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EFFECTS OF CLASSROOM SEATING ARRANGEMENTS ON CHILDREN'S QUESTION-ASKING

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ABSTRACT. This study investigated the relationship between classroom seating arrangements and the question-asking of fourth-graders. Data were collected during 53 lessons spread over 8 weeks. Children were assigned to sit in a semicircle and then in a row-and-column seating arrangement for 2 weeks each. This rotation was repeated. Both children's questions and the teacher's verbal reactions were recorded using an observational system based on Kearsley's question taxonomy. The results showed that children asked more questions in the semicircle than in the row-and-column arrangement, and that the pattern of question characteristics was stable over time. The findings also revealed that, within the row-and-column arrangement, there was an action-zone in which children asked more questions per lesson. The results are interpreted in terms of Steinzor's postulation that social interaction is encouraged when individuals are able to establish face-to-face contact.

KEY WORDS: classroom observation, physical environment, question-asking, seating arrangements

Although educational systems are now under intense scrutiny, educators and educational critics tend to ignore two facts. First, classrooms are physical entities as well as organisational units. Second, the physical characteristics of a classroom setting can influence the behaviour of its users. Awareness of these facts is needed, as efforts to create high quality educational experiences for our children must include consideration of the physical milieu (for reviews of the literature on the physical environment of schools, see Gump, 1987; Weinstein, 1985). Among the physical aspects in need of consideration is the positioning of students relative to the teacher in the classroom space. The present article examines an alternative to the arrangement of children's seats into rows and columns facing a teacher's area. Already in the 1930s, John Dewey and German educational reformers had remarked that there had been few studies of the use of alternative seating plans (Dewey, 1916; Gaudig, 1909). Even



today there are not many studies of classrooms as physically structured interaction settings, a state of affairs noted recently by Montello (1992) and Jones and Gerig (1994).

Helping to remedy this deficiency, the present study examined the influence of different classroom seating arrangements and seating locations on question-asking. Specifically, we studied the influence of different classroom seating arrangements on the frequency of question-asking and the characteristics of the questions asked by a sample of primary school children. We also investigated the children's question-asking behaviour as influenced by their location inside versus outside differently shaped 'action zones'.

1. SEATING ARRANGEMENTS AND STUDENT RESPONSE

Informative for the present purposes are studies which have described the relationship between interaction and seat locations or orientations of individuals in dyads and small discussion groups. Steinzor's (1950) landmark study established the principle that, among people sitting in a leaderless group arranged in a circle, a speaker is more likely to get a response from a person opposite or nearly opposite to him or her than from one seated adjacent. Later, Hare and Bales (1963) as well as Sommer (1967a) gave support for Steinzor's hypothesis that both centrality of seating position and distance between group members can be used to predict interaction patterns. Argyle (1975) argued that it is possible to manipulate the degree of interaction by operating on the angle between chairs. This appears to hold for other public facilities (cf. Proshansky et al., 1976). Sommer (1989) discusses his success in varying the 'distance for comfortable conversation' to increase significantly conversations and acquaintanceships among participants in various kinds of settings.

There are also some studies of seating arrangement and interaction in large classroom groups. Such groups can be distinguished from mere audiences by the greater likelihood of sustained and reciprocal verbal interaction between the group members and a teacher. Two physical variables converge when one assesses the quality of a particular seat within a seating arrangement: the distance of the seat from significant targets of perception or interaction (e.g. the teacher); and the orientation of the seat with regard to these targets (Gump, 1987). In ordinary-sized classrooms, however, it is assumed that the distance variable probably cannot operate as coercively (Koneya, 1976). However, orientation can

become important (Gump, 1987). In accord with the Steinzor (1950) hypothesis, students seated around tables distributed through a classroom can establish face-to-face contact more easily than those seated in rows-and-columns (Gump, 1987). Students around tables are not always oriented toward a teacher and toward the eye-contact control that teachers employ.

