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**AN INVESTIGATION OF IRISH STUDENTS' ATTITUDES TO
CHEMISTRY: THE PROMOTION OF CHEMISTRY
IN SCHOOLS PROJECT**

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ABSTRACT: Ireland's student participation in the sciences at Leaving Certificate (LC) level (17 years) has fallen considerably in the last fifteen years. We evaluate the opinions and attitudes of students at Junior Certificate (15 years) to science, prior to LC subject choice, as part of an intervention strategy to promote chemistry. This article is concerned with the reasons given by a group of third year students for their like or dislike of science and their reasons for choosing to study chemistry in the future. This case study shows positive views of science; most students would voluntarily choose science and chemistry (in the future) because they find it interesting. Physics was perceived to be less interesting than chemistry. [*Chem. Educ. Res. Pract.*: 2003, 4, 45-53]

KEY WORDS: *chemistry; attitudes; promotion; secondary schools*

INTRODUCTION

It has been long established that the physical sciences are struggling to sustain pupil interest at second level in Irish Schools (Childs, 1987, Lyons, 1995, Matthews, 1995, The Irish Times, 1999, Sweetman, 1999). The numbers of students choosing to study physics and chemistry at Leaving Certificate (LC) Level has continued to fall for the past two decades. Currently, the percentage of all LC students studying chemistry is 11 per cent (1998/99 figures), falling from 21 per cent in 1987. Fifty per cent of these students were female. In parallel, the numbers taking LC physics has dropped from 21 per cent to 15 per cent in the same period, but with only 25 per cent females.

More significantly is that these decreases in participation are coincident with a 17 per cent rise in LC candidates. Demand for science graduates is exceeding supply in our booming economy (Walsh, 2000). Universities and Chemical and Pharmaceutical industries have highlighted this shortfall (Woods, 2000c, Childs, 1998, 2000). Thus many intervention strategies have been employed at individual level with teachers within schools, and at state level with the Department of Education and Science. These include intervention projects in physics and chemistry (Ni Charthaigh and O'Brien, 1996, Ni Charthaigh and O'Sullivan, 1988, O'Brien and Porter, 1994, O'Donnabháin and Porter, 1991), primary science bus (Woods, 2000b), careers in science information pack (Woods, 2000a) and investment in development of physics and chemistry (Department of Education, 1999). It was against this background that *The Promotion of Chemistry in Schools Project* was established, to investigate (a) the attitudes and interests of Irish students towards the sciences, (b) factors

which may influence their subject choice at senior cycle, and (c) to test an intervention strategy which might increase interest in chemistry.

METHODOLOGY

Description of the project

The Promotion of Chemistry in Schools Project (PCSP) was devised following the results of a pilot scheme (Davies, 1998). The intervention was aimed at (a) positively influencing students attitudes to chemistry in the participating schools, in the hope of increasing the numbers of students studying chemistry at LC Level in subsequent years, and (b) investigating some of the variables influencing attitude formation and change and the effects of attitudes on individual behaviour.

The pilot scheme was introduced in the 1997/98 school year, and was expanded in the 1998/99-school year to involve approximately 8,500 students in sixty-seven schools directly (Intervention schools) and ten schools indirectly (Cooperating schools). It incorporated changes recommended by a survey of the schools involved in the previous year.

The Intervention consisted of two stages. Stage One involved interacting with the students in the participating schools, to actively promote chemistry through the use of a *Chemical Magic Show* (Regan, 1999). The *Chemical Magic Show* involved the presentation of a number of visual experiments with a 'wow' factor, which related to everyday life. Stage Two entailed the positive reinforcement of this promotion through the distribution of a *ChemKidz* magazine containing chemistry jokes, activities, cartoons and career information. This was followed in the second year of the intervention with a similar magazine *CheMystery*.

Evaluation of PCSP

The project is being monitored by a longitudinal study through the use of questionnaires administered to schools, teachers and pupils in the Intervention and Cooperating schools. The impact of the scheme will be measured in two ways. Firstly by any change in the uptake of chemistry at LC level. Secondly by any change in the students' attitudes towards chemistry. Attitudes may be regarded as the end products of the socialization process, and may significantly influence a person's responses to cultural episodes. If the attitude of a person toward a given object is known, then it may be used to predict and explain reactions, and even to alter the individual's reactions to relevant objects (Shaw and Wright, 1967). Attitudes, by definition, entail an existing predisposition to respond to social objects, which, in interaction with situational and other disposition variables, guide and direct the overt behavior of the individual (Cardno, 1955). A positive change in attitude may be an indication of the success of the project. A similar measure of the success of school intervention projects was completed in the *Department of Education Intervention Projects in Physics and Chemistry* (Ni Charthaigh and O'Brien, 1996).

