III. RESEARCH METHODS

Science is not just knowledge-based. It's the wisdom that goes along with that knowledge. It's not like I can say 'Eureka!' It's more like. 'Aaaah...'
There's a sense that I'm on the right path. This is what I was meant to do.

Leslie Cowperthwaite, naturalist (Drexler, 1991)

Overview

The preceding chapters contain the theoretical foundations which contributed to the conception of the problem and the formulation of the research questions for this study. In this chapter, more practical issues are covered, giving a complete picture of the context of the study. The case is described, data collection procedures are explained, as well as the research design, methods for data analysis, and the limitations of the study.

When planning any research, an important factor to consider is the characterization of the instruments for data gathering and analysis, because it provides relevant information to the reader to judge the validity and reliability of the procedures. In a qualitative study, the researcher is the primary instrument for data collection and analysis (Merriam, 1991). This fact requires the reader of the research report to be aware that the biases, opinions, and philosophical and theoretical assumptions of the researcher are part of the context of the study. The researcher's set of personal frameworks influences decision making in all the phases of the design, and helps to explain why the research moves in the direction it does. Such uniqueness that results from the interaction between the researcher and the events experienced during the study reflects a constructive process in the tradition of the qualitative case study methodology.

From the perspective of the researcher, during the development of the research, one guard against the influence of one's own biases by becoming aware of them and by making them explicit. Therefore, the next section describes my personal framework - my set of beliefs and conceptualizations about the study's critical issues, including innovation, teachers, students, interactive videodisc - that I identified before engaging in the research. Other descriptions in this chapter are permeated by my points of view.
Context of the Study

This section is a description of the ideas that, in addition to what is explained in the previous two chapters, constitute a detailed picture of the set of beliefs, conceptions, and theoretical principles which nurtured my conception of the study. The concept map in Figure 5 shows my representation of the theoretical framework within which the research questions originated. The accuracy of concept mapping as a technique for externalizing personal concepts and propositions is still conjectural (Novak & Gowin, 1984), but teachers and educators who have been using this method for depicting both the elements of information and their hierarchical relations as part of the individual's conceptual network consider it a valid instrument (Glynn, Yeany, & Britton, 1991). At present, this technique is a common practice among teachers from different areas to depict either their students' preconceptions about a topic to be taught for the first time, or their students' conceptual framework about a certain subject. The concept map in the figure has the advantage of both visualizing and relating the four elements central to this research - innovation, teachers, IVD, and students.

Figure 5. Concept map of the theoretical context of the study
For this study, innovation is considered as a change in the present classrooms' learning environments ones that empower students with more control over their own learning. In the map, innovation comes first, showing my concern with examining an innovative process that involves the development of IVD uses by teachers' initiative, and its consequences on both teachers and students. This notion of innovation is consistent with the constructivist approach in education, because it assumes that students have an active role in their own learning. My commitment to this approach is also shown in the map, through the inclusion of the beliefs, theories and attitudes that teachers have toward their role, the curriculum, IVD, and students, and the beliefs, theories and attitudes that students have toward teachers, their practice, the curriculum, and IVD. These personal aspects result from the interaction of each individual with both the physical and social components of the environment that influence how teachers teach, how students learn, and, particularly for this study, how IVD is integrated into the classroom and, hence, the direction innovation will take.

The triad in the center of the concept map that is formed by teachers, IVD and students shows that these three elements are dynamically interrelated. Consequently, no differences in the intensity of the flow of information between them are indicated. Traditionally, the flow of information from teacher to students either is the only form of communication that occurs in the classroom or is much stronger than the flow in the opposite direction (see Figure 6, I).

