Making the Transition:

A Student's Mathematical Journey from Primary to Post-Primary School in Ireland

Dr Veronica Ryan

Department of Mathematics & Statistics
EPI-STEM - National Centre for STEM Education,
University *of* Limerick

ILSA

Significance of this Study

- This is the **first Irish study** to investigate
  - **academic progress** in mathematics between the end of sixth class and the end of first year.
  - **student attitude** towards mathematics at the end of first year.

- What was your experience of mathematics in first year of post-primary school?
- Why do you think it is important to study the transition process?

Why study the transition process?

"The transition from primary to secondary schooling is one of considerable change for students. A student's ability to cope with the many changes inherent in this transition is likely to influence how they feel about school and how they progress and develop, academically, socially and emotionally."

(Cox and Kennedy 2008, p.121)

> Central to student confidence and the sustainment of student interest and passion for learning as students pass from primary to secondary school

> Unsuccessful transition- social and academic implications

> Significant point

> Impact on students' emotional health

> Need to get this right- raise levels of achievement

Significance of this Study

- What are the current efforts to support this transition?

- Background to the research
- Research intentions & objectives
- Motivation

Research Questions

> Academic Progress

- Do the majority of students make progress in mathematics in first year of post-primary school?
- What progress is made in the strand areas of No., Measures, Shape & Space, Algebra & Data?
- What progress is made in the process skills of Concepts & Facts, Computation & Word Problems?
- What are the implications from the results of first year data?

> Affective

- How do students engage with and learn mathematics at the end of their first year of post-primary school?
- Are they open to problem solving in their first year in post-primary school?
- What are students' self-beliefs towards mathematics at the end of their first year?
- Do students take responsibility for failure in mathematics in first year?
- Have they career aspirations relating to mathematics at this time?
- Do students engage in mathematics related activities?
- Do the parents and friends of the student value mathematics?

> Improving Performance

- How can academic progress and positive attitude towards mathematics be improved in first year?
- Are there links between the student attitude and performance?

Relevant Studies

- ORACLE Study (Galton *et al.,* 1999)
  - **40%** of students **failing to make academic progress** in mathematics.
  - **7%** of students making **significant losses of 25%** *to* **33%** of the possible marks.

- Moving Up Study (Smyth *et al.,* 2004)
  - The **majority of students did not make progress** in computation between the September and May of first year.
  - **Only 10%** of students showed a significant improvement in computation.
  - **Parental involvement** was also shown to be **positively correlated** with **progress** in computation scores.

- Students' Transition from Primary to Secondary Schooling Study (Cox and Kennedy, 2008)
  - By the **end of first year**, the majority of students were achieving **at or above** the **level achieved at the end of primary school**.
  - As all students journey through school, their **attitude** towards mathematics becomes **less positive.**

Methodology

- Chronology of research
- Research paradigms
- Research instruments
- Validity & reliability
- Sample (723 schools, 61 196 students)

	Projected			*Actual*		
Post-Primary School Type	**% total students attending**	**No. of sample schools**	**No. of Students**	**% total students attending**	**No. of sample schools**	**No. of students**
Secondary	*51.60%*	*10*	*197*	*47.68%*	*7*	*154*
Vocational	*32.81%*	*7*	*125*	*37.15%*	*5*	*120*
Community	*13.47%*	*3*	*51*	*15.17%*	*2*	*49*
Comprehensive	*2.13%*	*0*	*8*	*0.00%*	*0*	*0*
TOTAL	*100.00%*	*20*	*382*	*100.00%*	*14*	*323*

Curriculum Mapping

- The congruence and difference of learning outcomes between the sixth class curriculum and the Common Introductory Course are outlined by the map and a huge level of repetition exists between both curriculums.
- The SIGMA-T is fit for purpose to assess mathematical performance of both sixth class and first year students.