Several studies support the proposition that teacher-pupil interaction is strongly related to student position in the row-and-column pattern (Koneya, 1976; MacPherson, 1984; Montello, 1988; Sommer, 1967b; Stires, 1980). Moreover, when students are permitted to select their own classroom positions, the evidence is substantial that position is highly related to motivation, personality variables, and participation (Weinstein, 1985).

The variable receiving the most attention in this context has been that of class communication. Sommer (1967b) reported that an average of 61% of students from the front and centre location made voluntary statements, in contrast to only 31% from the back and the sides. Further investigations have confirmed the assumption that students seated in the frontal or central position communicate more (Levine et al., 1980; Montello, 1988), show different nonverbal behaviours (Breed & Colaiuta, 1974), and more interest, enjoyment and motivation (Millard & Stimpson, 1980) compared to those seated in the back or at the sides.

One outcome of inquiry into the relation between seating location and student-teacher interaction is the 'action-zone hypothesis'. Adams and Biddle (1970) observed 32 classes and reported that most of the verbal interaction came from students seated in the front row and centre seats. They called this T-shaped area of disproportionate interactions the action zone. Koneya (1976) reported a triangle of participation for university students that extended across the front row and ended at the middle seat of the middle row. Students categorised as high change verbalisers tended to communicate more when seated centrally than when seated noncentrally. Low change verbalisers communicated less no matter where they were seated in the classroom. For at least some grade school pupils (Axelroad et al., 1979; Wheldall et al., 1981) and university students (cf. Montello, 1988), the location in the classroom influences their patterns of communication, and these studies suggest that location is a likely determinant of an individual's interaction rate. Moreover, empirical findings have shown that students who choose frontal or central seats are more creative, assertive, aggressive and competitive (Totusek & Staton-Spicer, 1982), have greater success in doing things (Becker et al., 1973; Walberg, 1969), have higher self-

esteem (e.g. Hillmann et al., 1991; Pedersen, 1994; Srivastava et al., 1992) and are more attentive (Hillmann et al., 1991) and externally oriented (Pedersen, 1994) than students who choose side or back seats. Generally, these behavioural differences are in support of the self-selection hypothesis (Gump, 1987).

If the position effect, however, can be attributed to variables of the individuals occupying the positions, the importance of the position variable is not thereby eliminated. When seats are assigned, the operation of variables associated with personality differences cannot account for behavioural differences associated with the seat position. Applying this reasoning, not all researchers have succeeded in finding action zones in classrooms (Delefos & Jackson, 1972; Jones, 1990; Saur et al., 1984). Therefore, it is still an open question whether there are 'action zones' within ordinary-sized classrooms, with seating arranged in either rows-and-columns or in semicircles.

If one wishes to use seating variables to understand or change classroom interaction, question-asking behaviours are practically significant outcomes. Pupils' question-asking indicates the degree to which communication conditions among classroom participants are favourable (Fuhrer, 1994; Van der Meij, 1986).

The topic of question-asking has received attention in both cognitive and educational psychology in the last two decades (Carlsen, 1997; Fishbein et al., 1990; King, 1995; Van der Meij & Dillon, 1994). Along these lines of research, psychologists have stressed the importance of question-asking as part of children's problem-solving skills (Dillon, 1991; Fuhrer, 1987; King, 1990, 1995). In a similar way, questions are considered as stimuli that elicit cognitive and expressive responses, social relationships, and interactional discourse (cf. Carlsen, 1997). We know that questions serve many important educational functions, enabling individuals to seek information, obtain clarification, and receive information, among other uses (Good et al., 1987).

In sum, following Steinzor's (1950) work, it was hypothesised that pupils will ask more questions in assigned semicircular seating arrangements than in assigned row-and-column seating arrangements even in ordinary-sized classrooms. Whether or not this effect also holds for the pattern of question characteristics is an open question. Finally, it is also uncertain whether one can identify an action zone either in the row-and-column seating arrangement or in the semicircular seating arrangement in ordinary-sized classrooms.