Figure 6. Types of interactions between the teacher, students, and IVD
Constructivist approaches in science education have shown that information may flow in the opposite direction\(^7\) and that this is favored by certain instructional methodologies that actively engage the students in activities that are significant to them (see Figure 6, II). Abegg (1991) proposed this triad as an interpretive model that includes all the possible forms of interactions between teachers, students and IVD. The model has been the source of recent research on the effectiveness of student interaction with IVD in college (Ebert-Zawasky, 1989; Ebert-Zawasky & Abegg, 1990), middle school (Freitag & Abegg, 1991; Freitag, 1991), and high school (Chuckran, 1992). These studies show that when IVD is introduced for a significant period of time,

students learn substantial science content, develop better student group working relationships, and have a more positive attitude toward learning than students in the normal situation where the primary learning discourse is represented by the arrow between the teacher and student. (Abegg, 1991, p. 1)

This model also allows one to predict that the introduction of IVD in a classroom setting for the first time will cause changes in the following variables: (1) teacher practice, reflected by a different classroom structure, new routines, and, eventually, the formulation of new objectives, (2) interactions, such as teacher-student and student-student ones, and (3) student approach to information, mediated by IVD that works both as a source and a tool for processing information. These changes can be either superficial and immediate or deeply internalized by both teacher and students. If the changes are superficial in nature, they occur only while IVD is in use. If the changes are deeply rooted, the experience with IVD has provided teachers with new factors to consider while reflecting and deciding about their teaching practices. Students, on the other hand, have experienced new forms of approaching information that they will use even when IVD is not present. One goal of this study is to investigate the nature of the changes that occur in teachers' practices.

I assume that IVD, or any other computer-based material, is not the exclusive stimulator of new kinds of interactions between teachers and students. Hands-on strategies, and principally laboratory work in science education developed under the

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\(^7\) Research on students' alternative conceptions, for instance, has shown that students are not a tabula rasa, but they come to science class with well-established ideas about most of the concepts they have to learn. Teachers need to be aware of such knowledge. (Wittrock, 1985; Driver, 1988).
principles of inquiry, have the same potential. As discussed in chapter I, in spite of these qualities, laboratories are currently used in a heavily traditional framework. Most opportunities to provide students with greater responsibility for their own learning have been lost because the teacher remains the information transmitter. IVD may have a similar demise. However, since IVD is a recent practice whose implementation in schools is just beginning, this is the appropriate time to develop action-research projects in which teachers and researchers, in collaboration, have the grounds to reflect about the best manner to use it in the classroom.

In conclusion, the concept map described in this section did not constitute a predetermined model which I aimed to test in the study; however, it helped me in two important ways. First, the map made my ideas explicit and clear to myself and to others. This aspect was the most important in all the study's phases, including the design, data collection, and data analysis. It required a continuous questioning and reformulating of ideas. Thus, the concept map worked as a tool to which I returned whenever new questions or doubts about the study plan arose. It played a decisive role in the entry process as well. To be able to respond quickly and clearly to the numerous questions or the written requirements was crucial to the success of the entry negotiations. Second, the concept map helped me to narrow the general questions into a set of operational ones, appropriate for investigation.

The following sections contain descriptions of the actual elements of this qualitative research. For the sake of confidentiality, fictional designations were given to the school and the participants of the study.

**Description of the Case**

The focus of this study was two middle school science teachers who decided to implement IVD in their classes. They collaborated with a colleague, also a science teacher in the school, who trained them in the technology. This expert teacher, called John throughout this report, has extensive experience using IVD in the classroom. He has presented the work he has developed with his middle school students at several conferences and teachers' conventions, and made presentations at several universities. Two aspects of his presentation were particularly interesting to me. First, the quality of the students' reports was remarkable, showing their deep involvement in the work. Second, the description John gave of IVD as a powerful tool whose attributes and
limitations have not been established yet was interesting. He also explained how he integrates IVD with laboratory work, hands-on activities, and other relevant methodologies for teaching science.

Peter is an experienced teacher who has been teaching middle school science in the Laketown school system for 22 years. He uses the computer for his own personal work, mainly word processing, and sometimes his students complete lab assignments using spreadsheets to register the data. At the beginning of the study, Peter had no experience with IVD or similar technologies. He decided to work with John and the other teacher because he considered it a good opportunity to learn about both videodisc technology and Hypercard®. He was also very curious to see the results of this experience.

Andrew has been a teacher in the Laketown school system since 1979. This was his first year teaching science and mathematics. He had taught visual arts for ten years, and in 1989, he began teaching computer science. He is very interested in studying the use of computer-based technologies and audio-visuals in the classroom. He had an article about this topic published by a local newspaper, and he participated in several conventions in the area about computer use in education. He has collaborated with John for several years on the students' use of computers in the school, but had never used IVD in his science classes.

