

Students' Utilization of Instructional Resources in a Difficult Distance Education Physics Course

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This study investigated how students specifically overcame conceptual difficulty and solved problems through the use of intrapersonal and interpersonal instructional dialogues in a difficult physics course at Open University, UK. It was found that students initially tried to overcome difficulties alone; if unsuccessful, they turned to interpersonal dialogue, especially with tutors. Interpersonal dialogue was generally mediated by telephone, not by technology-based communication resources.

Introduction

Modern instructional systems (campus-based as well as distance) include a diverse array of resources for intrapersonal dialogue (individual study) such as self-instruction texts and multi-faceted Web-based instructional systems. In addition, there are various resources for interpersonal dialogue (instructor-student, student-student) such as face-to-face meetings, e-mail, telephones and websites for both synchronous and asynchronous interaction. We investigated students' learning activities (the dialogues they engage in and the resources that enable these dialogues) using a theoretical framework that recognizes the centrality of instructional dialogue (Gorsky & Caspi, 2005; Gorsky, Caspi & Chajut, 2007). The theory rests on the assumption that instruction is dialogue. Three propositions are derived from this assumption:

1. Every element in an instructional system is *either* a dialogue (intrapersonal or interpersonal) *or* a resource which supports dialogue.
2. Certain structural and human resources, common to all instructional systems, correlate with the type, amount and duration of interpersonal dialogue that occurs both in-class and out.
3. Specific, situated dialogues correlate with learning outcomes.

The differences between intra- and interpersonal dialogues are especially important for the current discussion. Intrapersonal dialogue is defined formally as the interaction between student and subject-matter that occurs when, and only when, it is *mediated* by a given instructional resource. Interpersonal dialogue is the interaction between instructor and student or between student and student. It may be face-to-face or mediated by communications media; if mediated, it may be synchronous or asynchronous. Given these propositions, *all* student-learning activities may be analyzed in terms of the *dialogues* they engage in and the *resources* (either structural or human) that enable the dialogues. Two illustrations follow:

1. A student reads a text. The text is a structural resource that enables intrapersonal dialogue.
2. Student X posts a message in an asynchronous forum. Student Y responds. The forum is a structural resource for interpersonal dialogue; Students X and Y are human resources.

This study reports on the kinds of instructional dialogues used by Open University, UK students to overcome conceptual difficulty and to solve Tutor Marked Assignments in a difficult, advanced-level Quantum Mechanics physics course.

Literature Review

To date, this theoretical approach has been used to track distance and campus-based students' dialogic behavior in three preliminary small-scale naturalistic studies (Gorsky, Caspi & Trumper, 2004, 2006; Gorsky, Caspi & Tuvi-Arad, 2004) and in one larger scale study (Caspi & Gorsky, 2006). The small-scale studies ($n \leq 14$) were based on interview data obtained from undergraduate students as they learned physics and chemistry. The larger scale study ($n=521$) was based on data obtained from an electronic questionnaire from undergraduate distance education students studying diverse courses.

Several findings emerged from these studies. First, it was found that *all* activities engaged in by students could be categorized as dialogues (instructor-student or student-student) that were enabled by some structural resource. Second, a general approach to the use of dialogue was discerned. For all students participating in these studies, *intrapersonal* dialogue was the primary and preferred study mode. This finding is supported by several other research studies such as Rourke et al. (1999) and Rourke & Anderson (2002). Distance students learned individually primarily from self-instruction texts and tutorials while campus-based students learned individually at lectures and tutorials. At large lectures (in the study cited above, group size was about 150 students per lecture), few students actually engaged in interpersonal instructor-student dialogue. Only for campus-based students participating in small introductory level courses (about 10 registered students) was interpersonal dialogue a significant mode engaged in while learning in the classroom. Third, both distance and campus-based students opted for interpersonal dialogue only when they could not solve the assigned problems. Fourth, for nearly all students, the primary partner for interpersonal dialogue was another student. Instructor-student dialogues were generally a last resort.