Sample

The data for this paper is a sub-sample gathered in an evaluation study of *The Promotion of Chemistry in Schools Project* that analysed student's interests and attitudes towards the sciences. The study was carried out from September 1998 to May 1999.

The pupils are 88 third year students (52.3% female and 47.7% male) from a mixed Secondary School, randomly selected from the sixty-seven Intervention schools that participated in the research activity. All pupils study Junior Certificate (J.C.) science. The

greater part of the sample (72.7%) is aged 15 years, with several aged 14 (21.6%) and 16 (5.7%) years. The general level of education of the subjects' parents is high: 86.6 per cent of fathers and 95.5 per cent of mothers had attended second level, and 41.7 per cent and 45.8 per cent had attended third level respectively. This is reflected in the occupations of same: 66.7 per cent of fathers and 33 per cent of mothers are professionals or skilled labourers.

Instruments

A questionnaire was designed for use before exposure to *The Chemical Magic Show*, to gather information on the several items (listed below), in an attempt to identify areas of concern to the students, their perceptions of chemistry and science, their attitudes to the subjects, and factors that may influence subject choice. Items were approximately evenly distributed over the three areas of science, and approximately half of the items were stated negatively. The hypothesized variables investigated in the questionnaires provide a means of accounting for observed consistencies in the behaviour of the students and of unifying what may be considered as otherwise discrete data (Shaw and Wright, 1967). Since attitudes have many dimensions and characteristics (Shaw and Wright, 1967) many different types of questions were necessary:

1. General Information: age, gender, year, school type.
2. Parental Information: educational background, occupation, involvement in school work.
3. Subject Information: current studies, subject preferences and choices, career options
4. Interests in the sciences: preference for physics, chemistry, biology, and the applications of the sciences.
5. Gender awareness.
6. General difficulty experienced in science.

Procedure and Analysis

Initial questionnaires were distributed to teachers from October 1998 to February 1999. The teachers in charge of the various classes that participated or cooperated with the research administered the questionnaires before and after exposure to *The Chemical Magic Show*. The second questionnaire was distributed in April 1999. Several of the questions put to pupils were open ended, so that the replies could not be guided or suggested. Pupils responses to these questions have been categorised during analysis, in a similar manner to Nash *et al*, (1984) and Selmes (1969). Quotations from pupils are included in the article to exemplify the types of responses received.

RESULTS

Choice of science as a subject at school

When students were asked the question "Would you choose to study science if you had a choice?" 87.5 per cent answered that they would. The most frequently stated reason was because it was interesting (62.2%), and other reasons included, because they liked it (9.5%) and for their future or for a career (6.8%). The range and frequencies of all responses given are displayed in Table 1. The total number of responses to this question was 74, the actual and valid percentage values are presented. Of the 12.5 per cent students that would choose

not to study science if given the choice, 60 per cent believed science to be difficult. Other reasons are presented in Table 2.

Respondents' favourite subjects were science (20.9%), followed by physical education (14%), woodwork (12.8%) and home economics (10.5%) see Table 3. The least favourite school subjects in the sample were maths (31%), Irish (23.8%), and French (15.5%). Science was considered to be the least favourite school subject among 4.8 % of the surveyed students (see Table 4).

Interest in the sciences

Interest in the sciences was ascertained by the question "List the following subjects in order of interest, with 1= most interesting, 2= somewhat interesting, and 3= least interesting". 71.6 per cent of the students surveyed considered biology to be the most interesting science. The physical sciences, physics and chemistry, show quite a different picture. The least popular science is physics, some 62.4 per cent of the sample considered physics to be least interesting, and just 8.2 per cent thought it to be most interesting. This contrasts strongly with biology, as only 4.5 per cent of the sample considered biology to be least interesting. Chemistry was considered to be least interesting by 32.9 per cent of the sample and most interesting by only 21.2 per cent.

There was however, 'some' interest in the physical science as indicated by the option 'somewhat interesting'. Chemistry was 'somewhat interesting' to 45.9 per cent of the sample, and physics was found to be 'somewhat interesting' to 29.4 per cent of the surveyed students.