Literature about qualitative case study methodology refers to two conditions that define a certain phenomenon as worth being investigated and, hence, constituting the object of a case study. The phenomenon under consideration, (1) is “an instance of a more general class of events” (Smith, 1978), and (2) is intrinsically interesting (Merriam, 1991). These two conditions are not exclusive; the present study observes both. That is, the three teachers involved and their project constitute a case that, paraphrasing Smith, constitute an instance of educational innovation. The in-depth understanding of the project and the subjects involved contribute with new grounds for a broader approach to innovation in the role of IVD as a vehicle for change. Moreover, the case is intrinsically interesting. Given the recent advent of IVD as an educational technology, few teachers have used it outside of being involved in research studies directed by entities external to the school whose aim is to study the educational attributes of IVD. The positions were reversed in this case. My goal as a researcher was to get insight into the way IVD is actually used by teachers who are not experiencing an ideal situation but who are facing the events and constraints that characterize a school's
daily life. Hence, this case involves a source of information that is usually difficult to access.

**The Students**

The 107 students in this study constituted the total population of sixth graders at Lake School. They were distributed in five classes, four taught by Peter and one taught by Andrew. Peter's classes were heterogeneous. A total of ten special needs students were integrated into his classes. Andrew's class did not have any special needs students but contained six students in the English as a Second Language (ESL) program, which requires individualized work with an ESL specialist in collaboration with the science teacher. This class was considered to be homogeneous by both Andrew and Peter, since all of its students were good achievers in mathematics. Classes were multicultural with children from different countries (Japan, Korea, Italy, Taiwan, just to name a few). The students in general were computer-experienced; the majority had computers at home.

**The School**

Lake Middle School is a modern and well-equipped school located in a upper-middle-class community in the suburbs of an urban center in the Northeast United States. In the year this study was conducted (1991-92), the school population was comprised of 633 students and 90 staff members, including 61 teachers, special education specialists, aids, tutors, librarians, and administrators. There were about 28 team teachers in the major subject areas of science, social studies, mathematics, and English. The student population is increasing in this community, where school administrators expect 700 students in the 1993-94 school year.

The school contains 120 Macintosh computers that are distributed over three computer laboratories, the library, and some classrooms. Based on the number of Macintosh computers available, the approximate computer-student ratio is one computer per five students.

**Entry Negotiations**

I had a meeting with John and my advisor at Lake School at the beginning of the spring semester, 1992. During this meeting I explained my project and carefully referred to the implications of a qualitative case study which involves data collection procedures.
that may be uncomfortable for some teachers. These procedures, such as interviews, observation of classes, and analysis of documents, also require open access to the school so that the researcher may move freely. John guaranteed that Lake School would offer these conditions. That day, several aspects regarding my entry into the study's field were arranged. John introduced me to several teachers and showed me some science classrooms, the library, the teacher room, and the faculty room. Appointments were scheduled with Peter and Andrew. It was decided that I would bring a laserdisc player and a monitor from my University department to be used by one of the teachers during the semester.

After this meeting, I began to visit the school almost daily. I was introduced to the principal and other administrators who offered their availability for interviews and collaboration. I interviewed Peter and Andrew and started to observe their classes. Within two weeks, I knew many teachers in the school, the librarians, some special needs teachers, and some parents I met during two field trips organized by a group of teachers coordinated by Peter. In conclusion, the situation offered by Lake School and the two case study teachers was ideal for the development of a qualitative case study.

The superintendent of the Laketown public schools system was informed about this project by a letter sent to him by my advisor. The superintendent answered personally, giving me instructions to submit a proposal to the school committee. He also required an interview with me. During this interview, in which my advisor was present, I described my project and answered the superintendent's questions about the data collection procedures. He offered suggestions about the informational letter that was to be sent to the students' parents. He concluded that a formal consent form would be necessary only if, during the study, I decided to submit the students to more obtrusive study methods, such as formal individual interviews. Due to the open situation that was created throughout the semester, the students quickly got used to my presence, and I was able to freely interact with them and ask them questions whenever necessary.

