

THE EFFECT OF REFORM CURRICULA ON PRE-SERVICE TEACHERS' ATTITUDE TOWARDS MATHEMATICS ON ENTRY TO INITIAL TEACHER EDUCATION

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Background to the Study

Students' experience of school mathematics prior to entering third level education has been shown to impact the development of attitudes towards mathematics.



Teacher attitudes influence instructional techniques used in classrooms and the organisation of content



Positive teacher attitudes play a part in the formation of positive student attitudes

Why 2003 and 2013?

- Review and reform has been a constant feature of the Irish mathematics education landscape for the last 15 years.
- Reform of school curricula began at the primary level and was followed almost a decade later by reform of secondary school mathematics.



‘Traditional’ Approach of
imparting knowledge



Teaching for understanding,
problem solving, discussion and
technology



Traditional Curricula

- exit exams strongly influence how and what is taught
- memorisation of formulae and procedures
- mathematical experiences limited to 'tell and drill'
- learned-helplessness
- lack of perseverance when presented with even slightly unfamiliar work

Reform Curricula

- to develop a positive attitude towards mathematics
- higher-order thinking and problem-solving skills
- prediction and estimation skills rather than rote learning
- collaborative learning
- child being the instrument of his/her own learning

Theoretical Perspective

Attitude can be defined as:

“mental and neural state of readiness, organised through experiences, exerting a direct or dynamic influence upon the individual’s response to all objects and situations with which it is related”

(Allport 1947, p805)

Attitude to mathematics can be defined as:

“an aggregated measure of a liking or disliking of mathematics, a tendency to engage or avoid mathematical activities, a belief that one is good or bad at mathematics, and a belief that mathematics is useful or useless”

Neale 1969, p. 632

Teacher Attitudes and Behaviour

The importance of teachers' possessing a positive attitude towards mathematics has long been established:

- Influence instructional techniques used in classrooms
- Influence their organisation of content
- Focus on understanding, exploration and the discovery of mathematical relationships rather than more rule-based, teacherdirected strategies
- More willing to embrace innovative instruction and reform

The Importance of Exploring Pre-service Teacher Attitudes Towards Mathematics

- Previous research indicated entrants to primary ITE programs, possessed negative attitudes towards mathematics and fears about the teaching of mathematics.
- More dominant among pre-service teachers than other university populations.
- Attitudes greatly influence what students learn and can impact their receptiveness to learning theories and approaches promoted in education programs.
- Left unchallenged, they will affect the next generation of pupils' attitudes

Research Design

Purpose of the study:

This study examined the mathematics attitudes of two cohorts of pre-service primary teachers entering an initial teacher education program, who had experienced both traditional and reform curricula.

Participants:

Attitudes of 360 pre-service primary teachers were compared to 419 pre-service teachers entering the same college of education a decade later. The latter experienced reform mathematics curricula at both primary and secondary levels whereas the earlier cohort experienced traditional curricula.

Research Instrument:

Participants' attitude towards mathematics was determined by administering Aiken's Revised Mathematics Attitude Scale (Aiken, 1974).

- Measures Enjoyment of Mathematics (E) and belief in the Value of Mathematics (V).
- Participants required to select a response from a range of responses presented on a Likert scale.
- Responses for each item ranged from 0 to 4 (0=strongly disagree, 1=disagree, 2=unsure, 3=agree, 4=strongly disagree),

Results

Mean scores were calculated for individual items.

As the mean scores for individual items may range from 0 to 4, it was considered that scores falling in the range 0–1.49 indicated disagreement, 1.50–2.49 indicated indecision and 2.5–3.99 indicated agreement.

Table 1 Descriptive statistics for items on the Aiken (1974) Enjoyment of Mathematics scale

Item no.	Item	2003 Mean (standard deviation)	2013 Mean (standard deviation)
1	I enjoy going beyond the assigned work and trying to solve new problems in mathematics	1.73 (1.13)	1.63 (1.04)
4	Mathematics is enjoyable and stimulating to me	2.17 (1.15)	2.08 (1.11)
7 ^a	Mathematics makes me feel uneasy and confused	1.37 (1.07)	1.67 (1.06)
9	I am interested and willing to use mathematics outside school and on the job	2.56 (0.908)	2.67 (0.860)
12 ^a	I have never liked mathematics, and it is my most dreaded subject	1.13 (1.14)	1.46 (1.26)
13	I have always enjoyed studying mathematics in school	2.25 (1.23)	2.07 (1.16)
15 ^a	Mathematics is dull and boring because it leaves no room for personal opinion	1.64 (1.09)	1.82 (1.07)
20	I would like to develop my mathematical skills and study this subject more	1.37 (0.902)	2.67 (0.888)
22 ^a	Mathematics makes me feel uncomfortable and nervous	1.36 (1.07)	1.54 (1.06)
23	I am interested and willing to acquire further knowledge of mathematics	2.85 (0.780)	2.80 (0.781)
25	Mathematics is very interesting, and I have usually enjoyed courses in the subject	2.34 (1.09)	2.25 (1.08)