% of Questions in SIGMA-T by Strand & Process Skill

Strand	Understanding concepts & recalling facts	Performing computations & procedures	Solving word problems	Total
Number	*17.65%*	*14.29%*	*7.56%*	*39.50%*
Measures	*4.20%*	*7.56%*	*18.49%*	*30.25%*
Shape & Space	*9.24%*	*1.68%*	*0.00%*	*10.92%*
Algebra	*1.68%*	*3.36%*	*0.00%*	*5.04%*
Data	*5.04%*	*6.72%*	*2.52%*	*14.29%*
Total	*37.82%*	*33.61%*	*28.57%*	*100.00%*

Theoretical Framework

The frameworks provide a lens for **interpretation of the findings** and **add depth** to the **analysis & recommendations**.

- Communities of Practice (Wenger 1998)
- Rite of Passage (Clark and Lovric 2009)
- Schlossberg's Theory on Adult Transitions (Schlossberg 1981)

Communities of Practice (Wenger 1998)

- The model stresses the **importance of relationships** and a **sense of membership to the community during transition** and this participation within the community involves a **reconstruction of identity**.
- By **feeling that they are part of the community**, the **learner actively engages** in the environment **supported** by the knowledge and skills of the more **competent members** of the community.
- **Learning** is a social endeavour within a community that requires the **collaboration of parents, children and teachers**.
- **Parents and teachers not only teach but also learn from their involvement with the child** (Rogoff *et al.* 2003).

Theoretical Framework

- Rite of Passage (Clark and Lovric 2009)
  - Importance of **functioning community as a support** for individual undergoing transition.
  - Examines transition over a **2yr period** > adapting to transition takes time.
  - Process must include **physical & psychological pain** *(death of old self for new self to emerge)*.
  - **Responsibility** firmly **on the student** > encourages **lifelong learning & self-discipline**.
  - **Warns against disempowering students through initiatives planned to smooth transition** > if such initiatives prevent students gaining skills they need to cope with future transitions in their lives.

- Schlossberg's Theory on Adult Transitions (Schlossberg 1981)
  - **Centres on the individual** experiencing the transition & their **unique perception** of the transition.
  - **Each transition type marks a change in relationships, routines, beliefs & roles** > inherent part of student's journey from primary to post-primary school.
  - The model contends that an individual's ability to cope with a transition depends on their apparent or actual **balance of resources to deficits** at the time of transition. **When the deficits outweigh the resources, adaptation to change can be more challenging.**

Academic Progress

- The academic **results** of this study **indicate student failure** to **successfully negotiate transition in mathematics**.
- On **average**, out of the 119 questions on the test, students scored **8 marks less than** they had scored a **year previously**, despite covering a very similar curriculum in sixth class and first year.
- The **losses incurred in mathematics in first year** found in this study were **far more pronounced than both national and international comparable studies**.
- The **mean decrease in percentiles was 12.00** with a **95% confidence interval** ranging from 9.87 to 14.14.
- There was a **statistically significant decrease in STEN scores** from Time 1 ($M = 6.62$, $SD = 1.96$) to Time 2 ($M = 5.85$, $SD = 1.96$), $t(175) = 11.04$, $p < .005$ (two-tailed). The data shows a **positive correlation between STEN score 1 and STEN score 2**, $r = 0.89$, $n = 176$, $p < .005$.
- The **mean decrease in STEN scores was .77** with **a 95% confidence interval** ranging from **.63 to .91**. The eta squared statistic (.41) indicated a large effect size.

Academic Progress

- In England, the replication of the **ORACLE** (Observation Research and Classroom Learning Evaluation) study of transfer found **34%** of students scoring less on the standardised mathematics tests after a year in secondary school than they had a year previously (Galton, Morrison, and Pell 2000).
- For student group A, where it was possible to compare raw scores at the end of sixth class with raw scores at the end of first year of post-primary, **81% of students disimproved**.

Academic Progress

- **Statistically significant decreases** were recorded in **all strand areas** and in **each process skill**.

Strand/ Process Skill	Decrease from 6th Class
Shape & Space	12.46%
Data	11.55%
Algebra	6.18%
Measures	5.39%
Number	3.82%
Computation	8.75%
Word Problems	6.91%
Concepts & Facts	5.77%

Student Attitude

- **28,155** questions were corrected by the author (n=304).

- **Motivation** to learn mathematics
  - **75%** of all students are **willing to study harder than is required**.
  - **Male students** have higher levels of perseverance: **25%** of males identify with *"When confronted with a problem, I give up easily"* compared to **40%** of females.