Two weeks after the interview, I received a letter from the superintendent informing me that the proposal had been accepted. Copies of the documentation related to this process are assembled in Appendix A.
Data Collection Procedures

Major Research Questions

The four phases of data collection are shown in Figure 7. Phase I was designed to fulfill two purposes: (1) to describe the school, the science curriculum, and the students, and (2) to characterize the teaching practices of the two teachers involved in the study before using IVD. The major questions related to this phase were the following:

- What are the beliefs/theories and feelings of these teachers toward their role as science teachers, the curriculum, and their students?
- What are the beliefs/theories and feelings of these teachers toward IVD before they start using it in their classes?
- What routines do these teachers develop in the classroom? Are they consistent with their own beliefs/theories?
- What kinds of interactions (teacher-student, student-student) occur in these teachers' classes?
- Which technologies do the students use in order to obtain information?
- Which modalities of technology use were observed?

<table>
<thead>
<tr>
<th>Phase</th>
<th>Description</th>
<th>Methods</th>
</tr>
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</table>
| I     | Knowing the case’s elements | Semi-structured interviews  
        |             | Participant observation  
        |             | Analysis of documents:  
        |             | Curriculum  
        |             | Textbook  
        |             | Student’s handbook  
        |             | Course booklet |
| II    | Teachers’ training | Semi-structured interviews  
        |             | Participant observation |
| III   | IVD Implementation | Students’ questionnaire  
        |             | Semi-structured interviews  
        |             | Participant observation  
        |             | Analysis of documents: students’ assignments |
| IV    | Teachers’ beliefs, theories, feelings toward IVD. | Semi-structured interviews |

Figure 7. Data collection procedures
Phase II corresponded to the period in which Peter and Andrew received training from John, the IVD expert. The research purpose of this phase was to describe this process, which is an example of peer collaboration. The following questions provided elements for such description:

- What are the components of John's plan to train his colleagues? Does he have a previous model? If yes, what are its components?
- What are the major difficulties these teachers had while working with IVD?
- How do these teachers react to IVD after training?

During phase III, data dealing with the implementation of IVD were collected. The purpose of this phase was to characterize the three components mentioned earlier in this chapter - teachers' practices, kinds of interactions, and students' approaches to information - while IVD is being used in the classroom. The major questions were:

- What are the opportunities and constraints of IVD which teachers new to technology consider when planning for its use in their classes?
- How do these teachers plan to overcome the constraints they perceive?
- How do these teachers integrate IVD into routines they normally follow in the classroom?
- What kinds of interactions (teacher-student, student-student) occur?
- How do students use IVD?
- How do students approach information while working with IVD?
- What do students think about their experiences with IVD technology?

Phase IV focused on the two teachers. The major purposes were to describe how they reason about IVD shortly after having experienced it for the first time, and how they plan, if they do, to use IVD in the next school year.

These questions are mainly exploratory and descriptive in nature, showing my purpose to understand a contemporary real-life process in which I had very little control. The techniques for collecting data to answer to these questions are indicated in Figure 7: semi-structured interviews, participant observation, and document analysis.
Semi-structured interviews

Bogdan & Biklen (1982) explain that “the interview is used to gather descriptive data in the subject's own words so that the researcher can develop insights on how subjects interpret some piece of the world” (p. 135). Given the nature of the study's questions stated above, involving individuals' thoughts, intentions, feelings, and past experiences - all issues that are not directly observable - the interview is the only process to obtain such information.

The formal interviews in this study followed the semi-structured dialogue model, as described by Spradley (1979). I designed a question outline for each interview to be used as a guide during the interview. In general, interviewees had many interesting things to say during the interview that I usually explored in depth. When the time available was short or when the issue was beyond the scope of the study questions, I registered the topic in my field book for later investigation.

The interviews had variable structure levels throughout the research. The first interviews in phase I had low structure, given their exploratory and relational function. They enabled me to become aware of issues that were relevant to the case study teachers as well as to create conditions for a trustful working relationship with them. I sent an outline of the questions to the principal and the library media specialist before the interviews. The questions involved a considerable amount of factual information; therefore, this procedure allowed them to organize the data for the answers beforehand. Interviews in phase III were more structured, because this phase of the research was more focused. This gradation in interview structure as well as other decisions taken in the design of this study were based on my previous experience in another school which I visited from middle September to middle December, 1991. Combined with the first days I spent at Lake School, that earlier experience served as a pilot study.