TABLE 1. *Why would you choose science?*

		<i>Frequency</i>	<i>Percent</i>	<i>Valid Percent</i>
Valid	It is interesting	46	52.3	62.2
	For course requirement	2	2.3	2.7
	For future and career	5	5.7	6.8
	Fun to learn	1	1.1	1.4
	Like doing experiments	2	2.3	2.7
	Like it	7	8.0	9.5
	Interesting and enjoy/like experiments	2	2.3	2.7
	It's Easy	4	4.5	5.4
	Total	74	84.1	100.0
Missing		14	15.9	
Total		88	100.0	

TABLE 2. *Why would you not choose science?*

		<i>Frequency</i>	<i>Percent</i>	<i>Valid Percent</i>
Valid	It's boring	2	2.3	20.0
	It's difficult	6	6.8	60.0
	Don't like cutting up animals	1	1.1	10.0
	Too much work	1	1.1	10.0
	Total	10	11.4	100.0
Missing		78	88.6	
Total		88	100.0	

TABLE 3. *What is your favourite school subject?*

		<i>Frequency</i>	<i>Percent</i>	<i>Valid Percent</i>
Valid	Irish	7	8.0	8.1
	English	6	6.8	7.0
	Maths	3	3.4	3.5
	History	4	4.5	4.7
	Geography	1	1.1	1.2
	Science	18	20.5	20.9
	Home Economics	9	10.2	10.5
	Art, Craft and Design	7	8.0	8.1
	Woodwork	11	12.5	12.8
	Technical Graphics	4	4.5	4.7
	Business	4	4.5	4.7
	PE	12	13.6	14.0
	Total	86	97.7	100.0
Missing		2	2.3	
Total		88	100.0	

TABLE 4. *What is your least favourite school subject?*

		<i>Frequency</i>	<i>Percent</i>	<i>Valid Percent</i>
Valid	Irish	20	22.7	23.8
	Maths	26	29.5	31.0
	History	8	9.1	9.5
	Geography	7	8.0	8.3
	French	13	14.8	15.5
	German	3	3.4	3.6
	Spanish	1	1.1	1.2
	Science	4	4.5	4.8
	Business	2	2.3	2.4
	Total	84	95.5	100.0
	Missing		4	4.5
Total		88	100.0	

Science class

When students were asked "Do you like science class?" 68.8 per cent stated that they did, 26.7 per cent stated that they did not, and 4.7 per cent stated that they liked science class some of the time. The reasons students liked class were varied (see Table 5), but the most frequent responses was because "it is interesting" (50.8%), followed by "because of the experiments" (30.5%). When further asked, "How many experiments do you complete in class per week?" 49.4 per cent stated that one or two experiments were completed per week, and 14.9 per cent stated that between two and four were completed. A further 18.4 per cent stated, "It varies from week to week depending on the chapter being studied". Table 6 shows the reasons why 26.7 per cent of the sample disliked science class. The most frequent responses, were because "its boring" (31.8%), and "too difficult" (22.7%). Other reasons included "don't understand it" (13.6%) and "not interested in it" (13.6%).

The parts of the science that students liked most involved the response to four items which had to be ranked as 'most favourite', next favourite', 'second next favourite', or 'least favourite'. The part of science class that the sample found to be their most favourite was the experiments that they complete themselves (88.5%), and the remaining order was as follows, 'teacher experiments' (13.2%), 'and 'the text you learn' (2.9%). The second next favourite

TABLE 5. *Why do you like science class?*

		<i>Frequency</i>	<i>Percent</i>	<i>Valid Percent</i>
Valid	Interesting	30	34.1	50.8
	Learn about different things about science	3	3.4	5.1
	Because of the experiments	18	20.5	30.5
	Its easy	1	1.1	1.7
	Interesting and I like the experiments	6	6.8	10.2
	I like the teacher	1	1.1	1.7
	Total	59	67.0	100.0
Missing		29	33.0	
Total		88	100.0	

TABLE 6. *Why do you dislike science class?*

		<i>Frequency</i>	<i>Percent</i>	<i>Valid Percent</i>
Valid	Cannot understand the teacher	1	1.1	4.5
	Difficult	5	5.7	22.7
	It's Boring	7	8.0	31.8
	Don't understand it	3	3.4	13.6
	Not interested in it	3	3.4	13.6
	Difficult and boring	1	1.1	4.5
	Don't do experiments	2	2.3	9.1
	Total	22	25.0	100.0
Missing		66	75.0	
Total		88	100.0	

TABLE 7. *Why would you choose chemistry?*

		<i>Frequency</i>	<i>Percent</i>	<i>Valid Percent</i>
Valid	Interested in the subject	19	21.6	23.8
	College course requirement	16	18.2	20.0
	Easiest science subject	5	5.7	6.3
	Opens up a variety of career doors	19	21.6	23.8
	Other	2	2.3	2.5
	College/career (rep 2+4)	4	4.5	5.0
	Interest/easy (rep 1+3)	3	3.4	3.8
	Wouldn't choose it	3	3.4	3.8
	Interest/requirement (1+2)	8	9.1	10.0
	All of the above	1	1.1	1.3
Total	80	90.9	100.0	
Missing		8	9.1	
Total		88	100.0	

was the teacher experiments and demonstration at 80.9 per cent. The least favourite part of science class was the 'written work they do' (75.8%), followed by 'the text you learn' (24.6%).

