DOCUMENT RESUME

ED 091 212 SE 017 782

AUTHOR Seymour, Lowell A.; And Others
TITLE The Measurement of Program Implementation and Students' Cognitive, Affective, and Social Performance in a Field Test of the Inquiry Role Approach (1972-73). II. Measurement of Social Skills and Attitudinal Development of IRA Biology Students.
PUB DATE Apr 74
NOTE 17p.; Paper presented at the Annual Meeting of the National Association for Research in Science Teaching (47th, Chicago, Illinois, April 1974). For related documents, see SE 017 781 and 783

EDRS PRICE MF-$0.75 HC-$1.50 PLUS POSTAGE
DESCRIPTORS Attitudes; *Biology; *Educational Research; Instruction; Science Education; *Secondary School Science; *Social Behavior; *Student Attitudes; Teamwork
IDENTIFIERS *Inquiry Role Approach; Research Reports

ABSTRACT

This report is one of three concerning the 1972-73 field test of the Inquiry Role Approach (IRA) to biology teaching developed by the staff of the Mid-Continent Regional Educational Laboratory (McREL), Kansas City, Missouri. This paper is focused on the measurement of social skills and attitudinal development of IRA biology students. The IRA program develops social skills by using four-member teams with specific role designations. The four roles are Team Coordinator, Technical Advisor, Data Recorder, and Process Advisor. Responsibilities for each role are identified, and there is a Team Analysis Form to be used for recording social and cognitive problems occurring during teamwork and for recording plans for overcoming these problems. Social skills checklists, to be completed by the individual students and by the group as a team, were developed to measure social skill development. In earlier work, 12 attitudinal qualities important to success at inquiry (curiosity, openness, risk-taking, etc.) and 48 related observable behaviors were identified. These served as the base for delineating the attitudinal goals for the IRA program. Reliability and validity of the instruments developed for the IRA program are briefly discussed. Data show good criterion referenced reliability (0.84, 0.81) for two of the six instruments and acceptable criterion referenced reliability (0.64, 0.62, 0.62, 0.60) for the remaining four. (Authors/PEB)

THE MEASUREMENT OF PROGRAM IMPLEMENTATION AND STUDENTS' COGNITIVE, AFFECTIVE, AND SOCIAL PERFORMANCE IN A FIELD TEST OF THE INQUIRY ROLE APPROACH (1972-73)

II. MEASUREMENT OF SOCIAL SKILLS AND ATTITUDINAL DEVELOPMENT OF IRA BIOLOGY STUDENTS

by

Lowell A. Seymour
Richard H. Bingman
Paul G. Koutnik
Lawrence F. Padberg

A paper presented to the annual meeting of the National Association for Research in Science Teaching, Chicago, 1974.

McREL projects described in this report were supported in development by funds from the U. S. Office of Education and National Institute of Education, Department of Health, Education and Welfare, under contracts OEC-3-7-062876-3076 and NE-C-00-3-0068. The opinions expressed in this paper do not necessarily reflect the position or policy of the U. S. Office of Education or National Institute of Education and no official endorsement by these agencies should be inferred.

Introduction:

The Inquiry Role Approach is a method of teaching secondary biology which includes teacher training materials, teacher instructions for class use, and student materials. While the goals of IRA include the learning of biology content, the goals also emphasize inquiry skill development, social interaction skills, and attitude development necessary for good inquiry. The IRA method is based on the premise that biology content understanding, inquiry skills, social skills, and attitudes are interdependent and can be achieved best in a program that integrates them.

Student development objectives for the areas of biology content understanding and cognitive inquiry skills have been identified both generally (Bingman, et al., 1969; Development of Inquiry Skills Program Staff, 1970) and specifically for each program activity (see Development of Inquiry Skills Program, 1971a) from early in the development of IRA. Instruments for measuring achievement in these areas have also been identified--Comprehensive Final Examination (Biological Sciences Curriculum Study, 1965) and Explorations in Biology (Koos, 1969-72). These instruments have had a lengthy and systematic development and have shown to be useful, highly reliable and valid for what they intended to measure. (These instruments are discussed in the first paper of this paper set, Seymour, et al., 1974.)

