Examining Teacher Collegiality in Context: An Uncertainty Management Perspective*

Seung-Hwan Ham (Michigan State University)

ABSTRACT

In order to examine how collaborative teacher interaction is contingent upon teachers’ immediate classroom and school-organizational contexts as well as broader societal and policy environments, this study elaborates and tests an uncertainty management perspective as a theoretical framework. A set of hierarchical linear modeling analyses was conducted in this study based on 5,928 eighth-grade mathematics teachers across 29 countries from the TIMSS 2007 dataset. The findings suggest that teacher collegiality may be understood in part as teachers’ collective effort to deal with various uncertainties they confront in their teaching. This result sheds light on the possibility that lateral collegial relationships among teachers may serve as a source of information processing, sensemaking, and problem solving, whereby they can better manage to go through given situations of uncertainty.

[Key words] teacher collegiality, uncertainty management, schools as organizations

I. Introduction

The virtues of teacher collegiality are widespread. A sizable body of empirical research links collegiality among teachers to their enhanced feelings of efficacy,
increased teaching quality, and greater accountability for student achievement (Bryk & Schneider, 2002; Saunders, Goldenberg, & Gallimore, 2009; Yasumoto, Uekawa, & Bidwell, 2001). Taking the form of collaborative lesson planning, classroom observation, peer coaching, or mentoring, teacher collegiality has often been conceptualized as an important factor contributing to teacher development whereby teachers can be provided with opportunities to share and develop their expertise together, so that they can be provided with opportunities to revisit, and take advantage of, their own reflections on teaching (Cochran-Smith & Lytle, 1999; McLaughlin & Talbert, 2001; Paine & Ma, 1993).

Considering that teachers' professional growth and development can be fostered by collegiality, it is not surprising that developing teacher collegiality is an important element of organizational capacity building (Cosner, 2009; Sergiovanni, 1994). Since teachers are the very persons who finally interpret and implement reform (Coburn, 2001; Spillane, Reiser, & Reimer, 2002), the successful transfer of reform ideas into practice is likely to depend greatly on how well collegial working relationships have been created and sustained among teachers. It is, thus, reasonable to expect both school-based and externally-introduced reform initiatives to be implemented more effectively in schools where productive collegial relationships are the norm than in other schools which lack enough organizational capacity to elicit shared understandings among teachers. In this respect, many argue that collegiality in schools is an important prerequisite for the effective implementation of various reform initiatives (Little, 1993; Louis, Marks, & Kruse, 1996).

Further, newly emerging social psychological perspectives posit that cognition is not simply a property of an individual person, but it is distributed across people (Hutchins, 1995; Salomon, 1993). Such distributed cognition perspectives commonly suggest the possibility that teacher collegiality may help “diverse groups of teachers with different types of knowledge and expertise . . . draw upon and incorporate each other’s expertise to create rich conversations and new insights into teaching and learning” (Putnam & Borko, 2000, p. 8). Similarly, images of leadership have also changed in a way that teachers are encouraged to actively engage in leadership roles. Recent literature on school organization challenges conventional conceptualizations of leadership as monopolized by administrators, emphasizing new styles of leadership, whereby leadership is shared with, and distributed among, teachers (Somech, 2005; Spillane, Halverson, & Diamond, 2004). These alternative
forms of leadership are characterized by shared decision making, collaborative problem solving, and supportive relationships, which all relate to collegiality.

Notwithstanding the widely acknowledged connection between teacher collegiality in schools and its beneficial effects, little systematic effort has been made to understand what types of teachers, under what contextual conditions, build and sustain collegial relationships with other teachers. Teacher collegiality, in most studies, has typically been treated as an independent variable that is presumed to yield some positive outcomes, irrespective of how it is conceptualized. Although those studies help us recognize various positive effects of teacher collegiality, it is also important to develop a comprehensive knowledge base that provides insight into how the level and type of collaborative teacher interaction varies depending on various factors. As a systematic investigation in this direction, this study explores teacher collegiality as a dependent variable contingent upon various factors at multiple levels of abstraction ranging from the teacher level to the national sociocultural and policy environment level. This approach can help us better understand not only the nature of teacher collegiality but also the contexts in which teacher collegiality arises and is sustained in schools. In particular, this study intends to elucidate and test an uncertainty management perspective that understands collegiality as largely a byproduct of teachers’ collective sensemaking of instructional and classroom-contextual uncertainties they confront in their teaching.