Finding three illustrates the tension between some instructional theories on the one hand and practices engaged in by students on the other. Many theories of instruction (e.g. Bruner, 1966; Rogers, 1969; Moore, 1993; Garrison & Anderson, 2003) often assign to interpersonal student-teacher dialogue an importance that may not be realized in practice. In the studies cited above, teacher-student dialogue appeared limited to dealing with specific difficulties raised by students.

Research Objectives

To investigate the:

1. dialogue types and resources utilized by students (1) to overcome conceptual difficulties that emerged while reading the course materials and (2) while solving difficult TMAs.
2. first partner choices for interpersonal dialogue.
3. structural resources utilized for interpersonal dialogue.

Mode of Inquiry

The Quantum Mechanics course from which participants were surveyed is an advanced level course required of all physics majors at Open University, UK. The course includes three 2 hour-long tutorials and one or two "day-schools". Tutorials are optional and generally less than 50% of the students attend. Students attending the tutorials put their contact details on a paper going around the room so that they can form a "self-help group" of peers to phone/email/meet. In addition, all students have access to what is called "FirstClass computer conferencing", an asynchronous course forum. Table 1 lists the human and structural resources available to students in the course and the dialogues associated with these resources. In this study, "instructor" is the term used for the person who communicated with students in tutoring sessions, by e-mail, by telephone or in person.

Table 1: Human and structural resources available to the Open University students participating in the Quantum Mechanics course.

Dialogue Types	Human Resources	Structural Resources
Intrapersonal	Students	A textbook accompanies the course units FirstClass conference
Interpersonal	Instructor-Student Student-Student	Tutorial sessions Face-to-face meetings Telephone E-mail Self-help groups FirstClass conference

All 355 students in the course Quantum Mechanics were sent written questionnaires posted to their home addresses. 124 students returned completed or nearly completed questionnaires. 121 students perceived the course as "difficult".

Students' use of dialogue and resources was investigated through a "Tactical Approaches to Study" questionnaire (See Appendix A) that elicited dialogic behavior. Students were asked to record all actions undertaken to overcome difficulty encountered while reading course materials, and the resources they utilized to do so. We repeated this procedure for the Tutor Marked Assignments (TMAs).

Findings

Findings for Research Objective 1

Table 2 summarizes the dialogic profiles that emerged from the data analysis.

Table 2: General dialogic profiles for resolving conceptual difficulty that emerged while reading course materials and while solving difficult TMAs.

Dialogic Profiles (N=121)	Reading (%)	TMAs (%)
Intrapersonal only	43.8	54.2
Intrapersonal to Interpersonal	40.5	33.1
Intrapersonal to Interpersonal to Intrapersonal	9.9	6.8
Other	5.8	5.9
Totals	100	100

The first three profiles, which characterize 94.2% of the students, indicate that students initially tried to overcome difficulty on their own. Only when these efforts failed did they turn to others for help. The reported dialogic behaviors were similar in both instances. A Chi-Square test showed no significant difference [$\chi^2(3) = 4.42, p=0.22$] between profiles for addressing difficulty that emerged while reading course materials and while solving difficult TMAs.

Findings for Research Objective 2

Table 3 lists the dialogues engaged in alongside the resources utilized for addressing conceptual difficulties that emerged while reading the course materials. Resources labeled "other" were structural resources for intrapersonal dialogue not listed in the questionnaire (e.g., internet, study previous exams), but cited by students. A similar analysis was carried out for resource utilization while solving difficult TMAs. Again, differences were negligible.