Student development objectives for the areas of social skills and attitudes have been identified generally (Bingman, et al., 1969; Development of Inquiry Skills Program, 1970). However, a systematic specification of social skill and attitude objectives within the activity-by-activity materials, and identification of means for measuring achievement in these areas, had not been undertaken in the early stages of program development. During the revision of materials prior to the 1972-73 field test, this issue of specifying and measuring social skill and attitude development was addressed. The purpose of this paper, therefore, is to report the results of that and subsequent work.

This paper will: (1) Review the social skill and attitude goals and measurement of the attainment of these goals in the early development of IRA. (2) Identify the social skill and attitude development goals specified in the instructional materials field tested in 1972-73. (3) Describe the instruments used to measure attainment of these goals during the 1972-73 field test. (4) Present and discuss the data collected using these instruments. And (5) discuss future directions for further development of these instruments.

Social Skills Measurement

Instruments during early IRA development:

The primary method of developing social skills in the Inquiry Role Approach program is the use of four-member teams with specific role designations. Each role has a set of related tasks assigned as the role responsibilities of the person who is performing the role. The four roles are: Team Coordinator--coordinates team discussion, clarifies team direction, summarizes or synthesizes team discussions and decisions; Technical Advisor--assists team in analyzing,

challenging, and understanding concepts, principles, statements of evidence, underlying assumptions, etc.; leads team in technical aspects of laboratory work; Data Recorder--records, or directs the recording of data and notes of team's discussions; organizes and maintains team records; checks for consistency in records and between records and team decisions or interpretations; and Process Advisor--leads team in analysis of team interaction, identification of strengths and weaknesses, and planning actions to improve teamwork.

In order to assist the student in learning and fulfilling his/her role responsibilities, a student form outlining specific tasks was given to students. These role responsibilities forms at least in part identified social skills needed for successful group interaction. Students evaluated their role performance at the end of an activity by completing a role performance checklist; the team identified whether or not each student had performed the tasks assigned. The team also completed a Team Analysis Form in which they recorded social and cognitive problems that occurred during teamwork and plans for overcoming their problems.

While all of these forms (role responsibilities form, role performance checklist, team analysis form) were developed through student and teacher feedback, they did not provide either a specification of skills to be developed or a reliable and quantified means of evaluating development.

One instrument did provide quantified data--Differentiation Between Roles--a 20-item quiz designed to measure understanding of role responsibilities. Alone, however, it is not a measure of social skill development. Revision of this instrument and later studies of its reliability are included later in this paper in discussion of the instrument Understanding Role Responsibilities.

Social Skill Development Goals:

Drawing from the previously identified general social skill development goals and the instructional materials included in the IRA program, social skill goals were identified for each of the IRA themes* as part of the IRA revision for the 1972-73 field test. These goals follow:

THEME I SOCIAL SKILLS:

Prerequisite to performing the roles and thus developing the skills associated with a role, the student must understand the role responsibilities.

In addition to knowing role responsibilities, skills will be developed in the following areas:

COORDINATION --

1. Organize the work to be done.

2. Coordinate team activities to reach team decisions or complete tasks.

*The IRA program activities are organized into three sequential sets of activities called themes.

3. Identify various positions or ideas.

4. Ask for questions and/or clarifications.

5. Build on each other's ideas or suggestions.

COMMUNICATION --

6. Take part in team discussions by expressing your ideas.

7. Listen to other team members and try to understand clearly what they are saying.

8. Respond to other team members' ideas and opinions.

ROLE PERFORMANCE --

9. Recognize when a role responsibility has not been performed.

10. Suggest ways to overcome role responsibility problems.

11. Carry out your role responsibility.

THEME II SOCIAL SKILLS:

The coordination, communication, and role performance skills developed in Theme I will be used to build successful social interaction, build team spirit, and create an atmosphere of acceptance.