II. Theoretical Framework

Teaching has often been seen as an uncertain technology. Instructional decisions regarding how to promote student learning in a particular classroom environment can never be made with absolute certainty. Although teachers are expected to possess a set of specialized knowledge and skills, such a social expectation contrasts with the relatively weak core technology teachers actually have (Labaree, 2000; Lortie, 2002); further, teachers always face the vivid realities of classroom teaching that are often inexplicable in terms of theoretical conceptualizations of educational practice (Floden & Buchmann, 1993). In this study, “uncertainty in teaching” denotes a state of doubt or a feeling of incertitude about particular instructional or classroom situations as perceived by teachers. Operationalized in this way, uncertainty in
teaching is likely to increase when details of given situations appear complex or unpredictable due to insufficient information, knowledge, or resources readily available to teachers. More specifically, this study posits that the amount of uncertainty teachers confront in their teaching may vary depending on both the instructional strategies they use and the classroom contexts in which they are positioned to implement their teaching, which this study conceptualizes as sources of instructional and classroom-contextual uncertainty, respectively.2)

On the basis of an uncertainty management perspective that views collegiality as organizational members’ collective effort to deal with uncertainties, it is possible to expect that teacher collegiality may arise from teachers’ collective response to various instructional and classroom-contextual uncertainties they confront in their teaching. Indeed, there is some educational research that sheds light on the relationship between the nature of teaching as an uncertain task and the collegial behaviors of teachers. Rowan and his colleagues (Rowan, 1990; Rowan, Raudenbush, & Cheong 1993), for instance, posit that when teaching is understood to be a complex and uncertain activity, “organic” structures are likely to emerge in schools; they assert that teachers who recognize the complexities of teaching are more prone to form collegial networks for sharing useful information and mutual support. Similarly, Bidwell (2001) postulates that teachers are likely to turn to their colleagues for guidance and support when they are situated “in an environment of substantive uncertainty, [where] pedagogical doctrines rarely provide procedural templates of sufficient specificity to guide [their] day-to-day practice effectively” (p. 106). That is, “[i]f the complexity of the task generates uncertainty, then lateral relations between workers can serve as a source of problem-solving and processing of information as well as coordination” (Cohen, Deal, Meyer, & Scott, 1979, p. 21).

In addition, some organizational literature also suggests that, when faced with complex and unpredictable situations, organizational members frequently rely on

2) It should be noted that there may be various ways to conceptualize the uncertainties teachers may confront in their work life (Floden & Bachmann, 1993; Labaree, 2000; Lortie, 2002; Munthe, 2007). The notion of uncertainty in teaching that this study relies on is, therefore, only one of many possible conceptualizations. Alternative avenues to frame the notion of uncertainty deserve further systematic research in order to examine how varying conceptualizations of uncertainty are similarly or differently related to collaborative teacher interaction patterns. In addition, further studies are needed to see if (or to what extent) what I have described above as sources of uncertainty in teaching really cause teachers to experience feelings of uncertainty. Qualitative case studies, accompanied by some psychological testing, would be very useful in this respect.
collective sensemaking, which is a collaborative process through which the link between actions and beliefs becomes clarified (Weick, 1995). If what action to take seems unclear to organizational members under a given uncertain situation, collective sensemaking as part of collaborative effort to overcome individual organizational members’ “bounded rationality” (March & Simon, 1993; Simon, 1991) can serve as an effective mechanism that “prevents an already uncertain world from becoming a meaningless one” (Collinson & Cook, 2007, p. 38). In this respect, collegiality may be largely a byproduct of the collective sensemaking of uncertainties, which lessens organizational members’ feelings of discomfort with given uncertain situations and thus helps them manage uncertainties without actually removing them completely from given situations (Berger, 1995; Brashers, 2001).

In sum, drawing on an uncertainty management perspective, this study postulates that collegial networks among teachers may emerge from their collective response to various instructional and classroom-contextual uncertainties they confront in their teaching. In this regard, the following three hypotheses are examined in this study:

**Hypothesis 1:** Teachers who face a greater level of instructional uncertainty are more likely to engage in collaborative interaction with other teachers. An important example showing the complexities teachers go through is that many teachers often do not encourage their students towards deeper intellectual engagement (Cusick, 1983; McNeil, 1986). Rather than encouraging their students towards deeper intellectual engagement, many teachers try to find “an optimal level of student engagement” (Kennedy, 2005, p. 183); from teachers’ point of view, there may be considerable advantages to conventional teaching because it helps protect them from the uncertainties that could emerge from students’ unexpected responses. If teachers try to develop and use instructional strategies that open up possibilities for students to engage in intellectually challenging questions and inquiry-based explorations, they inevitably confront a greater amount of instructional uncertainty (Fennema & Romberg, 1999; McLaughlin & Talbert, 1993). That is, as teachers put more effort to incorporate such instructional strategies into their teaching, the practice of teaching becomes more unpredictable, less reducible to a set of predictable routines.