2. METHOD

2.1. *Subjects*

The subjects in the study were 27 German children ($M = 10$ years, $SD = 0.63$; 15 girls; white) enrolled in a fourth-grade class. The class was taught by an experienced and competent female teacher. Parents gave written permission for their children's participation. Both children and teacher were unfamiliar with the main goal of the study.

2.2. *The Classroom*

The room in which the class met was built in a rectangular form (20×8 meters). The classroom was furnished with 15 tables and 30 chairs. The entrance door was at the front of the classroom to the teacher's left and windows lined the side of the room to the teacher's right.

2.3. *Design and Procedure*

Besides the row-and-column seating arrangement usually found in the given classroom, an alternative seating plan was arranged consisting of two semicircles (see Figure 1). To test whether or not seating location influences children's question-asking, T-shaped and triangular shaped action-zones were specified for both seating arrangements.

Before the study began, the children were assigned seats at tables, with 2 seats per table and with the tables arranged in rows-and-columns. Beginning in the fourth week of the school year, children sat in the semicircle seating arrangement for 2 weeks. In a following 2-week period, the arrangement was changed to row-and-column. These arrangements were then rotated through a two-week semicircle and two-week row-and-column periods a second time. An advantage of the within-subjects design is the control for relevant individual differences such as intelligence, motivation, and personality. Children were randomly assigned to seats with each of the four changes in seating arrangement, with the restriction that each child be positioned only once within the action zone for the given arrangement.

Over the 8 weeks of the study, observations were made in 27 lessons in the row-and-column arrangement and 26 lessons in the semicircle seating arrangement. Lessons were distributed approximately equally across the different seating arrangements and rotations (13 in both

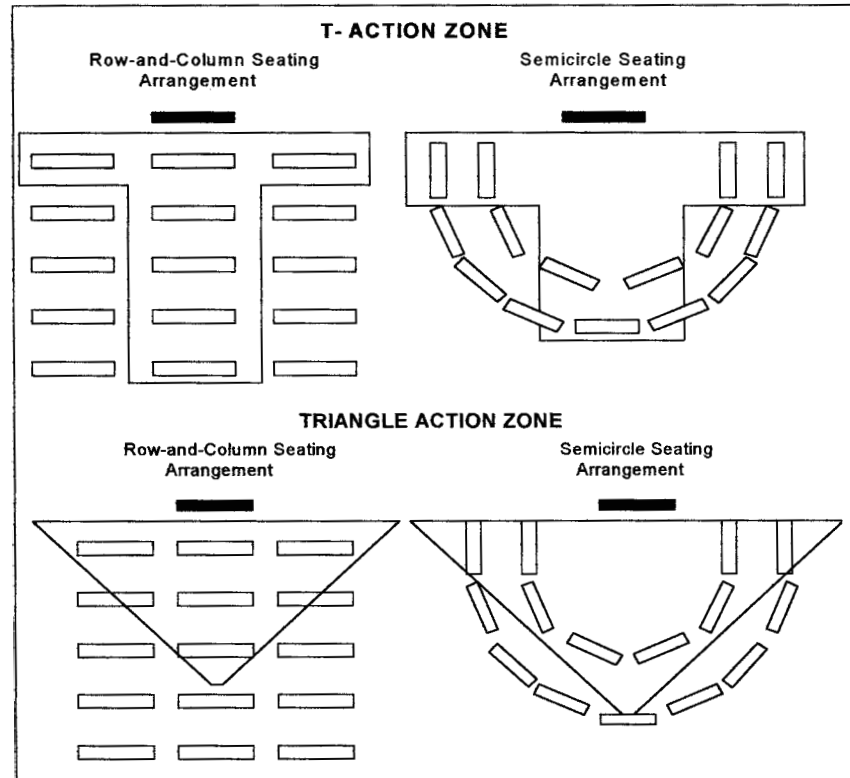


Figure 1. Action zones.

rotations of the semicircle arrangement, 15 in the first rotation of the row-and-column arrangement, and 12 in the second rotation of the row-and-column arrangement). With a few exceptions, the lessons were held in the morning hours prior to lunch (7:30–10:30 am). On all days, observations were made in both a German lesson and a mathematics lesson, each lesson lasting 45 minutes. During the lessons, the teacher remained in front of the class, either seated at her desk or standing. There were no differences in both lessons' difficulty or novelty and instructional strategies used by the teacher when comparing the two-week rotations.

