The Think Aloud Procedure: A Research Technique for Gaining Insight into the Student Perspective

G. Linda Rikard and David J. Langley

The purpose of this paper is to describe the use of the think aloud procedure as a research technique for examining student perspectives during class performance. First, a general description of this procedure is presented. Second, the use of this procedure to understand student cognition is reviewed through selected studies in education and physical education. Third, an example of how the think aloud procedure has been used for research in a school setting is provided. Finally, we indicate how physical education teachers can acquire insight into student perspectives using the think aloud technique.

General Description

The think aloud procedure is one technique used by researchers to elicit verbal reports from participants during task performance. The procedure is commonly used in educational research to examine both teacher and student thought processes (Clark & Peterson, 1986; Shavelson, Webb, & Burstein, 1986; Wittrock, 1986). In physical education, researchers have used this procedure to examine teacher planning (Housner & Griffey, 1985) and as a method of gaining access to student meanings and interpretations constructed during motor skill learning (Langley, 1992; Shea & Zimny, 1983). Shavelson et al. (1986) cite the following strengths of the think aloud technique: (a) verbal reports are obtained concurrent with task performance; (b) under voluntary elicitations, the structure of cognitive processes is relatively undistorted compared to the researcher's use of probes; and (c) think aloud reports are likely to be closely linked to ongoing student cognitive processes. Based on these strengths, the think aloud procedure is believed to provide a valid representation of student cognitive processes (Ericsson & Simon, 1980; Shavelson et al., 1986).

There are limitations to this procedure when used with students in a physical education setting. First, all student thought processes used in task performances are unlikely to be reported. The choice of which thoughts to verbalize is left to the individual student. Second, students may lack the content knowledge necessary to describe ongoing task behavior particularly if the task is novel. In addition, complex motor tasks may be guided primarily by tacit knowledge (Polanyi, 1958), and the student may be unable to fully verbalize thoughts associated with these tasks. Finally, from a practical standpoint, students may be initially hesitant to engage in self-talk in a social setting. Most students are unaccustomed to verbalizing their self-talk in the presence of others, and some students may be hesitant to provide verbal reports that may be overheard by fellow students. However, students are likely to share thoughts with other students in an interactive social context.

Insight Into Student Learning

Educational researchers have employed the think aloud procedure to examine student problem-solving processes in a variety of subject areas. For example, Muth (1993) recently used the think aloud procedure as a diagnostic tool to understand how middle school children develop conceptual knowledge of mathematics. Performed in the presence of the teacher question-

G. Linda Rikard and David J. Langley are faculty members in the Department of Exercise and Sport Science at East Carolina University.

ing and probes, this procedure indicated the range and sequence of strategies used by students to solve geometry problems. Muth concluded that the procedure allowed teachers to examine student misconceptions of the tasks to be performed and thereby redesign the instructional environment to better meet student needs.

In physical education, traditional motor learning research has benefited from using the think aloud procedure as an experimental tool to link motor behavior and cognitive processing (Shea, Hunt, & Zimny 1985; Shea & Zimney 1983). In these studies, the subject was isolated during task performance and requested or prompted to reveal ongoing problem- solving processes prior to or following task engagement. The data indicated that the subjects who formed a cognitive model of the movement produced more accurate performance than subjects who did not form such a model. In addition, the think aloud reports revealed how subjects used previous knowledge from other domains to aid their performance on the task. Shea and Zimny (1988) concluded that the think aloud method provided "a rich source of information as to subject's processing activities" (p. 304).

In physical education pedagogy, Langley (1992) used the think aloud procedure to examine student perspectives during a 10 week university bowling course. A sample of students were requested to think aloud for 20 minute periods while engaged in bowling. Transcriptions of the reports revealed that student perspectives were primarily task-driven and often focused on performance errors prior to and following task performance. Negative evaluations of performance also predominated the verbal reports of bowlers.

From the standpoint of physical education pedagogy, another useful application of the think aloud procedure may be in understanding the social and communicative context that supports or constrains student learning. In most schools, skill learning occurs in a social setting occupied by other students and the teacher, although the teacher's one-to-one presence may be limited. Social interactions provide an important context that underlies how learning is to be carried out during a class session (Bloome & Theodorou, 1988). In this sense, recording devices associated with the think aloud procedure may be used to capture social interactions occurring in the learning environment in addition to student self-talk related to task performance.

Under these assumptions, we used the think aloud procedure with videotape in a recent study to examine how teacher feedback about paddle striking is interpreted and used by elementary age students. The 12 students involved in the study wore microcassette recorders and were requested to think aloud prior to and immediately following execution of a striking task and at any other time during the lesson. Teacher feedback focused on eight refinement cues associated with the mechanics of striking. Videotape was used to examine student motor actions as well as provide an audiotape of teacher instructions. The data revealed that student-student interactions and student self-talk rarely focused on teacher feedback information, even though teacher interactions with individual students were strongly feedback oriented. Instead, student-student interactions and self-talk focused on motor outcomes or superficial aspects of practice such as ball collecting. Thus, the social context in the learning environment did not play a supportive role to enhance student learning of proper form associated with striking.

