor characteristics since they may not be worth the cost and effort. Instead the focus should be more on the qualitative aspects of classroom interaction and teaching. This seems particularly important for beginning learners making the transition into college. Instead of shuttling them through large and anonymous classes in their formative college years, with the side-effect of producing high numbers of withdrawals, absenteeism, sleeping, and intellectual alienation, we should create learning environments for classes fulfilling undergraduate general education requirements "that set high expectations, promotes active and interactive learning, and gives students personal validation and frequent feedback on their work" (Cuseo 2007, 6). This would require small classes with no more than 20 to 25 students practicing interactive forms of quality teaching.

Another conclusion we can draw is that several class characteristics are important in explaining interaction quantity: small class size, class length and class time but also differences by discipline (like natural versus social sciences) and the General Education status of a course, indicating the importance of course topic. Many science, math, and related disciplines require the accumulation of basic knowledge and skills. Therefore, they tend to be less open to interactive query in the form of discussions, debates, or role play and, instead, use a lecture or lab format.

While interactive elements can and should be integrated, it is likely that differences between the 'hard' sciences and the social sciences and other disciplines remain.

General Education classes struggle inherently with a student motivation gap because they appear unrelated to degree acquisition and contradict the predominant instrumental perception of education and learning at American colleges. Lower interaction quantity in these classrooms may be explained by differences in intrinsic and extrinsic student motivation and interest, in combination perhaps with instructors who are resigned to the prevailing student attitude and expectations. A similar finding is the impact of time of day and class length on interaction quantity. Although studies about academic achievements have confirmed that students prefer afternoon classes (Ammons et al. 1995), this factor turned out to be stronger in this study.

Another OLR outcome that begs deeper investigation is the strong association of interaction quality and interaction quantity. It points to the importance of the instructor's role in creating and maintaining an interactive environment in which high levels of quality interaction translate into interaction quantity and vice versa. But certain other - mostly qualitative - contextual, topical and situational characteristics must be met, as listed in Tables 5 and 6. Understanding the links among all factors involved is helpful for the development of settings that are conducive to teaching excellence, such as small class size, shorter class time, afternoon classes, topics that attract student attention, and the use of teaching styles and methods that trigger student motivation and relate to their previous knowledge and experience as well as personal goals.

This study affirms that notwithstanding the increasing diversity of the student body or the continuous advance of new class technologies (i.e., multimedia and hybrid online teaching tools), student-centered classroom interaction remains important. In other words, knowledge of the interconnected nature of interaction and the conditions that make it work remains central for designing successful college curricula, faculty training programs, and for educating the next generation of students achieving high academic excellence and reasoning ability (Cundell and Pierce 2009). But questions remain how and why students are "actively engaged in the learning process, the extent and nature of student interactions with faculty, the focus and intensity of academic experiences, and the overall level of student engagement" (Umbach and Wawrzynski 2005, 154, citing Pascarella 2001). For this reason, the development of better quantitative indicators that measure interaction in combination with qualitative studies about student and faculty practices in the undergraduate classroom remain a central topic of education research.

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APPENDIX: Class Observation Worksheet

1. Observer Name:
2. Observed Class:
3. Date of observation:
4. Time when observation began:
5. Time when observation ended:
6. Class Attendance (Head count 15 minutes after class start OR count # on attendance sheet:
7. Number of times students interacted AT INSTRUCTOR'S REQUEST:
8. Number of times students interacted WITHOUT instructor request:
9. HOW MANY students were INVOLVED in interaction? Avoid counting same students twice:
10. HOW MANY students interacted MULTIPLE TIMES in interaction?
11. Number of INDIVIDUAL students SLEEPING during class session. Avoid counting identical student twice:

Questions to be answered immediately after the end of class (CIRCLE CORRECT ANSWER):

12. QUALITY of student-teacher interaction in this session compared to previous sessions: (a) much better, (b) somewhat better, (c) no or not much difference, (d) somewhat worse, (e) much worse.
13. QUALITY of session in general compared to previous sessions: (a) very interesting, (b) somewhat interesting, (c) no or not much difference, (d) somewhat less interesting, (e) very boring.
14. Use of UNTYPICAL media, teaching tools, examples, or other educational efforts compared to previous sessions: (a) yes, a lot, (b) yes, but only a few, (c) no or not much difference, (d) less than usual.
15. QUALITY of student contributions compared to previous sessions: (a) Much better, (b) Somewhat better, (c) no or not much difference, (d) somewhat worse, (e) significantly worse.
16. QUANTITY of student contributions compared to previous sessions: (a) much more, (b) somewhat more, (c) no or not much difference, (d) somewhat less, (e) significantly less.
17. EXPLAIN reasons why quantity and quality of interaction patterns in this session was different compared to previous sessions? a) Reasons for different quantity of class interaction:
    b) Reasons for different quality of class interaction:

ABOUT THE AUTHOR

Dr. Hermann Kurthen: Professor, Department of Sociology, Grand Valley State University, Allendale, Michigan, USA.

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