Depending upon the teachers' time availability, the individual interviews had variable duration; however, they never exceeded 50 minutes. The interviews consisted of a set of opinion/value, knowledge, feelings, and experience/behavior questions, according to Patton's classification (Patton, 1980). They were tape recorded, and verbatim transcriptions were made for analysis. The time-line in Figure 8 indicates when formal interviews were conducted.

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8 See the outlines of the interviews in appendix B.
Informal conversations need to be added to this category of data collection procedures. As I became more comfortable with the school's members, I had more opportunities to talk with them. Since this advantageous situation was created and teachers had so little time available, I reduced the number of formal interviews and asked them questions whenever necessary. I did not use the tape recorder in these occasions because it would break the spontaneity. I wrote notes in the field book briefly after each encounter.

**Participant Observation**

Participant observation and interviewing are the most widely used techniques for collecting data in qualitative research. While interviews provide information about non-observable issues, observations inform about subjects' behaviors. Participant observation consists in “collecting data from observing phenomena of interest” (Merriam, 1991, p. 87), and it implies the researcher's “firsthand involvement in the social world chosen for study” (Marshall & Rossman, 1989, p. 79). Observing is an
activity in which humans engage spontaneously. Observing in a scientific context requires adherence to a number of rules, as Kidder & Judd (1986) explain:

Observation becomes scientific when: (1) it serves a formulated research purpose, (2) is planned deliberately, (3) is recorded systematically, and (4) is subjected to checks and controls on validity and reliability. (p. 285)

Observations were conducted either during the classes or at IVD stations. They were mainly centered on the teachers' practices, the interactions between subjects9 and the subjects' approaches to IVD. The first observations were conducted using the techniques recommended by Hawkins (1982). They were both impressionistic and informal, allowing me to become familiar with the new situation. These early observations also helped me to decide about the best ways to decrease the effect of my presence on the performance of the subjects while involved with IVD. These procedures were based on Kazdin's suggestions for conducting unobtrusive observations (Kazdin, 1982).

I took preliminary notes during each session. These notes constituted the raw data that I later elaborated as full notes after the observation period. This procedure led to the development of a narrative about each class. During phase III, observational notes of all the classes were taken. For three days, the classes were videotaped in order to register the classroom organization, the IVD setting, the physical distribution of the students in the room, and the first reactions of the class members to IVD. The periods in which students worked with IVD were audio recorded to obtain a record of the students' interactions. Informal notes were taken at casual events, increasing the amount of raw data that I organized in a research journal. The validity and reliability of these procedures are discussed in another section of this chapter. Figure 8 indicates the dates when classroom observations occurred.

Document Analysis

This procedure provided information complementary to the data obtained from the interviews and observations. Figure 9, indicates the documents that were examined for the study.

9 Subjects include both teachers and students.
<table>
<thead>
<tr>
<th>Documents</th>
<th>Purpose</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Philosophical statement of middle schools</td>
<td>Description of school</td>
<td>IMC</td>
</tr>
<tr>
<td>Lake School bulletin</td>
<td>Description of school</td>
<td>Lake School General Office</td>
</tr>
<tr>
<td>Newspaper published by the journalism class</td>
<td>Description of school</td>
<td>Lake School General Office</td>
</tr>
<tr>
<td>Laketown's Guide</td>
<td>Student population</td>
<td>Laketown Public Library</td>
</tr>
<tr>
<td>Local environmental newspaper</td>
<td>Data about Laketown Conservation Land</td>
<td>Laketown Public Library</td>
</tr>
<tr>
<td>Lake School's plant</td>
<td>Description of school</td>
<td>Laketown School District</td>
</tr>
<tr>
<td>Peter's curriculum materials</td>
<td>Description of science curriculum</td>
<td>Peter</td>
</tr>
<tr>
<td>Article: Harris, M., Nilson, L., and Hawkins, K. (Undated)</td>
<td>Description of science curriculum</td>
<td>Peter</td>
</tr>
<tr>
<td>Curriculum Guide K-12 Science</td>
<td>Description of science curriculum</td>
<td>Laketown School District</td>
</tr>
<tr>
<td>Curriculum Guide Library Media Program</td>
<td>School's advocated approaches to information</td>
<td>Laketown School District</td>
</tr>
<tr>
<td>A journal article authored by John</td>
<td>Description of case study teachers.</td>
<td>John</td>
</tr>
</tbody>
</table>