These studies indicate how the think aloud procedure has been used in both education and physical education research to discover the nature of student perspectives during task performance. The growing interest in student perspectives in the physical education literature (Griffey, 1991; Lee, 1991; Lee & Solmon, 1992) suggests a need to fully describe how this technique may be used for research in a school setting.

Use of the Think Aloud Procedure for Research

The following is a description of how the think aloud procedure was successfully used with fourth and fifth grade students in a recent study. Prior to data collection, the researchers

introduced the procedure to students and assisted in developing a supportive environment conducive to their thinking aloud. Providing a research orientation is important for collecting, analyzing, and summarizing the data while preserving student anonymity. Anonymity of student data is essential for increasing each participant's willingness to provide honest and spontaneous responses.

Given these conditions, four factors were important in planning to use the think aloud procedure with these students: (a) the choice and use of recording equipment; (b) the selection of a striking unit; (c) the selection of participants; and (d) steps for introducing the technique to children.

Recording equipment. Each participant was provided with a mini-cassette recorder and a lapel microphone during each striking lesson. Recorders were attached to each student's waist by a belt or a child-size fanny pack. In addition, a videotape of students and the teacher during each lesson provided a continuous account of class events. The audio portion of the videotape also provided a complete verbal record of the teachers instructions.

Selection of a striking unit. The researchers discussed activities for the teaching unit that met student curricular needs and that was conducive to the use of recording devices in a multipurpose room. In order to obtain quality recordings of student talk and to provide students with a productive learning experience, the teacher and researchers decided on a series of paddle striking lessons using plastic paddles and plastic whiffle balls. Individual and partner practice consisted of hitting balls against walls and across low nets.

Student selection. The availability of mini-cassette recorders and indoor space influenced the number of students participating in this study at one time. First, students from both classes were pretested on forehand wall striking to determine lower and higher skilled students. On the recommendation of the teacher, the pool of high and low skilled students was reduced by identifying and eliminating the frequently absent students and those who posed behavior problems.

Introducing the think aloud procedure to children. The following steps were useful in providing a relaxed class atmosphere to increase each student's comfort for recording their thoughts. (a) The researchers entered the classroom in advance of the data collection to introduce themselves and to interact with the students both individually and as a group. (b) Students were assured that their participation in the think aloud procedure and their recordings were not a graded experience and had no impact on their class evaluation. (c) The general purpose of the study was explained to the students along with reasons for their participation, and the importance of their cooperation. (d) Students practiced using the recorders and listening to their voices during two class lessons prior to data collection. (e) Students were asked periodically about their comfort levels in using the equipment and in thinking aloud. If equipment was interfering with striking actions, adjustments were made. "Comfort checks" with each student occurred just before and immediately after each recorded lesson.

Teacher Use of the Think Aloud Procedure

In the previous section, we described how thinking aloud can be used in a research setting. This section provides recommendations for adapting the procedure for direct teacher use, using Muth's (1993) study as a guide.

The practical applications of the think aloud procedure in a physical education setting center on diagnosing student problem-solving strategies and reinforcing those strategies or prescribing alternatives. In this sense, the use of recording devices is unnecessary if the technique is applied to individual students with the teacher present.

Following Muth's (1993) study, the role of the teacher is to encourage a student to think aloud prior to and immediately following task performance. As the student practices, the teacher observes the movement pattern and listens to the student's self-talk. Then the teacher poses a

line of questions aimed at redirecting or reinforcing the focus of the student's thinking. Listening to student self-talk becomes an opportunity for the teacher to understand the problem-solving strategies used by the student. In addition, an indication of student mood or attitude provides a basis for understanding how the student gauges task success relative to the teacher's view of success.

Two examples from our research on paddle striking are useful to examine how knowledge of student thought processes during practice can assist the teaching/learning process. Jeff, a high skilled fourth grader, had been focusing in his self-talk on completing a task of hitting a variety of wall targets in sequence. When Mrs. Rogers arrived, she attempted to change his focus to his mechanics of striking:

Rogers: OK. That looks good. Do you know what you just did?

Jeff: Scooped too low.

Rogers: Exactly, Exactly. Know how we can fix that?

Jeff: Come in?

Rogers: (Swing) to the side. Remember to swing to the side. (Student practices) That was much better . . . Sideways. Work on sideways.

Jeff: Because I was scooping again?

Rogers: Exactly

In this example, Mrs. Rogers' knowledge of Jeff's focus of thinking was instrumental in developing a problem solving approach to improve his striking mechanics.