**Hypothesis 2:** Teachers who confront a greater level of classroom-contextual uncertainty are more likely to engage in collaborative interaction with other teachers. Uncertainty in teaching as perceived by teachers may arise from a range of classroom-contextual factors; some of the most common examples include a low level of overall student perform-
ancence, a high level of student heterogeneity, and a shortage or inadequacy of classroom resources (Cohen, Raudenbush, & Ball, 2003; Gay, 2000; Hallinan, 1994). If teaching occurs in such a classroom environment, teachers are likely to confront various difficult challenges and complex classroom dynamics which they need to deal with in their everyday teaching practice. Despite the fact that teachers are expected to possess a set of specialized knowledge and skills to deal with various classroom-contextual challenges (Wilson, Floden, & Ferrini-Mundy, 2001), such a social expectation often contrasts with the relatively weak core technology teachers actually have (Lortie, 2002).

Hypothesis 3: Teachers in countries with a higher level of sociocultural heterogeneity are more likely to engage in collaborative interaction with other teachers. Extending the central logic of the uncertainty management perspective, it is plausible that the level of sociocultural heterogeneity of a given country may be positively related to the overall level of teachers' collaborative interaction. In a socioculturally heterogeneous society, the range of the goals of schooling envisioned by different groups of people is likely to be very wide (Hochschild & Scovronick, 2003), and many of those goals may be conflicting with one another (Labaree, 2000), adding further uncertainty to the inherent complexities of teaching. This accounts for why “teaching performances ... can be free of controversy only in societies which are marked by an extremely high degree of value consensus” (Lortie, 2002, p. 136). That is, it is plausible to expect that teachers in a socio-culturally more heterogeneous society are more likely to confront various complex issues in teaching due to a lower level of value consensus at the societal level, which may necessitate a higher level of engagement in collaborative interaction with their colleague teachers.

III. Data and Methods

The data for this study are primarily from the TIMSS 2007 eighth-grade mathematics dataset. This dataset, chiefly known for its student achievement data, also contains extensive contextual data on schools and classes, including useful information about collaborative interaction among teachers. Since this study is concerned primarily with collaborative teacher interaction, the teacher is the primary
unit of analysis. In terms of hierarchical linear modeling (Raudenbush & Bryk, 2002), teacher-level data constitute level-1 variables. The teachers selected for TIMSS 2007 are those who taught the nationally representative sample of classes within each country. Since teachers are nested within each country in terms of the data structure, the country is the level-2 unit of analysis. In terms of the sample size, 5,928 teachers across 29 countries, for which the complete data are available with respect to the all following variables, are analyzed in this study.

1. Measures

A. Dependent variables: Measures of collegiality

With respect to teacher collegiality measures for dependent variables, a question in TIMSS 2007 asked eighth-grade mathematics teachers, “How often do you have the following types of interactions with other teachers?” The types of collaborative interaction given were: “discussions about how to teach a particular concept,” “working on preparing instructional materials,” “visits to another teacher’s classroom to observe his/her teaching,” and “informal observations of my classroom by another teacher.” For each interaction type, teachers were asked to choose one of the following response options: “never or almost never,” “2 or 3 times per month,” “1-3 times per month,” “4-6 times per month,” “7-9 times per month,” “10-12 times per month,” “13-15 times per month,” “16-18 times per month,” “19-21 times per month,” “22-24 times per month,” “25-27 times per month,” “28-30 times per month,” “31 or more times per month.”

3) In the TIMSS 2007 dataset, teacher-level, classroom-level, and school-level data are virtually at the same level in terms of data structure; this is because only one or two intact classes were selected per school in most cases, and each class was usually taught mathematics by only one or two teachers. Therefore, although teachers, classrooms, and schools are all separate levels conceptually, it is unreasonable to treat them as separate levels in statistical analyses. This study uses the classroom level as the data level to which teacher-level and school-level data are matched together. That is, in places where the number of cases differed between these levels, the number of cases was adjusted to be consistent with the number of classrooms in the dataset. This strategy is useful because the TIMSS 2007 dataset contains a weight variable designed to be used for analyses where the unit of analysis is the classroom. This study uses this weight variable after transforming it into a purely proportional weight variable that makes the total weighted sample size remain equal to the total unweighted sample size while allowing all countries to have the same weighted sample size to make each country treated equally.

4) The 29 countries are Australia, Bulgaria, Chinese Taipei, Colombia, the Czech Republic, Egypt, England, Ghana, Hong Kong, Hungary, Indonesia, Iran, Israel, Italy, Japan, Kuwait, Lebanon, Malaysia, Norway, Romania, the Russian Federation, Saudi Arabia, Scotland, Singapore, South Korea, Sweden, Thailand, Turkey, and the United States.
times per week,” or “daily or almost daily.” These response options were assigned with numeric values of zero, one, two, and three, respectively.