When students were asked for reasons why they would choose to study chemistry (selected from a list), 'interest in the subject', 'college course requirement', and 'opens a variety of career doors' were the most frequent of the responses at 23.8 per cent, 20 per cent, and 23.8 per cent respectively. A small number of students (3.8 per cent) indicated that they would "never ever" choose chemistry. All responses may be seen in Table 7.

CONCLUSION

General science has become a core component of many schools' curricula, despite being absent from the core as devised by the Department of Education and Science. Thus a large proportion (87% J.C. cohort) of students (Department of Education, 1999) study general science. We were curious to determine if these students would choose to study science for the J.C. examination if they had been given a choice, how they feel about science, science class and what their favourite school subjects are. The findings of this article may be seen as uncharacteristically positive, and not the least representative of previous research or expected outcomes of the current research however, and must be viewed only for what they are, the views of a group of students from one Irish school.

The first most startling result is that quite a majority of the students sampled (87.5%) would choose to study science voluntarily. More significantly, their reasons refute research reporting reasons for the decline in the interest in the sciences. The drop in the numbers of students studying chemistry at senior level has been described as the decline in the *interest* in science (The Irish Times, 1999). Our case suggests that the reason these students would choose science is precisely *because* they are interested. '*Interest*' was also cited by Scottish students, as motivation for continuing studies of science/physics in a study to investigate factors influencing the popularity of Physics at Higher Grade level (Reid & Skryabina, 2002). Reflecting published research, the perceived difficulty and 'boring' nature of science (Drudy, 2000, Moran, 1998, Sweetman, 1999, Cashell, 1999) is the explanation given by students that would not have willingly chosen science given the opportunity.

Furthermore, 20.9 per cent of students believe that science is their favourite subject, the highest preference for any subject from some 33 subjects on offer at this level. Only 4.8 per cent viewed it as their least favourite. Thus it appears that these students perceive science positively. One could conclude that these students must have a very dedicated, enthusiastic and entertaining teacher. The influence of the teacher on attitudes to science has been reported by Ormerod and Duckworth (1975). Moreover, these students have reported the completion of two or more experiments per week, believed to increase pupils' interest in science. The influence of the teacher in this scenario appears to be supported by the low preference for Maths as a favourite subject, 3.5 per cent, and the high percentage of students, 31 per cent that reported it as their least favourite school subject. On viewing these results our 'magician' consulted a diary maintained during the delivery of *The Chemical Magic Show*, where this school is commented on as follows:

"All shows here were great, from first years to fifth years. No trouble getting volunteers, laughs or amusing comments. Well-behaved students, unafraid to respond. Excellent!"

A large percentage (68.8%) like their science class, substantiating the suggestion that these students have a committed teacher, especially considering the reasons for liking the class. The main reason was 'because it is interesting' followed by 'because of the experiments', rather than the reverse. The parts of science class that these students liked most reflect this.

There were only minor revelations in the replies to probes concerning the interest in the components of general science; 71.6 per cent found biology to be most interesting. The popularity of such responses is consistent with previous research findings, which found that chemistry, together with physics, ranked low on popularity (Wienekamp *et al.*, 1987). With regard to the physical sciences however, physics rather than chemistry is reported as the least interesting science.

Should these students choose to study LC chemistry next year, the reasons for their choice indicate their interest in the subject and college or career intentions. It seems clear that this school is marketing chemistry adequately since these students certainly have positive views of science.

Finally, the impact of The Chemical Magic Show on student uptake of LC chemistry overall was difficult to determine based on preliminary results, as the response rate to the uptake questionnaire is only 46 per cent. Based on actual responses from schools however, 43 per cent experienced an increase in the uptake of LC chemistry. It is intended to compare the actual uptake of chemistry in the schools visited to the Department of Education and Science Statistics. Seventy per cent of these schools attributed the increase to our intervention strategy. This is very encouraging at this early stage of analysis.

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