SOCIAL INTERACTION --

1. Recognize when conflicts arise between teammates.

2. Identify the conflict and bring it to the team's attention.

3. Suggest ways to solve the problem.

4. Accept each person during the problem-solving process.

5. Identify and suggest different ways to improve teamwork.

BUILDING TEAM SPIRIT/EXPRESSING ACCEPTANCE --

6. Praise good ideas or responsibilities performed well.

7. Recognize the different talents of team members and use them effectively.

8. Relieve tension in the team through a sense of humor or other "break in the action."

9. Understand and accept a team member's feelings, particularly when his behavior is rejected by others.

10. Direct criticism to a person's ideas, not the person himself.

THEME III SOCIAL SKILLS:

The social skill goals for Theme III are behaviors which combine and integrate skills developed in Themes I and II.

COORDINATION/COMMUNICATION --

1. Ask others for their ideas as often as you give your own.

2. When others present ideas, explain your understanding of what has been said and then ask if that is what was intended.

3. Help students having difficulty during discussion so the student can continue and complete his point of discussion.

ROLE PERFORMANCE/SOCIAL INTERACTION --

4. Identify instances in which role responsibilities for two or more roles overlap.

5. Suggest ways of redefining or exchanging roles within the team to match the role responsibilities to each team member's demonstrated talents and skills.

6. Carry out extra or modified responsibilities delegated to you by the team as effectively as those responsibilities ordinarily assumed in your role.

7. Initiate action to resolve conflicts among teammates regardless of what role you have.

8. Reconcile and communicate differences of opinion, ideas, and feelings when different from those of other teammates.

COORDINATION/RESPONSIBILITY/PERSEVERANCE --

9. Encourage team members to continue working to solve the problem under investigation.

10. Participate willingly in making team decisions and team planning even when your own ideas are not being adopted.

11. Participate willingly in carrying out team decisions and plans even when they are based on ideas suggested by others.

Measuring Social Skill Development:

It was decided that a simple way to measure this array of social skills was to utilize always-present observers: the student and his/her three teammates. A social skills checklist was designed for each theme. The checklist was to be completed first by the student, then by the team (with the equal participation of the student being rated). The final rating would be the average of the student's own rating and the team's rating.

Validity of the checklist was established by the professional judgment of McREL staff and consultants including IRA teachers.

The social skills checklist for Theme I follows.

Social Skills Checklist (IRA student form 121-4, Bingman, et al., 1972)

NAME: _____

TEAM MEMBERS: _____

Summary: To help you determine your social skills development, you and your teammates will fill out this checklist.

1-very poor 2-poor 3-satisfactory 4-good 5-excellent

	YOUR RATING	TEAM RATING
THEME I - ORIENTATION TO INQUIRY		
COORDINATION		
1. Organizes the work that needs to be done.	____	____
2. Coordinates team activities to reach team decisions or complete task.	____	____
3. Identifies various positions or ideas.	____	____
4. Asks for questions and/or clarifications.	____	____
5. Builds on each other's ideas or suggestions.	____	____
COMMUNICATION		
1. Takes part in team discussions by expressing his/her ideas.	____	____
2. Listens to other team members and tries to clearly understand what they are saying.	____	____
3. Responds to other team members' ideas and opinions.	____	____
ROLE PERFORMANCE		
1. Recognizes when a role responsibility has not been performed.	____	____
2. Suggests ways to overcome role responsibility problems.	____	____
3. Carries out his/her role responsibilities.	____	____
Your rating + team rating divided by 2 = Theme I social skills rating:		____

In view of the 1 through 5 rating system, ratings can be interpreted according to the following scale:

Excellent	50-55
Good	39-49
Satisfactory	28-38
Poor	17-27
Very Poor	11-16

A rating of 28 was set as the criterion level.