*Figure 9. List of documents analyzed for the study.*

**Other Procedures**

Two questionnaires were applied investigating both teachers and students background knowledge about computers and computer-based technologies. Copies of these questionnaires are included in appendix C. In this appendix are also included copies of the questionnaires Peter gave to his students when they finished using the IVD. The two questions in this questionnaire related to the students' opinions about the IVD were asked to Andrew's students.
Research Design

The nature of the research questions, the methods for collecting data, the focus of the study on a well-defined situation, and the descriptive quality of the end product all define this research as a qualitative case study. Moreover, other issues intrinsic to the qualitative case study design are present in this research, such as the following ones extracted from a synthesis done by Merriam (1991, p. 11-19). The study is, (1) particularistic, because it is focused on a particular situation or phenomenon: two science teachers implementing IVD for the first time. Related to this, Kidder and Judd (1986) clarify that, through this design, researchers “study how people behave in specific organizations, communities, or circumstances and conclude that anyone would behave similarly in those situations” (p. 170); (2) descriptive, because the research results are organized in a complete and literal description\textsuperscript{10} of the process under study; (3) heuristic, or interpretive, because it brings new explanations, generates new hypotheses and meanings about the process in study. Since the study under consideration is an instance of a broader issue - innovation and IVD use - it has the potential to shed some light on both topics; (4) inductive, because its purpose is to discover new relationships and concepts or to build theoretical categories rather than to test predetermined hypotheses; (5) naturalistic, because the researcher focuses on natural behaviors and situations, that is, no pre-established, controlled experimental settings or treatments were created; (6) primarily concerned with processes rather than outcomes or products; (7) involves fieldwork, because the researcher was present in the setting where the process under study was naturally occurring. Finally, (8) the researcher is the primary instrument for data collection and analysis.

Data Analysis

This study's data analysis procedures included two approaches that were different in nature: (1) a descriptive approach in which data were analyzed with the purpose of describing all the processes that were observed, and (2) an interpretive approach that led to devising regularities in the process observed. Therefore, the following levels for analysis were considered:

\textsuperscript{10} Also called a thick description in anthropological studies.
Level 1 - continuous analysis. This analysis occurred during the data collection period. It provided new guidelines for the development of the research.

Level 2 - devising of categories. At the end of data collection, transcripts, field notes, and other documents were arranged either chronologically or topically. Their content was analyzed to search for regularities and patterns that were then transformed into categories. This process of devising categories is mainly intuitive; however, it is systematic and is based on both the study's purpose, and the orientation and knowledge of the researcher (Merriam, 1991).

Level 3 - generation of hypotheses. This level of analysis involves making inferences and generating hypotheses following the grounded theory methodology created by Glaser & Strauss (1967). According to this method, the categories are the first elements of an emerging theory. These categories are then defined by properties and the hypotheses are originated as suggested links between categories and properties.

Reliability and Validity

“The objectivity of a piece of qualitative research is evaluated in terms of the validity and reliability of its observations” (Kink & Miller, 1986, p. 13). Meeting this standard creates a problem for qualitative case study methodology specialists in defining or suggesting procedures for the observer. During the research, several procedures were performed in order to enhance the study's reliability and validity. The selection of these techniques was primarily based on Merriam's review (Merriam, 1991, p. 163-184).

Each technique is briefly described in this section with a reference to the authors or researchers who contributed to its improvement or discussion. To ensure reliability, three procedures were utilized: the investigator's position, triangulation, and an audit trail.

(1) Revealing the investigator's position consists in providing the reader with information about the theoretical background, assumptions and biases of the researcher. It is also important to provide a picture as complete as possible of the case's physical and social context (Geotz & LeCompte, 1984).