Based on these four types of collaborative interaction between teachers, the following two collegiality measures were constructed: collaborative lesson planning (Coll_plan, $\bar{x} = 1.37$, SD = 0.76), which is the mean of “discussions about how to teach a particular concept” and “working on preparing instructional materials,” and collaborative class observation (Coll_class, $\bar{x} = 0.47$, SD = 0.63), which is the mean of “visits to another teacher’s classroom to observe his/her teaching” and “informal observations of my classroom by another teacher.” Little (1990) argues that collaborative lesson planning and class observation constitute strong forms of collegiality. Such joint work implies collective action, creating strong interdependence, shared responsibility, and a great degree of readiness to participate in reflective inquiry into practices.

B. Independent variables

To test hypotheses 1 and 2, two composite factors, instructional uncertainty ($\bar{x} = 0.00$, SD = 1.00) and classroom-contextual uncertainty ($\bar{x} = 0.00$, SD = 1.00), have been derived from an exploratory factor analysis of the following seven variables:

Challenging problem solving: a variable that captures the degree to which an eighth-grade mathematics teacher uses instructional strategies to foster students’ engagement in intellectually challenging problem solving. The mean of how often the teacher asks students to “work on problems for which there is no immediately obvious method of solution” and to “decide on their own procedures for solving complex problems” is used as the variable (ranging from 0.0 for “never” to 3.0 for “almost every lesson”; $\bar{x} = 1.35$, SD = 0.66).

Inquiry-based learning: a variable that reflects the degree to which an eighth-grade mathematics teacher uses instructional strategies to foster students’ engagement in inquiry-based learning. The mean of how often the teacher asks students to “relate what they are learning in mathematics to their daily lives” and to “explain their answers” is used as the variable (ranging from 0.0 for “never” to 3.0 for “almost every lesson”; $\bar{x} = 2.03$, SD = 0.70).

Classroom-level student achievement: a continuous variable that measures the overall mathematics achievement level of the classroom that an eighth-grade mathematics
teacher teaches. In order to construct this variable, the individual student-level mathematics achievement data were aggregated into the classroom level, which was then linked to the eighth-grade mathematics teacher data. The mean score of mathematics achievement for a given classroom is used as the variable (divided by 100 to make 100 score points as a one-unit; $\bar{x} = 4.70$, $SD = 0.93$).

**Variation in student achievement:** a continuous variable that measures the variation in mathematics achievement in the classroom that an eighth-grade mathematics teacher teaches. For the construction of this variable, the student-level mathematics achievement data were aggregated into the classroom level, which was then linked to the eighth-grade mathematics teacher data. The standard deviation of the mean score of mathematics achievement for a given classroom was changed into the coefficient of variation, which is the ratio of the standard deviation to the mean in terms of percentage. This coefficient is used as the variable (divided by 10 to make 10% as a one-unit; $\bar{x} = 1.44$, $SD = 0.56$).

**Classroom-level educational capital:** a continuous measure that captures the overall socioeconomic background of the classroom that an eighth-grade mathematics teacher teaches. A student-level index of educational capital was first constructed based on individual students’ answers regarding a range of family possessions related to learning, as done by Chudgar and Luschei (2009). Next, this student-level information was aggregated into the classroom level. Finally, the classroom-level mean was linked to the eighth-grade mathematics teacher data ($\bar{x} = 6.60$, $SD = 1.69$).

**Variation in educational capital:** a continuous variable that measures the variation in the socioeconomic backgrounds of students in the classroom that an eighth-grade mathematics teacher teaches. For this measure, a student-level index of educational capital was first constructed based on individual students’ answers regarding a range of family possessions related to learning, as done just above. Next, this student-level index was aggregated into the classroom level, which was then linked to the eighth-grade mathematics teacher data. Finally, the classroom-level standard deviation of this index was changed into the coefficient of variation, i.e., the ratio of the standard deviation to the mean in terms of percentage. This coefficient is used as the variable (divided by 10 to make 10% as a one-unit; $\bar{x} = 2.42$, $SD = 1.06$).

**Shortage of classroom resources:** a variable that reflects an eighth-grade mathematics teacher’s perception of how much her/his classroom teaching is
negatively affected by a shortage or inadequacy of classroom resources. The mean of the degrees to which the following limit her/his teaching is used as the variable: “shortage of textbooks for students’ use,” “shortage of other instructional equipment for students’ use,” “shortage of equipment for your use in demonstrations and other exercises,” and “inadequate physical facilities” (ranging from 0.0 for “not at all” or “not applicable” to 3.0 for “a lot”; \( \bar{x} = 0.93, \) SD = 0.81).

Since all of these variables have been constructed to measure teachers’ uncertainty in teaching commonly on the basis of an uncertainty management perspective, high interrelationships among the variables are expected. An effective statistical method to examine underlying structures of variable interrelationships is exploratory factor analysis, which shows variable interrelationships with as few as possible factors. As reported in Table 1, two factors with an eigenvalue over 1.0 were derived from the above seven variables. Consequently, these two composite factors are used as the measures of uncertainty in teaching.