This checklist was administered to students at the end of Theme I (approximately at the end of the first semester of the academic year). The results per teacher are shown in Table 1.

TABLE 1: Social Skills Checklist Data From End of Theme I

Teacher No.	$\bar{X}$	Student N	Population from which sample was taken
01	33.8	24	150
02	43.2	24	140
03	40.2	22	80
04	49.4	26	30
10-14	33.4	77	500
20	35.9	20	35
21	41.0	20	70
22	42.4	26	70
30	38.8	26	105
31	43.2	25	105
40	42	103	103

The results show that all student groups reached criterion on the social skills checklist. The mean scores ranged from 33.4 to 49.4. Three teachers reported student mean scores classified as "satisfactory" and eight reported mean scores in the "good" category.

The criterion referenced reliability (Thorndike, 1971, p. 435) for this instrument was found to be 0.84 (N=20). The rank correlation (Spearman) between the individual's rating and the group's rating was 0.92 (N=20).

The Theme II and Theme III social skills checklists follow the pattern of the Theme I checklist. The Theme II checklist included all items from Theme I plus additional items relating to the Theme II social skill development goals. The Theme III checklist included items relating to the Theme II and Theme III social skill development goals (but not items from the Theme I checklist). Eight teachers (teachers 02, 03, 10, 11, 12, 13, 14, and 21) submitted data from administration of the Theme II checklist. One teacher (03) submitted data from administration of the Theme III checklist.

Ratings for both the Theme II and Theme III checklist can be interpreted according to the following scale:

Excellent	95-105
Good	74-94
Satisfactory	53-73
Poor	32-52
Very Poor	21-31

Criterion level for both instruments was set as 53.

Data from these instruments is shown in Table 2.

TABLE 2: Social Skills Checklist Data, Themes II and III

	$\bar{X}$	S.D.	N	Population from which sample was taken
Theme II Social Skills Checklist	71.8	13.3	50	790
Theme III Social Skills Checklist	74.3	18.35	20	80

The criterion referenced reliability for the Theme II checklist was found to be 0.60 (N=50); for the Theme III checklist, 0.64 (N=20). Rank correlations between individual ratings and group ratings were 0.86 (Theme II checklist N=20) and 0.85 (Theme III checklist N=20).

The data resulting from the use of these three social skill checklists indicates that the social skills measured are developed and that criterion levels are not too high. Further studies of the validity, reliability, and setting of the criterion levels are suggested and will be discussed later in this paper.

Understanding Role Responsibilities:

As noted in the section Social Skill Development Goals, student role performance (and, therefore, social skill development) is dependent on understanding the role responsibilities. Therefore, use of the instrument Understanding Role Responsibilities has been included as part of the measurement of social skill development. The development of this 20-item, multiple choice instrument has occurred over the past three years. Revisions have occurred periodically to keep items consistent with development of instructional materials on roles and in response to student and teacher feedback on the clarity and accuracy of items. A portion of the instrument as used in the 1972-73 field test follows. Only the first four (of twenty) items are shown.

Understanding Role Responsibilities (IRA student form 121-3, Bingman, et al., 1972.)

NAME: _____ ROLE: _____

Summary: This form is designed to assess your understandings of the responsibilities associated with each role. Each statement was made by a team member while carrying out a particular role. You are to identify which role was being carried out.

TC-Team Coordinator TA-Technical Advisor DR-Data Recorder PA-Process Advisor

TC TA (DR) PA	1.	Bob, do you think this evidence is enough for this interpretation?
(TC) TA DR PA	2.	In order to reach a decision, can we find a way to make your statement go along with the statement made earlier by Tom?
TC TA DR (PA)	3.	I don't think everyone sees a plan for tomorrow.
TC (TA) DR PA	4.	When you use the word "satisfaction" what assumption are you making?