During lessons, pupils' question-asking behaviour was registered by two observers, who recorded every question asked by a child. The characteristics of questions and the teacher's responses were monitored using an instrument based on Kearsley's (1976) question taxonomy and included question trigger, question function, question form, and the teacher's reaction to the question. Additional details and examples for

each of the taxonomic categories are given in Table I. Note that the instrument limited the types of verbal interactions recorded. That is, only verbal interactions that occurred between teacher and pupil were recorded. Inter-observer agreement (Hays, 1994) was calculated separately for the question-trigger, function, form and teacher's reaction categories (see Table I).

3. RESULTS

3.1. *Question-Asking Rate*

During the 8-week observation period, a total of 158 questions were asked, with an average of 3 questions per lesson for the class as a whole ($SD = 2.9$). The number of questions asked by each student during the 8-week observation period ranged between 0 and 16. Two students asked no questions, 12 students asked 1–5 questions, 8 students asked 6–9 questions, and 5 students asked 13 or more questions. The

TABLE I

Modified question taxonomy of Kearsley (1976)			
Taxonomic category	Verbal interaction	Example	Inter-observer agreement ^a
Trigger	Children asking	"What is that?"	0.96
	Teacher's request	"Please answer the following question."	
	Task completion	Children completing tasks on their own	
	Environment	"May I open that window?"	
Function	Echoic	"What?"	0.72
	Epistemic – topic related	"Why did that happen?"	
	Epistemic – organisational	"How many are there?"	
	Expressive	"Are you studying?"	
	Social control	"May I do this?"	
Form	Direct – open	"Why did you do that?"	0.96
	Direct – closed	"Is that a verb?"	
	Indirect	"I wonder . . ."	
Teacher's Reaction	Answer question	Teacher answered the question.	0.87
	Tip	Teacher gave a tip to the students.	
	Transfer question	Teacher transferred the question to another child.	
	Transfer answer	Teacher transferred the answer to another child.	
	Ignore question	Teacher ignored the question.	
	Delay answer	Teacher delayed answer.	

^aKappa coefficient

variations in the number of lessons observed in each seating arrangement and class (German, mathematics), and the fact that some students missed one or more lessons during which observations were made (e.g. due to sickness), precluded analysis of the raw numbers of questions that each child asked under the different conditions. The dependent variable analysed was the mean number of questions asked per lesson, obtained by averaging across the lessons that were actually attended by the given child in the given seating arrangement, class, and rotation. The analysis, then, was a repeated-measures ANOVA with three within-subjects factors (seating arrangement, class, and rotation), each with two levels. Gender was included in the analysis as a between-subjects factor.

Seating arrangement had a main effect on question-asking rate that was both statistically significant, $F(1, 25) = 5.28, p < 0.05$, and substantial, $R^2 = 17.4\%$. It also interacted with class, such that the semicircle arrangement promoted more question asking in the German class, $F(1, 25) = 5.01, p < 0.05$. There tended to be fewer questions in mathematics lessons ($p = 0.08$), and the amount of question asking declined over the course of the study, as indicated by the main effect of rotation, $F(1, 25) = 10.77, p = 0.00$. The between-subjects main effect of gender only tended toward statistical significance ($p = 0.09$), with girls asking more questions than boys on average. Gender did not interact with seating arrangement, alone or in combination with class or rotation. The mean number of questions asked per student per lesson is given for each seating arrangement in each rotation and class in Figure 2, collapsed across gender.