In addition to the two composite factors at level 1, the following variable is used at level 2 to test hypothesis 3:

Sociocultural heterogeneity: a country-level ethnic fractionalization index calculated by Alesina, Devleeschauwer, Easterly, Kurlat, and Wacziarg (2003). This index ranges theoretically from 0.0 for no fractionalization to 1.0 for perfect fractionalization (multiplied by 10 to rescale the index to range between zero and 10). This index is

### Table 1: Exploratory factor analysis to construct uncertainty measures

<table>
<thead>
<tr>
<th>Factor 1: Classroom-contextual uncertainty</th>
<th>Factor 2: Instructional uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classroom-level educational capital</td>
<td>-.891</td>
</tr>
<tr>
<td>Variation in educational capital</td>
<td>.864</td>
</tr>
<tr>
<td>Classroom-level student achievement</td>
<td>-.863</td>
</tr>
<tr>
<td>Variation in student achievement</td>
<td>.750</td>
</tr>
<tr>
<td>Shortage of classroom resources</td>
<td>.513</td>
</tr>
<tr>
<td>Challenging problem solving</td>
<td>.018</td>
</tr>
<tr>
<td>Inquiry-based learning</td>
<td>.121</td>
</tr>
</tbody>
</table>

Note: Principal component extraction with promax rotation (kappa = 4) was used. Bartlett’s weighted least squares method was used for factor score estimation. Factor loadings are sorted by size. Factor loadings greater than 0.5 in terms of absolute values are indicated by dotted-line boxes. Bartlett’s test of sphericity is significant at the \( p < .001 \) level. \( n = 5,928 \).
used in this study as a measure of the degree to which a country is heterogeneous in terms of sociocultural values held by people in that country (\(\bar{x} = 3.08, SD = 2.32\)).

C. Control variables

The following six variables are also considered to see if the hypotheses of this study derived from the uncertainty management perspective are supported even after some other possibilities are simultaneously taken into account:

School climate: a variable that measures the degree to which a school has a positive organizational climate according to eighth-grade mathematics teachers’ perception of “teachers’ job satisfaction,” “teachers’ understanding of the school’s curricular goals,” “teachers’ degree of success in implementing the school’s curriculum,” and “teachers’ expectations for student achievement” (ranging from 1.0 for “very low” to 5.0 for “very high”; \(\bar{x} = 3.64, SD = 0.60\)). Research has suggested that the extent to which teacher collegiality is fostered and sustained in a school depends largely on the organizational climate of the school (Freiberg, 1999; Hoy, Tarter, & Bliss, 1990).

Principal instructional leadership: a variable that captures the degree to which an eighth-grade mathematics teacher’s school principal spends time on instructionally relevant activities, including “developing curriculum and pedagogy,” “supervising and evaluating teachers and other staff,” and “teaching.” The sum of the percentages allocated to these activities is used as the variable (divided by 10 to make 10% as a one-unit; \(\bar{x} = 5.03, SD = 1.59\)). An expanding body of literature suggests the possibility that principal instructional leadership is an important factor that helps change a school into a collaborative inquiry community (Printy, 2008; Reitzug, 1997).

Novice teacher: a binary variable indicating whether an eighth-grade mathematics teacher has been in the profession of teaching for three years or less (coded one) or for more than three years (coded zero; \(\bar{x} = 0.15\)). One might plausibly suspect that novice teachers are more likely to seek collaborative interaction with other teachers in order to either join already existing networks or form new ones.

Female teacher: a binary variable indicating whether an eighth-grade mathematics teacher is female (coded one) or male (coded zero; \(\bar{x} = 0.57\)). This variable is used to see if any gender differences exist in collaborative teacher interaction.

Curriculum standardization: a country-level index of curriculum standardization con-
constructed by Ham (2011). This level-2 variable ranges from one for the lowest level of standardization to six for the highest level of standardization ($\bar{x} = 4.62, SD = 1.47$). A standardized curriculum may facilitate collaborative teacher interaction in a given country insofar as the curriculum serves as a coherent framework that provides teachers with a shared technical language (Lortie, 2002; Schmidt, Wang, & McKnight, 2005), by which they can secure at least a certain degree of efficiency in communicating with other teachers about teaching and learning.

Individualist culture: a country-level individualism index by Hofstede and Hofstede (2005). This level-2 control variable captures the extent to which people in a given society tend to emphasize goals and interests of individuals rather than those of groups (divided by 10 to rescale the index to range between zero and 10; $\bar{x} = 4.53$, $SD = 2.58$). One might expect teachers in countries with a more individualist culture to be less likely to engage in collaborative interaction with other teachers.