Understanding Role Responsibilities is the product of three years of development. In the 1970-71 IRA materials the instrument used to measure role understanding was Differentiation Between Roles. The validity of this 20-item instrument was judged by interviewing and observing teachers and students (Anderson, et al., 1971). The instrument was then revised and included 13 unchanged items and seven modified items. A test-retest reliability study of the 13 identical items indicated a rank correlation coefficient (Spearman) significantly different from zero at the 0.01 level. The items were very stable in this test-retest situation. The per cent correct deviations ranged from 10.6 to 1.5. Ten of 13 scores deviated no more than 5.1 per cent. These statements are based on an N of 6 teachers and 580 students (Development of Inquiry Skills, 1971b).

During 1971-72 the instrument was changed from a 20-item to a 33-item instrument and was termed Assessment of Role Functions. The longer instrument was found to be less useful due to its length and an unequal distribution of items related to each of the four roles used in the small groups. Further, it was found that some of the items were ambiguous and could be attributed to more than one role. In revising this instrument for the 1972-73 field test, the professional judgment of three program development specialists, one research and evaluation specialist, and two experienced IRA teachers was combined to select the 20 items (five for each role) which were most obviously characteristic and exclusive to a role. The revised form was designated Understanding Role Responsibilities. The IRA staff set a score of 30, or 75 per cent of the maximum possible score (twenty items, each item valued two points, maximum possible score of 40), as being a satisfactory criterion level as a class mean. The instrument was administered during the 1972-73 field test as part of the end-of-Theme I evaluation. Results per teacher are shown in Table 3.

TABLE 3: Understanding Role Responsibilities Data From End of Theme I

Teacher No.	$\bar{X}$	Student N	Population from which sample was taken
01	20.9	24	150
02	20.8	24	140
03	18.9	21	80
04	30.0	25	30
10-14	20.0	85	500
20	20.2	20	35
21	29.8	20	70
22	26.7	26	70
30	29.3	28	105
31	22.4	25	105
40	28.0	103	103

Table 3 shows that the students of only one teacher reached the criterion level. The criterion level was not emperically based, and these data indicate that it may have been set unrealistically high. Note that students in most cases had only experienced the performance of one role by the end of Theme I. It may be that they had adequate knowledge of their own role, but inadequate knowledge of the other three. It was also found that four items on the instrument were not clearly stated (in terms of role specific task descriptions); these have been modified in the revised materials. Note that even though student means did not reach the criterion level except in one case, all mean scores reported were well above the chance level of the instrument (chance score = 10.0). Further study of the instrument, particularly with a view toward establishing an emperically based criterion level, is warranted.

Attitude Development Goals:

Chapter 5 of Inquiry Objectives in the Teaching of Biology (Bingman, et al., 1969) identifies 12 attitudinal qualities important to success at inquiry: curiosity, openness, reality orientation, risk-taking, objectivity, precision, confidence, perseverance, satisfaction, respect for theoretical structures, responsibility, and consensus and collaboration. In addition, 48 related observable behaviors are identified. This set of attitudes and related behaviors provided the base for delineating the attitudinal development goals of the IRA program. While this had been done to some degree previously (DIS Program, 1970), attitudinal goals for each of the three IRA themes were identified as part of the revision for the 1972-73 field test. These goals follow:

THEME I ATTITUDINAL QUALITIES:

The attitudinal qualities to be developed are those necessary for an inquiry orientation.

1. A willingness to participate in inquiry activities.
2. A willingness to assume responsibility in inquiry activities.
3. A willingness to cooperate with other students to complete an inquiry activity.
4. A willingness to change ideas and evidence when necessary.
5. A willingness to admit your mistakes.
6. A willingness to look for additional data and evidence.
7. A concern for issues in the public domain.
8. A willingness to consider knowledge as tentative.
9. A willingness to record and report data as it was actually observed.