As a check on the findings, we followed up the ANOVA with nonparametric tests using ranked data. Each main and interaction effect was tested. The results largely conformed with those of the ANOVA, and all of the effects reported above were corroborated. We present the results of the initial analysis because the original units are more intuitively meaningful.

3.2. *Question Characteristics*

The analysis of the question taxonomy showed a common pattern in the question-asking of these fourth-graders (see Figure 3). The trigger for question-asking was usually independent task completion (80%). The purpose was to gain information about either topic-related (48%) or organisational (40%) issues. The questions were mainly presented in a direct closed format (86%). Most questions (85%) were answered by the teacher directly. Furthermore, this pattern of question char-

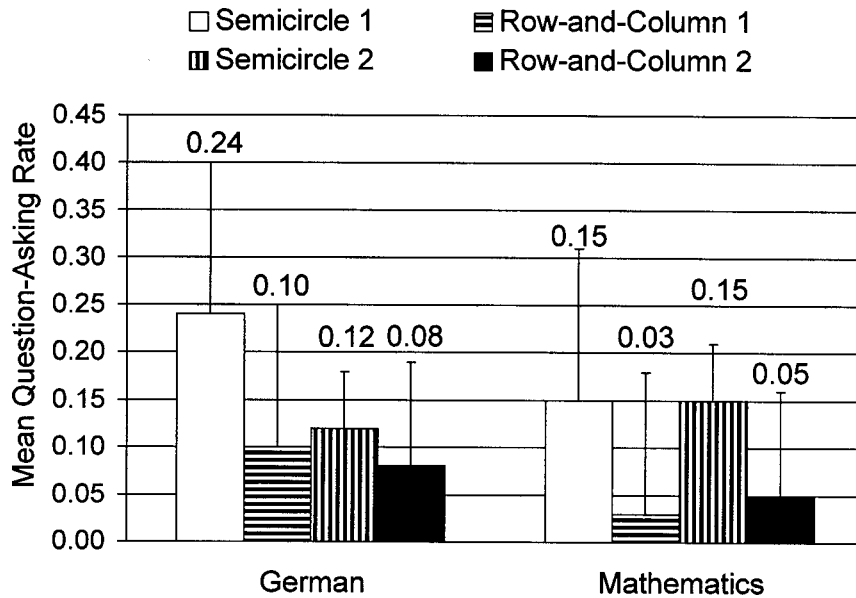
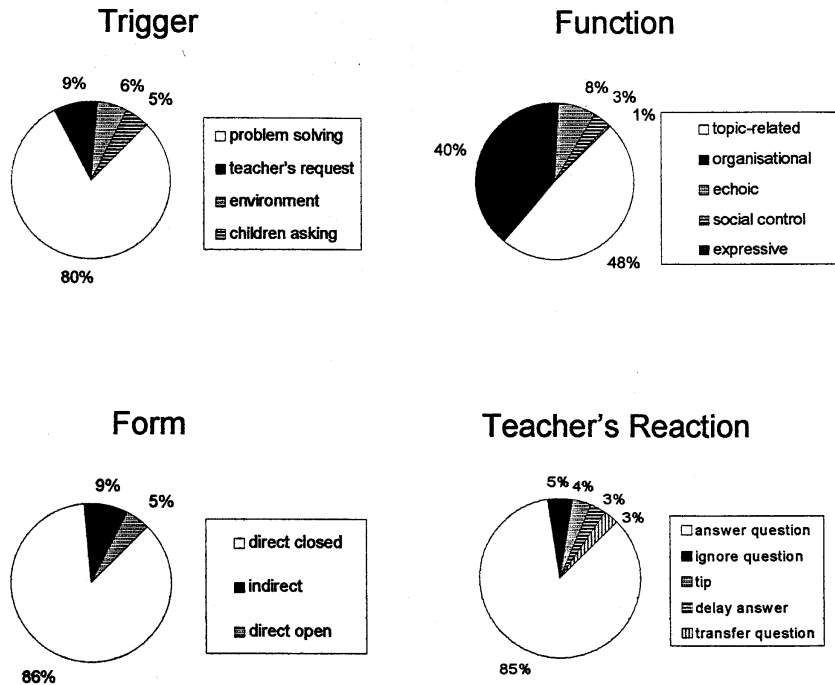