Table 3: Dialogues and resources utilized for addressing conceptual difficulties that occurred while reading course materials. (N=121)

Dialogues	Resources	1 st resource utilized (%)	2 nd resource utilized (%)	3 rd resource utilized (%)	4 th resource utilized (%)
Intra-personal	Course text	90.9	5.5	0.0	3.3
	Alternate texts	2.5	50.9	22.9	6.7
	FirstClass conf.	1.7	11.1	20.0	6.7
	Other	0.0	9.3	7.1	3.3
	Subtotal	95.1	76.8	50.0	19.9
Inter-personal	Peer	0.8	1.9	5.7	6.7
	Tutor	3.3	13.0	25.7	40.0
	Outsider	0.8	3.7	5.7	6.7
	Tutorial	0.0	4.6	12.9	26.7
	Subtotal	4.9	23.2	50.0	80.1

The movement from intrapersonal dialogues to interpersonal ones is reflected most clearly in the “subtotal” rows. Furthermore, texts were the preferred resources utilized for the intrapersonal dialogues that addressed conceptual difficulty. Only after these intrapersonal courses of action failed to resolve conceptual difficulty did students turn to interpersonal dialogue, primarily with the tutor.

Fifty-six students reported that they learned independently; that is, they sought no help or advice from anyone. Sixty-five students engaged in some form of interpersonal dialogue when confronted with conceptual difficulty. First partner choices follow: 76.9% chose the tutor (either personally or at a tutorial), 10.8% chose a peer and 12.3% chose an outside source. Again, differences between these findings and those for first partner choice vis-a-vis solving difficult TMAs are negligible.

Findings for Research Objective 3

One might expect a large variability between students' utilization of communication means given the diversity of available tools. However, it was found that most students used the telephone for interpersonal dialogues. Telephone is perceived as a "rich medium" (Daft & Lengel, 1984); it offers synchronous communication and no specific skills, such as good written expression, are required. Other mediated communication means do not match these criteria. The mere fact that writing formulas in discussion groups or chats is not easy may cause students studying exact sciences to avoid utilizing these tools. We note, however, that the kinds and amount of activities in discussion groups is also a function of teacher presence, especially their readiness to answer students' questions.

Conclusions and Implications

In this difficult physics course, tutors were the overwhelming first partner choice in interpersonal dialogue. Peers and outside sources were utilized sparsely. These findings differ from the four previous ones cited above where peers were the preferred first partners in interpersonal dialogue.

Based on the findings from this study alone, however, we cannot yet make the following generalization that for courses generally perceived as difficult, the preferred partner for interpersonal dialogue is the tutor. This is so because the previous findings in which peers were the preferred first partners came from four studies with Israeli students. Only further studies with UK students participating in courses perceived as "easy" will clarify the issue.

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Appendix A: "Tactical Approaches to Study" Questionnaire

1. Age: _____
2. Gender: M / F
3. How do you rate your motivation to achieve a high grade? very high, high, moderate, low or very low
4. How difficult do you consider the course to be? very difficult, difficult, moderate, easy or very easy
5. How do you prefer to learn? independently or with others
6. Did you know at least one other student in the course before you started? Y / N

Questions seven and eight asked students to record their dialogic behavior as they addressed conceptual difficulties that occurred while reading the course materials.

7. How have you typically addressed conceptual difficulties that have occurred while reading the course materials? Mark *all* actions undertaken:
 - a. reread the text(s) Y / N
 - b. found alternative texts or instructional materials Y / N
 - c. without participating, read through on the FirstClass conference Y / N
 - d. contacted another student from the course Y / N
 - if yes, then typically how (circle the appropriate response):
 - 1. face-to-face meeting
 - 2. telephone
 - 3. email
 - 4. FirstClass conference
 - 5. other _____
 - e. contacted your tutor Y / N
 - if yes, then typically how (circle the appropriate response):
 - 1. face-to-face meeting
 - 2. telephone
 - 3. email
 - 4. electronic conferencing
 - 5. other _____
 - f. contacted someone from outside the course (parent, friend, employer, etc.) Y / N
 - g. asked a question at the next tutorial Y / N
 - h. gave up Y / N
 - i. enter any other additional actions taken: _____
8. List the order in which your first four actions were carried out (enter the appropriate letter) and estimate the relative contribution made by each (Total 100%).
 - 1st action: ___; relative contribution: ___%
 - 2nd action: ___; relative contribution: ___%
 - 3rd action: ___; relative contribution: ___%
 - 4th action: ___; relative contribution: ___%

Questions nine and ten are identical to questions seven and eight except that they refer to solving difficult TMAs.