THEME II ATTITUDINAL QUALITIES:

Attitudinal qualities to be developed are those necessary for development of inquiry skills.

1. A commitment to examine your role and then make changes in your role or try new ideas in your inquiry activities.
2. Satisfaction or confidence that inquiry activities are helping you.
3. An understanding and preference for certain scientific values that underlie science.
4. Perseverance to stay with the inquiry task.

THEME III ATTITUDINAL QUALITIES:

1. A belief or value that the inquiry process can affect his daily life positively both in and outside the classroom.
2. A desire to engage in a variety of divergent problem situations in the classroom and community.
3. A desire to move towards self-direction and control of his own learning activities.
4. A commitment to identifying and prioritizing factors affecting a decision in order to make a more responsible decision.
5. A belief or value that he can carry out the team decision-making process with persons having different ideas, views, and interests.
6. A belief that different habits of thought, creative abilities, and talents are important to conducting effective inquiry.

Measuring Attitudinal Development:

A notable exception to the lack of instrumentation for measuring social skills and attitudes discussed earlier is the Biology Student Behavior Inventory developed by Steiner (1970). This instrument measures four of the 12 attitudinal qualities identified in Inquiry Objectives in the Teaching of Biology: responsibility, curiosity, openness, and satisfaction. The BSBI has been described in paper one of this paper set.

A more comprehensive instrument or set of instruments was required for measuring attitudinal qualities. Checklists, following the pattern for the social skills checklist, were designed for each of the three IRA themes. Validity was established by judgment of staff and consultants, as done with the social skills checklists.

The attitude checklist for Theme I follows.

Theme I Attitude Checklist (IRA student form 121-5, Bingman, et al., 1972)

NAME: _____

TEAM MEMBERS: _____

Summary: To help you determine your attitude development, you and your teammates will fill out this checklist. The rating is given in terms of how often a behavior occurs. For some items it is not necessary to indicate the frequency and may be more appropriate to indicate how well a behavior is performed. A rating of "5" is always the best a student can receive.

1-rarely or never 2-seldom 3-sometimes 4-frequently 5-very frequently

In Theme I a student should have developed these attitudes:

1. A willingness to participate in inquiry activities.
2. A willingness to assume responsibility in inquiry activities.
3. A willingness to cooperate with other students to complete an inquiry activity.
4. A willingness to change ideas and evidence when it is necessary.
5. A willingness to admit his mistakes.
6. A willingness to look for additional data and evidence.
7. A concern for issues in the public domain.

These attitudes are often demonstrated by the following behaviors. Rate the student on how often or how well he has performed these behaviors.

	YOUR RATING	TEAM RATING
1. Reports his data, ideas, and evidence even when they do not agree with those of others.	___	___

		YOUR RATING	TEAM RATING
2.	Volunteers his opinions and ideas freely during inquiry activities.	____	____
3.	Suggests changes to improve discussion procedures or working in the laboratory.	____	____
4.	Shows respect for the ideas of other students.	____	____
5.	Admits his mistakes.	____	____
6.	Carries out his assigned responsibilities.	____	____
7.	Responds to the ideas expressed by other students.	____	____
8.	Tells others when they do not carry out their role functions or other assigned responsibilities.	____	____
9.	Challenges the ideas, evidence and assumptions of other students.	____	____
10.	Asks other students to help him carry out an assigned responsibility when it is necessary to help the team.	____	____
11.	Expresses a desire for more data, ideas, and evidence.	____	____
12.	Volunteers to help others carry out their assigned responsibility when it is necessary to help the team.	____	____
13.	Suggests ways in which scientific findings can be related to world problems or public issues.	____	____
	TOTAL	____	____

Your rating + team rating divided by 2 = Theme I attitude rating: ____

In view of the 1-5 rating system, ratings can be interpreted according to the following scale:

Very frequently	59-65
Frequently	46-58
Sometimes	33-45
Seldom	20-32
Rarely or never	13-19

A rating of 33 was set as the criterion level.