Figure 2. Mean number of questions per student per lesson in each seating arrangement. (Error bars show standard deviations.)

acteristics appeared stable over seating arrangements. There were no significant changes for the parameters investigated while sitting in different seating arrangements (question trigger: $\chi^2(12, N = 158) = 4.2, p = \text{ns}$; question function: $\chi^2(9, N = 158) = 15.0, p = \text{ns}$; question form: $\chi^2(6, N = 158) = 3.5, p = \text{ns}$; teacher's reaction: $\chi^2(12, N = 158) = 5.3, p = \text{ns}$).

3.3. Action Zones

Figure 4 shows the mean rates and the standard deviation of questions asked by the children when sitting within versus outside action zones of different shapes. Paired-samples t-tests were used to compare the question-asking rates within versus outside the action zones. In the row-and-column seating arrangement, questions were more frequent when the child was sitting within a T-shaped action zone, $t(26) = 2.3, p < 0.05$, or a triangle-shaped action zone, $t(26) = 2.1, p < 0.05$, than when seated outside these action zones. In the semicircle seating arrangement, however, neither a T-shaped action zone, $t(26) = 0.12, p = \text{ns}$, nor a triangle-shaped action zone effect was observed, $t(26) = -0.10, p = \text{ns}$.



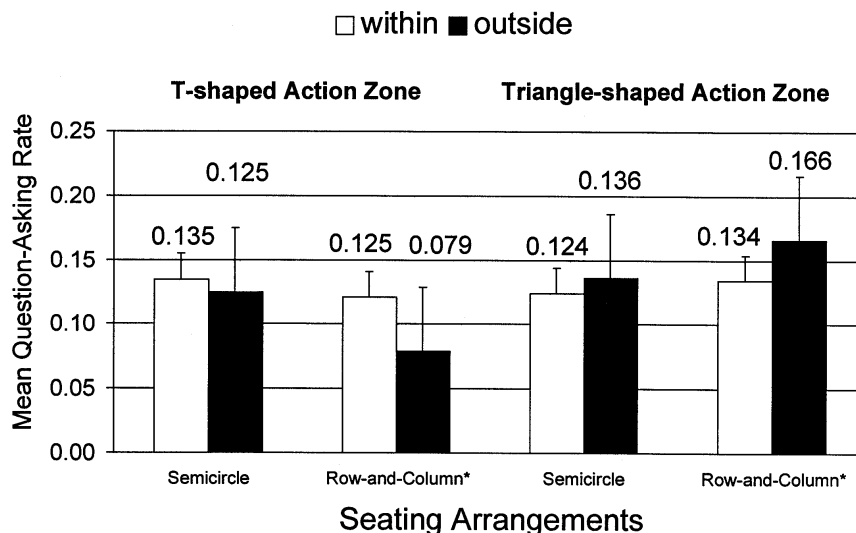
Note. The categories and their subordinate characteristics are from Kearsley's (1976) Question Taxonomy.

Figure 3. Pattern of question characteristics.

4. DISCUSSION

Over the past decades, the generally low active participation rate of children in school lessons has been discussed in numerous ways (Carlsen, 1997; Fuhrer, 1994; Jones, 1990; Van der Meij, 1986), but none of these studies have analysed the impact of a physical environmental feature. Thus, the present study tested the hypothesis that a semicircular seating arrangement in ordinary-sized classrooms will stimulate children's question-asking to a greater degree than a row-and-column seating arrangement.