(2) The procedure of triangulation involves the use of different procedures for data collection and analysis (Denzin, 1970).
(3) Utilizing an *audit trail* implies that the development of the investigation be periodically communicated to other researchers (Guba & Lincoln, 1981). I regularly informed my dissertation advisors about the development of the research and the analysis of data.

Triangulation, member-checks, long-term observation, participatory modes of research, and description of the researcher's biases are the common procedures to provide *internal validity*. An explanation of each follows:

1. **Triangulation**, as described above, consists in using multiple resources throughout the research. This procedure involves a special role of the literature review in a study with the characteristics of this one (Merriam, 1991; Delamont, 1992). In this case, data from other studies give relevant information for data analysis, namely, for the devising of categories or the discussion of emerging hypotheses, and the conclusions as well. Consequently, chapter II of this report, following the traditional way of writing a dissertation, is the review of the literature; however, it is expanded with considerable referencing to other studies in all the chapters.

2. **Member checks** consists of asking the informants\(^{11}\) to read the data and the interpretations in order to confirm their plausibility (Guba & Lincoln, 1981). At the end of phase II, I asked the two teachers in the case to read the transcripts of the interviews and observation notes. I also asked them to add anything they thought would clarify certain issues included in the notes.

3. **Long-term observation**. The validity of the observations increases with the time spent conducting on-site observations (Merriam, 1991; Kidder & Judd, 1986; Bogdan & Biklen, 1982). There are no rules determining the optimal period of time that on-site observations should last. In the present study, the entire project conducted by each teacher was traced; therefore, the observations took place over an entire semester.

4. **Participatory modes of research** imply the involvement of the participants in all the phases of the research (Merriam & Simpson, 1984). One purpose of this technique is to decrease the effects of subjects' reactivity caused by the fact that they know that their behaviors are being observed (Kazdin, 1982). Because of the study's naturalistic nature, it was difficult to establish the appropriate levels of the teachers' participation. Early in the research, I noticed their tendency to do things “because of the

\[^{11}\text{Informant, actor, or respondent are synonyms for subjects in ethnographic or observational research (Delamont, 1992).}\]
study.” I explained the study's design and made clear that my goal was not to evaluate how they implemented IVD but to understand the entire implementation process. I showed my availability to investigate particular aspects of the process by following their suggestions. In this respect, I emphasized that nothing would come from my initiative because I wanted to interfere the least possible.

(5) **Description of the researcher's biases** is a crucial issue in qualitative methodology. The principle behind it is that one can guard against the influences of one's own biases by becoming aware of them and by making them explicit. Besides, the reader needs a detailed description of these biases in order to make conclusions about the plausibility of the study's procedures. The first section in this chapter is a description of my biases and assumptions when I designed the study. The following chapters contain discussions of my biases identified at several stages of the study.

Finally, concerns about the external validity of the study led me to develop a detailed description of the process and settings where it occurred, and to establish the typical or modal category of the case. A **thick description** allows the reader to judge the transferability of the study's results (Lincoln & Guba, 1985). The establishment of the **typical or modal category of the case** consists in describing how typical the case is when compared to others in the same category. This allows other researchers, working in the same kind of research, to make comparisons to their own situation (Geotz & LeCompte, 1984).

**Limitations**

IVD is a recent instructional resource. Few teachers are using it without being involved in a formal in-service training program or working with an expert support person. Specialized literature is scarce in case studies of this kind. Consequently, this study focuses strictly on one case of two teachers without the advantage of including a cross-site or a cross-case analysis to reinforce the study's external validity.

**Summary**

This research is a qualitative case study focused on the process of two middle school science teachers implementing IVD-based instruction. Semi-structured interviews, participant observation, and document analysis were carried out (1) before the teachers began to use IVD, (2) during their training directed by another science
teacher who had long experience in using this technology with his students, (3) during the period in which IVD was used in sixth-grade science classes, and (4) after this experience.

This study is framed in a constructivist perspective of learning, which influences the way teachers, students, and the use of IVD are approached as objects of research. Data were analyzed in terms of how IVD implementation changed teachers' common practices, the kinds of interactions that usually occur among the classroom participants, and the ways students approach information.