This checklist was administered to students at the end of Theme I. The results per teacher are shown in Table 4.

TABLE 4: Attitude Checklist Data From End of Theme I

Teacher No.	$\bar{X}$	Student N	Population from which sample was taken
01	43.7	24	150
02	48.4	23	140
03	46.6	22	80
10-14	41.7	82	500
20	44.4	20	35
21	45.6	20	70
22	49.4	26	70
30	43.0	27	105
31	51.1	25	105
40	47.0	103	103

The table shows that all student groups reached criterion on the attitude checklist. The mean scores ranged from 41.7 to 51.1. Four teachers reported student mean scores classified as "sometimes" and six reported mean scores in the "*frequently*" *category*.

The criterion referenced reliability for this instrument was found to be 0.81 (N=20). The rank correlation between the individual's rating and the group's rating was 0.88 (N=20).

The Theme II and Theme III attitude checklists follow the pattern of the Theme I checklist. (Note, however, that the Theme II and III attitude checklists include only items related to the attitudinal goals of their own theme; they do not repeat items related to goals from the previous theme, as do the social skill checklists.) Eight teachers submitted data from administration of the Theme II checklist (teachers 02, 03, 10, 11, 12, 13, 14, and 21). One teacher (teacher 03) submitted data from administration of the Theme III checklist.

Ratings for the Theme II and III checklists can be interpreted according to the following scales:

	Theme II Checklist	Theme III Checklist
Very frequently	77-85	59-65
Frequently	60-76	46-58
Sometimes	43-59	33-45
Seldom	26-42	20-32
Rarely or never	17-25	13-19

Criterion level for Theme II checklist is 43; for Theme III checklist, 33.

Data from these instruments is shown in Table 5.

TABLE 5: Attitude Checklist Data, Themes II and III

	$\bar{X}$	S.D.	N	Population from which sample was taken
Theme II Attitude Checklist	58.3	11.4	50	790
Theme III Attitude Checklist	43.4	8.37	20	80

The criterion referenced reliability for the Theme II checklist was found to be 0.62 (N=50); for the Theme III checklist, 0.62 (N=20). Rank correlation between individual ratings and group ratings were 0.86 (Theme II checklist, N=20) and 0.54 (Theme III checklist, N=20).

The data resulting from the use of these three attitude checklists indicates that the attitudes measured are developed and that criterion levels are not too high. Further studies of the validity, reliability, and setting of the criterion levels are suggested and will be discussed in the following section of this paper.

Further Study of the Instruments

The data on the Social Skill Checklists and Attitude Checklists are summarized in Tables 6 and 7, respectively.

TABLE 6: Summary of Data for the Social Skills Checklists

	Criterion	$\bar{X}$	S.D.	N	Correlation Ind. vs Group	N	Criterion Referenced Reliability	N	No. of Teachers Represented
Theme I	28	39.8	--	393	0.92	20	0.84	20	15
Theme II	53	71.8	13.3	50	0.86	20	0.60	50	8
Theme III	53	74.3	18.40	20	0.85	20	0.64	20	1

TABLE 7: Summary of Data for the Attitude Checklists

	Criterion	$\bar{X}$	S.D.	N	Correlation Ind. vs Group	N	Criterion Referenced Reliability	N	No. of Teachers Represented
Theme I	33	45.6	--	372	0.88	20	0.81	20	14
Theme II	43	58.3	11.4	50	0.86	20	0.62	50	8
Theme III	33	43.4	8.4	20	0.54	20	0.62	20	1

Validity Studies:

Validity of these instruments has been judged primarily by IRA development staff members. Further evaluation of instrument validity should be carried out by a panel of judges other than IRA staff including experienced IRA teachers, science educators, and other educators with background experience related to social skill and attitude development in secondary students. Concurrent validity, assuming that instruments can be identified which share validity with the social skill and attitude checklists, should also be studied.