### 2. Model

This study uses hierarchical linear modeling to analyze the data (Raudenbush & Bryk, 2002). At level 1, for teacher $i$ in country $j$, the model is specified as

$$Coll_{ij} = \beta_0j + \beta_1j(\text{instructional uncertainty})_{ij} + \beta_2j(\text{classroom-contextual uncertainty})_{ij} + \beta_3j(\text{school climate})_{ij} + \beta_4j(\text{principal instructional leadership})_{ij} + \beta_5j(\text{novice teacher})_{ij} + \beta_6j(\text{female teacher})_{ij} + r_{ij},$$

where $\beta_0j$ is the mean outcome for country $j$, and the remaining $\beta$'s are the slopes for the level-1 variables; $r_{ij}$ is a random error.\(^5\)

With respect to model specification at level 2, the intercept, $\beta_{0j}$, and the slopes, $\beta_{bq}$, are specified as

$$\beta_0j = \gamma_{00} + \gamma_{01}(\text{sociocultural heterogeneity})_j + \gamma_{02}(\text{curriculum standardization})_j + \gamma_{03}(\text{individualist culture})_j + u_{0j},$$

and

$$\beta_{bq} = \gamma_{b0} + u_{bq} \quad \text{for} \quad 1 \leq q \leq 6,$$

where $\gamma_{00}$ is a constant, and $\gamma_{b0}$ for $1 \leq b \leq 3$ is the slope for each level-2 variable.

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\(^5\) All independent and control variables in the model, at both level 1 and level 2, were centered around their grand means. Thus, one may interpret the intercept as the expected degree of collaborative teacher interaction for a typical teacher in a typical country in the sample.
Random errors, \( u_{ij} \) and \( u_{qi} \), were added to the level-2 model in light of significant random differences due to factors unique to each country.6)

IV. Results

Tables 2 and 3 present the results from the hierarchical linear models for collaborative lesson planning and collaborative class observation, respectively. In each table, model I includes only those variables that pertain to the three hypotheses from the uncertainty management perspective, while model II includes all variables as specified above in order to see if the hypotheses are supported even after some other possibilities are simultaneously taken into account.

A very clear pattern shown in Table 2 is that instructional uncertainty is significantly positively associated with both collaborative lesson planning and collaborative class observation, which is in line with hypotheses 1. Since instructional uncertainty is a standardized factor score with a mean of zero and a standard deviation of one, the coefficient for this variable in Table 2 can be interpreted as the amount of expected increase in the degree of participation in collaborative lesson planning for every one-standard-deviation increase in the amount of instructional uncertainty. With all other things in the model held constant, an increase in instructional uncertainty by one standard deviation is significantly associated with an expected increase in collaborative lesson planning by 0.116, which is equivalent to 15.3\% of one standard deviation of this variable. Similarly, as reported in Table 3, a one-standard-deviation increase in instructional uncertainty is significantly related to an expected increase in collaborative class observation by 0.061, which translates into 9.7\% of one standard deviation. All these results give credence to hypothesis 1 that teachers who face a greater level of instructional uncertainty are more likely to engage in collaborative interaction with other teachers.

6) That is, all slopes and the intercept of the model are permitted to randomly vary across countries. This is because a large body of comparative education literature has suggested that there may be various national contextual factors that are rather unique to individual societies’ educational policies and practices. However, it is still in debate to what extent education is culturally contextualized within individual countries (Baker & LeTendre, 2005; Ham, Paine, & Cha, 2011; Kim, Ham, & Paine, 2011). In fact, treating all slopes as fixed does not change much the results reported in this article.
With regard to the effect of classroom-contextual uncertainty, Table 3 reports that, all other things in the model being equal, a one-standard-deviation increase in classroom-contextual uncertainty is significantly linked to an expected increase in collaborative class observation by 0.093, which represents 14.8% of one standard deviation of this variable. Although classroom-contextual uncertainty does not appear to have a significant effect on collaborative lesson planning as shown in Table 2, the significant positive association found between classroom-contextual uncertainty and collaborative class observation provides some evidence to substantiate the relationship between teachers’ exposure to complexities and difficulties emerging from classroom contexts and their engagement in collaborative interaction with their colleague teachers. This result is in alignment with hypothesis 2 that expects teachers who confront a greater level of classroom-contextual uncertainty to participate to a greater degree in collaborative interaction with other teachers.