In spite of its assumed importance, the average primary school pupil tends to ask his or her teacher less than one question per 50-minute period (Good et al., 1987). As with this study, others have found an average of 4 or fewer questions per hour per class (Dillon, 1988; Pearson & West, 1991; West & Pearson, 1994). This finding is similar



Note. * $p < .05$

Figure 4. Mean number of questions per student per lesson within and outside different action zones. (Error bars show standard deviations.)

to other studies which have described a non-verbal-communication rate of nearly one-third of all students in the classroom (Jones, 1990).

Our results showed that question-asking was more frequent when the children were seated in the semicircular arrangement than in the row-and-column arrangement. These findings are in accord with Steinzor's (1950) hypothesis. In contrast to the row-and-column seating arrangement, the distance of the seats from significant targets of perception or interaction (i.e. the teacher) and the orientation of the pupil's seats with regard to both the target and others (i.e. face-to-face) are generally closer in the semicircular arrangement of seats. Thus, in contrast to Gump's (1987) assumption, the 'Steinzor mechanisms' could operate even in ordinary-sized classrooms with a semicircle seating arrangement. This suggests that the possibility for unobstructed eye contact might be a crucial variable affecting question-asking in the semicircle seating arrangement (Sommer, 1967b). In addition, it could also be that pupils have stronger feelings of being in the presence of the teacher (King, 1994; Millard & Stimpson, 1980) and feel obliged out of courtesy to pay attention and show interest (Becker et al., 1973) while sitting in the semicircle seating arrangement. Several of these factors could interact closely and produce more communication.

The present investigation studied the influence of seating arrangement not only on the quantity but also on the characteristics of children's questions. Applying Kearsley's question taxonomy (1976), the fourth-graders asked questions about either organisational or topic-related issues in a direct closed format, mainly during independent task completion, and they usually got a direct short answer from the teacher. These results were reproducible for the seating arrangements studied. Therefore, these findings highlight a traditional question-answer pattern between a child and a teacher which was already described extensively by Dillon (1991). Children's questions might be discouraged by the definition of the social situation, the allocation of relative status, the roles of participants, and the control function that teacher's questions serve in the classroom discourse. Children are left to ask mainly clarifying questions about factual and procedural matters presented to them. Previous investigations have shown that question-asking is influenced by question-asking comfort which depends on multiple demographic, social, and personal factors on question-asking (Daly et al., 1994) and the perceived teacher support (Karabenick & Sharma, 1994). In this context, the complexity of questioning was highlighted (Roth, 1996).

Another ongoing discussion refers to classroom participation in different zones of the row-and-column seating arrangement in the classroom (Montello, 1988, 1992). The results of the present study indicated a statistically significant relationship between seating location and question-asking behaviour when children sat in the row-and-column formation. In both T- and triangle-shaped action zones, children from central positions asked more questions than children from non-central positions. Thus, our findings support the action zone-theory as it was described earlier by other authors (Adams & Biddle, 1970; Koneya, 1976; Levine et al., 1980). It seems that assigned seat locations influence question-asking rate. As the children were randomly assigned to seats with each change in seating arrangement, the effect of seat location can be seen as independent of pupil characteristics. The mechanisms responsible for these findings are either children's proximity to the teacher, which leads to a higher likelihood of being engaged in the class, or the 'face-to-face' orientation with the teacher, which implies more social control. Further research is needed to clarify whether the proximity or the face-to-face explanation is more potent. In contrast, no action zone associated with rows could be observed in the semicircle seating arrangement and therefore the mechanism described above seems to be equally operative for each pupil. Thus, a

semicircle seating arrangement could lead to equal opportunities for everyone in the class. However, the influence of other factors, such as the teacher's personality and teaching style, cannot be ruled out and need to be included in further investigations.

In summary, the study revealed a positive effect of a semicircle seating arrangement on children's question-asking, and demonstrated an action-zone effect on question asking in the traditional row-and-column arrangement. Seating in other than the row-and-column arrangement deserves further consideration as a means to promote children's question-asking in primary schools.

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