A technique has been used by Moore and Sutman (1970) for studying validity by providing relevant and irrelevant instruction over a brief period to two comparable groups with pre and post administration of an instrument. Sensitivity of the instrument to the positive and negative instruction is (or is not) demonstrated. Investigation of this procedure for application to the Social Skill and Attitude Checklists should be considered.

Confidence in the criterion levels established for these instruments should be reviewed as a result of the further validation studies.

Reliability:

While the individual score vs. group score correlations and criterion-referenced reliability studies have generated confidence in the reliability of these instruments, further studies could include a test-retest reliability. (Since the individual rating was followed by the group rating, and the individual participated in the group to decide the group rating, it was decided that the individual vs. group correlation provided data somewhat analogous to a test-retest study. Obviously, the test-retest data is more desireable.)

Summary

The specification of social skill and attitude development goals in the Inquiry Role Approach program, and the development of instruments used to assess social skills and attitudes are reviewed. Data from the use of these instruments during the 1972-73 IRA field test are presented. The data show good criterion referenced reliability (0.84, 0.81) for two of the six instruments, and acceptable criterion referenced reliability (0.64, 0.62, 0.62, 0.60) for the remaining four. Suggested further studies of these instruments are discussed.

REFERENCES

Anderson, J. R., Bingman, R. M., and Dowler, C. R. Summary of evaluation meeting, January 20, 1971. Kansas City, Missouri: Mid-continent Regional Educational Laboratory, 1971.

Bingman, R. M., Ed., Anderson, J. R., Blankenship, J. W., Carter, J. L., Cleaver, T. J., Jones, W. G., Kennedy, M. M., Klinckmann, E., Koutnik, P. G., Lee, A. E., and Stothart, J. R. Inquiry objectives in the teaching of biology. Kansas City, Missouri: Mid-continent Regional Educational Laboratory, 1969.

Bingman, R. M., Koutnik, P. G., Seymour, L. A., Padberg, L. F., and Bingman, K. J. Inquiry role approach. Student forms. Kansas City, Missouri: Mid-continent Regional Educational Laboratory, 1972.

Biological Sciences Curriculum Study. Comprehensive final examination. New York: The Psychological Corporation, 1965.

Development of Inquiry Skills Program. Development of inquiry skills intermediate objectives. Kansas City, Missouri: Mid-continent Regional Educational Laboratory, 1970.

Development of Inquiry Skills Program. Teacher's manual for DIS student component. Kansas City, Missouri: Mid-continent Regional Educational Laboratory, 1971a.

Development of Inquiry Skills Program. Report on academic year 1970-71 evaluation and revision of IRA component of DIS. Kansas City, Missouri: Mid-continent Regional Educational Laboratory, 1971b.

Koos, E. M., Principal Author. Explorations in biology. A series of eight instruments for measuring cognitive inquiry skills. Kansas City, Missouri: Mid-continent Regional Educational Laboratory, 1969-72.

Moore, R. W., and Sutman, F. X. "The development, field test and validation of an inventory of scientific attitudes." Journal Research in Science Teaching, 1970, 7, 85.

Seymour, L. A., Padberg, L. F., Bingman, R. M., Koutnik, P. G., and Burton, K. A. The measurement of program implementation and students' cognitive, affective, and social performance in a field test of the Inquiry Role Approach (1972-73). I. Implementation: Its documentation and relationship to student inquiry development. A paper presented to the annual meeting of the National Association for Research in Science Teaching, Chicago, 1974.

Steiner, M. E. A study of the relationship between teacher practices and student performance of selected inquiry process behaviors in the affective domain in high school biology classes. Unpublished doctoral dissertation, University of Texas, Austin, 1970.

Thorndike, R. L., Ed. Educational measurement. Washington, D. C.: American Council on Education, 1971.