^a Item is negatively worded

Examination of Table 1 shows:

- Five of the items fell within the 'undecided' range (i.e. item 1, 4, 13, 15, 25) for both cohorts.
- Four items had mean scores that were non-neutral for both cohorts (item 9, 12, 20 and 23).
- Both cohorts disagreed with the statement (item 12) 'I have never liked mathematics, and it is my most dreaded subject'.
- 2003 score was statistically significantly lower when compared to 2013, suggesting a stronger level of disagreement

- Two items on the E scale showed divergent responses between cohorts.
- Item 7 'Mathematics makes me feel uneasy and confused' and item 22 'Mathematics makes me feel uncomfortable and nervous'.
- In both cases, the 2013 cohorts' mean score suggests uncertainty with the statements as compared to the 2003 cohort who disagreed with both statements.
- The 2003 cohort had a higher mean score compared to the mean score for the 2013 cohort.
- These mean scores are higher than that of Aiken's (1974) study of American teachers

Table 2 Descriptive statistics for items on the Aiken (1974) value of mathematics scale

Item no.	Item	2003 Mean (standard deviation)	2013 Mean (standard deviation)
2	Mathematics has contributed greatly to science and other fields of knowledge	3.42 (0.668)	3.40 (0.733)
3 ^a	Mathematics is less important to people than art or literature	1.4 (1.08)	1.55 (1.04)
5 ^a	Mathematics is not important for the advance of civilization and society	0.874 (0.879)	0.71 (0.828)
10	Mathematics is a very worthwhile and necessary subject	3.16 (0.636)	3.16 (0.723)
11	Mathematics is needed in order to keep the world running	2.93 (0.889)	3.22 (0.766)
14 ^a	There is nothing creative about mathematics; it's just memorizing formulas and things	1.47 (1.06)	1.49 (1.07)
16	An understanding of mathematics is needed by artists and writers as well as scientists	2.06 (0.88)	2.23 (0.889)
17	Mathematics helps develops a person's mind and teaches them to think	3.27 (0.641)	3.20 (0.638)
21 ^a	Mathematics is not important in everyday life	1.06 (0.933)	0.91 (0.884)
24	Mathematics is needed in designing practically everything	2.82 (0.855)	3.05 (0.778)

^a Item is negatively worded

Examination of Table 2 shows:

- Only one item (Item 3) in the undecided band and only for the 2013 group.
- Both cohorts had the same two items with mean scores which indicated disagreement with the statements (item 5, 21).
- Item 5 'Mathematics is not important for the advance of civilization and society' and (item 21) 'Mathematics is not important in everyday life'
- The 2013 scores were statistically significantly lower than that of the 2003 scores

- Both cohorts, six items had a mean score indicating agreement with the statements (item 2, 10, 11, 16, 17 and 24).
- For item 24 'Mathematics is needed in designing practically everything' 2003 participants had a more positive attitude than the 2013 cohort
- The overall mean score indicated that students were in agreement that mathematics is valuable.
- An independent samples t test indicated that the 2013 cohort had more positive attitudes regarding the value of mathematics.
- Again, these means were higher than that of Aiken's (1974) study of American pre-service teachers.

Discussion

- Responses on both scales indicate very positive attitudes towards mathematics on entry to third-level education.
- Responses on the 11-item Enjoyment of Mathematics scale were very similar for both groups.
- The 2003 cohort's total score on the Enjoyment scale was statistically significantly higher than the 2013 cohort.

- While we might anticipate change in attitudes, it is based on the premise that reforms are faithfully implemented.
- It worth noting that the 2013 participants only experienced the reform primary curriculum for the latter years of their primary school education.
- In addition, they were one of the first cohorts of secondary school students to experience the full secondary school reform curriculum.

- Responses on the Value of Mathematics scale reveals similarity in how cohorts responded to specific items on the scale
- However the 2013 cohort scores for the Value of Mathematics scale were significantly higher than for the 2003 cohort.

The evaluation of the reform curriculum provides support for this hypothesis as the evaluation revealed that students 'tend to recognise the broader application of mathematics' and 'are developing a general awareness of the importance of mathematics in further study and of its broader application' (Jeffes et al., 2013, p. 63).