<Table 2> Hierarchical linear model for collaborative lesson planning

<table>
<thead>
<tr>
<th></th>
<th>Coeff. (SE) I</th>
<th>Coeff. (SE) II</th>
</tr>
</thead>
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<tr>
<td>Intercept, $\gamma_{00}$</td>
<td>1.415 (.042) ***</td>
<td>1.383 (.039) ***</td>
</tr>
<tr>
<td>Sociocultural heterogeneity, $\gamma_{01}$</td>
<td>.055 (.018) **</td>
<td>.045 (.021) *</td>
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<td>Curriculum standardization, $\gamma_{02}$</td>
<td>.015 (.020)</td>
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<tr>
<td>Individualist culture, $\gamma_{03}$</td>
<td>-.013 (.014)</td>
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<tr>
<td>Instructional uncertainty, $\gamma_{30}$</td>
<td>.131 (.016) ***</td>
<td>.116 (.016) ***</td>
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<tr>
<td>Classroom-contextual uncertainty, $\gamma_{20}$</td>
<td>-.019 (.024)</td>
<td>.020 (.023)</td>
</tr>
<tr>
<td>School climate, $\gamma_{30}$</td>
<td>.159 (.030) ***</td>
<td></td>
</tr>
<tr>
<td>Principal instructional leadership, $\gamma_{40}$</td>
<td>.011 (.008)</td>
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</tr>
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<td>Novice teacher, $\gamma_{50}$</td>
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<tr>
<td>Female teacher, $\gamma_{60}$</td>
<td>.059 (.040)</td>
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Random effect

<table>
<thead>
<tr>
<th></th>
<th>Var.</th>
<th>df</th>
<th>$\chi^2$</th>
<th>Var.</th>
<th>df</th>
<th>$\chi^2$</th>
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<td>Intercept, $u_{0j}$</td>
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<td>.039</td>
<td>25</td>
<td>119.4 ***</td>
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<td>73.7 ***</td>
<td>.004</td>
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<td>67.7 ***</td>
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<td>71.4 ***</td>
<td>.009</td>
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<td>63.8 ***</td>
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<tr>
<td>School climate, $u_{3j}$</td>
<td>.013</td>
<td>28</td>
<td>68.6 ***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Principal instructional leadership, $u_{4j}$</td>
<td>.001</td>
<td>28</td>
<td>41.3 *</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Novice teacher, $u_{5j}$</td>
<td>.047</td>
<td>28</td>
<td>79.0 ***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female teacher, $u_{6j}$</td>
<td>.030</td>
<td>28</td>
<td>92.1 ***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level-1 random error, $r_{ij}$</td>
<td>.513</td>
<td></td>
<td></td>
<td>.490</td>
<td></td>
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</tr>
</tbody>
</table>

Note. Coeff. = unstandardized coefficients. SE = robust standard errors.
*p ≤ .05; **p ≤ .01; ***p ≤ .001.

With regard to the effect of classroom-contextual uncertainty, Table 3 reports that, all other things in the model being equal, a one-standard-deviation increase in classroom-contextual uncertainty is significantly linked to an expected increase in collaborative class observation by 0.093, which represents 14.8% of one standard deviation of this variable. Although classroom-contextual uncertainty does not appear to have a significant effect on collaborative lesson planning as shown in Table 2, the significant positive association found between classroom-contextual uncertainty and collaborative class observation provides some evidence to substantiate the relationship between teachers’ exposure to complexities and difficulties emerging from classroom contexts and their engagement in collaborative interaction with their colleague teachers. This result is in alignment with hypothesis 2 that expects teachers who confront a greater level of classroom-contextual uncertainty to participate to a greater degree in collaborative interaction with other teachers.
Concerning the effect of sociocultural heterogeneity at level 2, it has a significant positive effect on collaborative lesson planning, which is in accordance with hypothesis 3. As shown in Table 2, a one-unit increase in sociocultural heterogeneity is significantly related to an expected increase in collaborative lesson planning at level 1 by 0.045. Since the standard deviation of sociocultural heterogeneity is 2.32, it is possible to say that a one-standard-deviation increase in sociocultural heterogeneity is related to an increase in collaborative lesson planning by $0.045 \times 2.32 = 0.104$, which translates into 13.7% of one standard deviation of collaborative lesson planning. Such a significant effect of sociocultural heterogeneity, however, does not exist with respect to collaborative class observation as shown in Table 3. That is, it appears that teachers in countries characterized by a high level of sociocultural heterogeneity tend to engage to a greater degree in collaborative lesson planning although not necessarily in collaborative class observation. This finding gives credence to the uncertainty...
management perspective in which collaborative teacher interaction is understood as a collective response to uncertainty; it seems that teachers in a socioculturally more heterogeneous society are more likely to confront various complex issues in teaching due to a lower level of value consensus at the societal level, which appears to necessitate a higher level of collaborative interaction among teachers.

V. Conclusion and Discussion

Much research has identified “the collaboration associated with a professional community of teachers as a key element of successful schools” (Darling-Hammond, 2010, p. 261). However, little systematic effort has been made to understand what types of teachers, under what contextual conditions, are likely to show a greater tendency to build and sustain collegial relationships with other teachers. In order to understand how to promote the beneficial effects of teacher collegiality, it is an important prerequisite to develop a comprehensive knowledge base that provides insight into how collaborative teacher interaction varies depending on various factors. As a systematic investigation in this direction, this study explored collaborative teacher interaction as a dependent variable contingent upon various factors at multiple levels. In particular, this study intended to elucidate and test an uncertainty management perspective as a theoretical framework.