A second example describes how an understanding of a student's evaluation of her skill, overheard through self-talk and discussed later in direct interaction, enabled the teacher to redirect the focus of student thinking. Amelia, a low skilled fifth grader, had been attempting to hit forehand strokes to a wall target without success. She mentioned in her self talk that she "couldn't hit it straight on." Mrs. Rogers overheard her remark and asked how she was doing. "Terrible", Amelia replied. When Mrs. Rogers probed her for more details, it became clear that Amelia hinged her success on hitting the target. Mrs. Rogers quickly redirected Amelia's attention by saying, "You know how close you were? . . .Two days ago you hardly got (the ball) to the wall . . . I think you're doing fabulous." After attempting to change Amelia's perception of task success, Mrs. Rogers was able to provide corrective feedback about Amelia's technique and shift her focus to mechanics of hitting rather than solely on task outcome.

Another source for teacher insight into student perspectives comes directly from research results that have applied the think aloud procedure. For example, our recent research demonstrated that student thoughts during practice were less concerned with teacher corrective feedback and more concerned with skill outcome when the teacher was not engaged in a one-to-one interaction with the student. This type of research can help teachers better understand the type of student cognition that occurs in teacher absence when self-talk and student-to-student interactions are predominant forms of discourse. If findings such as these occur in typical physical education classrooms, teachers may choose instructional strategies such as peer tutoring that attempt to maintain student focus on content during teacher absence.

Conclusions

In this paper, we have discussed the potential of the think aloud procedure as a research technique for entering into student thought processes. A review of research that uses this procedure may give specific results that are helpful to the teacher. Finally, we encouraged the informal use of this technique by teachers interested in discovering the problem-solving strategies used by students. These uses of the think aloud procedure can provide insightful information about student learning patterns, attitudes, interests, and self perceptions of their motor skill abilities.

The think aloud procedure can aid in describing the subjective experiences of learners as they interpret instruction. Understanding how instruction is experienced by the learner is a necessary step toward developing a holistic view of the teaching/learning process (Erickson &

Shultz, 1992). We believe that the think aloud procedure is an essential tool for gaining access to these experiences.

References

Bloome. D., & Theodorou, E. (1988). Analyzing teacher-student and student-student discourse. In J. Green & J. Harper (Eds.), *Multiple perspective analysis of classroom discourse* (pp. 217-248). Norwood, New Jersey: Ablex Publishing Co.

Clark, C. & Peterson, P. 1986. Teachers' thought processes. In M. Wittrock (Ed.), *Handbook of research on teaching* (3rd. ed., pp. 255-296). New York: Macmillan.

Ericsson, K. A., & Simon, H. A. (1980). Verbal reports as data. *Psychological Review, 87,* 215-251.

Erickson, F., & Shultz, J. (1992). Students' experience of the curriculum. In P. Jackson (Ed.), *Handbook of research on curriculum* (pp. 465-485). New York: Macmillan.

Griffey, D. (1991). The value and future agenda of research on teaching physical education. *Research Quarterly for Exercise and Sport, 62,* 380-383.

Housner, L., & Griffey, D. (1985). Teacher cognition: Differences in planning and interactive decision making between experienced and inexperienced teachers. *Research Quarterly for Exercise and Sport, 56,* 45-53.

Langley, D. (1992). *Student cognition during motor skill learning.* Unpublished doctoral dissertation, University of Oregon, Eugene, OR.

Lee, A. (1991). Research on teaching in physical education: Questions and comments. *Research Quarterly for Exercise and Sport, 62,* 374-379.

Lee, A., & Solmon, M. (1992). Cognitive conceptions of teaching and learning motor skills. *Quest, 44,* 57-71.

Muth, K. D. (1993). The thinking-out-loud-procedure: A diagnostic tool for middle school mathematics teachers. *Middle School Journal, 24*(4), 5-9.

Polanyi, M. (1958). *Personal knowledge: Towards a post-critical philosophy.* London: Routledge and Kegan Paul.

Shavelson, R., Webb, N., & Burstein, L. (1986). Measurement of teaching. In M. Wittrock (Ed.), *Handbook of research on teaching* (3rd. ed., pp. 50-91). New York: Macmillan.

Shea, J., Hunt, J., & Zimny, S. (1985). Representational structures and strategic processes for movement production. In D. Goodman, R. Wilberg, & I. Franks (Eds.), *Differing perspectives in motor learning, memory, and control* (pp. 55-87). Amsterdam: North-Holland.

Shea, J., & Zimny, S. T. (1983). Context effects in memory and learning movement information. In R. A. Magill (Ed.), *Memory and control of action* (pp. 345-366). Amsterdam: North-Holland.

Shea, J., & Zimny, S. T. (1988). Knowledge incorporation in motor representation. In O. G. Meijer & K. Roth (eds.), *Complex motor behavior: The motor action controversy* (pp. 289-314). Amsterdam: Elsevier Science Publishers.

Wittrock, M. C. (1986). Students' thought processes. In M. C. Wittrock (Ed.), *Handbook of research on teaching* (3rd. ed., pp. 297-314). New York: Macmillan.