The main findings from this study give credence to the central proposition of this perspective that teacher collegiality may arise as a collective effort to manage various uncertainties in teaching. More specifically, the results indicate that teachers who place greater emphasis on instructional strategies to engage students in intellectually challenging tasks and inquiry-based explorations, and thus confront greater instructional uncertainty, are more likely to engage in both collaborative lesson planning and collaborative class observation. Similarly, teachers who are faced with difficult challenges and complex classroom dynamics, and thus are exposed to a greater level of classroom-contextual uncertainty, appear to be more likely to participate in collaborative class observation. Further, teachers in countries with a higher level of sociocultural heterogeneity tend to engage to a greater degree in collaborative lesson planning. Considering that a higher level of sociocultural heterogeneity of a country
is likely to indicate a lower degree of societal-level value consensus with respect to various aspects of schooling as a social institution, it is not surprising from the uncertainty management perspective that teachers in socioculturally more heterogeneous countries tend to collaborate to a greater degree with their colleague teachers in order to collectively manage the consequent uncertainty in teaching. All these results shed light on the possibility that lateral collegial relationships among teachers may serve as a source of information processing, sensemaking, and problem solving, whereby they can better manage to go through given situations of uncertainty.

Considering the possibility that teacher collegiality may be in part a collective response to various sources of uncertainty in teaching, a potentially fruitful area of research would be to examine the ways in which educational administrators can help individual teachers become empowered agents to foster and sustain a collegial work environment in which they can “discuss problems they face, share ideas, help one another in preparing lessons, exchange tips, and provide other support to one another” (Sergiovanni & Starratt, 2002, p. 247). In fact, “uncertainty is an essential driving force in teaching” (Floden & Buchmann, 1993, p. 380) insofar as teachers’ recognition of uncertainties in their teaching helps them “stop and think and want to find out more. ... Being aware of the uncertainties [involved in] teaching ... can be an attitude towards the profession of teaching” (Munthe, 2007, p. 17). In this respect, providing teachers with the necessary administrative and professional support for them to collaboratively recognize and inquire into various uncertainties in teaching may be an important task for educational administrators and policy makers.

It should be noted that there are some limitations to this study. One methodological limitation of this study arises from the cross-sectional nature of the TIMSS dataset, which makes causal inference difficult because it is usually not possible to identify and measure all confounding variables and include each as a covariate in a quantitative model (Frank, 2000). Thus, the availability of reliable large-scale quantitative datasets that can possibly be used to carry out longitudinal studies of teacher collegiality needs to be scrutinized. In this respect, one possibility is to use the School and Staffing Survey compiled by the National Center for Education Statistics. This U.S. dataset, as a longitudinal one, contains some useful data on collaborative teacher interaction as well as extensive information about individual teachers and their schools and districts.
In addition, future studies need to examine how collaborative teacher interaction patterns differ qualitatively depending on various factors. Although this study uses measures of collaborative teacher interaction constructed based on quantitative data about how often teachers participate in certain types of interaction with other teachers, these measures do not capture various qualitative aspects of teacher interaction. Qualitative data on what kinds of information are actually exchanged during collaborative teacher interaction and what specific discursive strategies are used to exchange information, for example, would allow deeper analyses. Conceptual and methodological issues concerning which qualitative aspects of teacher interaction to observe and how to adequately measure those aspects need further systematic exploration. Further, since this study focuses only on eighth-grade mathematics teachers, it would also be a useful future study to explore how the relationships between various contextual factors and collaborative teacher interaction patterns are dependent upon subject areas and grade and school levels.
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교사간 협력관계 맥락 이해를 위한 불확실성 관리 관점

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요 약

교사간 협력적 상호작용이 교사의 교실 및 학교조직 맥락과 사회 및 경제 환경에 따라 어떤 식으로 차이를 보이는지 탐구하기 위해, 본 연구는 불확실성 관리 관점을 이론적틀로서 정교화하고, 그 이론적 타당성을 검토하고자 하였다. TIMSS 2007 데이터를 바탕으로 29개국에 걸친 5,928명의 8학년 수학교사의 교사간 협력적 상호작용에 대한 본 연구의 위계적 선형 모델 분석 결과에 따르면, 교사간 협력관계는 교사들이 교수 상황 속에서 발생하는 다양한 불확실성 요소들에 효율적으로 대응하기 위한 집단적 노력의 부산물로서 이해될 수 있다는 불확실성 관리 관점이 일정 부분 지지되는 것으로 나타났다. 이러한 결과는 교사간 수평적 동료관계가 불확실성 요소들에 대한 인지적 공유 및 집합적 의미부여를 촉진함으로써 교사들이 개인의 제한된 장벽을 극복하고 불확실성을 보다 효과적으로 관리할 수 있도록 돕는 기능을 하고 있을 가능성을 시사한다.

[주제어] 교사간 협력관계, 불확실성 관리, 조직으로서의 학교