- Mathematics **self-beliefs**
  - **Affects engagement**.
  - **All students** show **high levels of anxiety**, particularly **female** students.
  - **Male** students show significantly **higher levels of self-efficacy** and **self-concept** than female students.

- **Students' attributions of failure & openness to problem solving**
  - **Male** students more **open to problem solving**.
  - **Female** students more likely to **attribute failure to lack of ability**.

Student Attitude

- **Mathematics related behaviours, intentions & subjective norms**
  - **2.7%** of students participate in a **mathematics club**.
  - **68.9%** of students plan on pursuing a **career** involving a lot of **mathematics**.
  - **98.4%** of students agree that their **parents believe it's important for them to study mathematics.**
- **How students learn** mathematics
  - **53.1%** go through **examples** again and again in order to solve a mathematics problem.
- **Gender** differences
  - **Female students** have **higher levels of anxiety** and **lower levels of self-concept & self-efficacy**.
  - I often worry that mathematics classes will be difficult for me. (F=56.2%, M=38.5%)
  - Calculating how much cheaper a TV would be after a 30% discount (F=54.5%, M=74.7%)
  - Working out from a train timetable how long it would take to get from one place to another (F=69.2%, M=86.3%)

Item Analysis

- **35,819** questions were corrected by the author (n=301).
- Statistically **significant difference in raw scores of female students** (**M = 62.56**, SD = 20.31) and male students (**M = 70.35**, SD = 20.30), t (299) = -3.27, p < .001 (two-tailed).

- GENDER GAP IN PERFORMANCE

		% Questions Answered Correctly		
		Female	**Male**	**Difference**
Strand Area	*Number*	*57%*	*64%*	*7%*
	Measures	*42%*	*49%*	*7%*
	Shape & Space	*48%*	*53%*	*5%*
	Algebra	*57%*	*68%*	*11%*
	Data	*63%*	*68%*	*4%*
Process Skills	*Concepts & Facts*	*59%*	*68%*	*8%*
	Computation	*52%*	*58%*	*6%*
	Word Problems	*44%*	*49%*	*5%*

Item Analysis

- Number
  - 19% of students could not subtract 498 from 6256.
- Measures
  - 26% of respondents could not write the time 25 to 7 on the digital watch image provided.
- Shape & Space
  - 44% of students could not draw a line perpendicular to a given line.
- Algebra
  - 42% of first year students were not able to figure out what number came next in the following sequence: 5, 8, 14, 26, 50, …
- Data
  - 61% of students failed to calculate the average monthly rainfall given a trend graph which presented the monthly rainfall for the year.

Attitude & Achievement

- *293 students*

Students who Agree or Strongly Agree	**STEN 1-3**	**STEN 4**	**STEN 5-6**	**STEN 7**	**STEN 8-10**
I often worry that mathematics classes will be difficult for me.	83.33%	72.92%	43.75%	35.56%	12.28%
I am just not good at mathematics.	46.67%	60.42%	24.11%	8.89%	5.26%
I get very tense when I have to do mathematics homework.	43.33%	40.43%	18.75%	8.89%	5.26%
I get good grades in mathematics.	43.33%	45.83%	83.93%	88.64%	98.25%
I get very nervous doing mathematics problems	44.83%	43.75%	27.68%	6.82%	3.51%
I learn mathematics quickly.	46.67%	29.17%	65.77%	77.78%	98.21%
I have always believed that mathematics is one of my best subjects.	43.33%	16.67%	57.14%	75.56%	87.50%
I feel helpless when doing a mathematics problem.	53.33%	31.25%	23.42%	2.22%	0.00%
In my mathematics class, I understand even the most difficult work.	34.48%	22.92%	45.54%	57.78%	75.44%
I worry that I will get poor grades in mathematics.	82.76%	72.92%	53.57%	24.44%	22.81%

Attitude & Achievement

> Perseverance
  - **No student with a STEN score above 7 identified with** *"When confronted with a problem I give up easily"* or *"I put off difficult problems".*

Potential Causes

> Mathematics instruction time

> Textbooks

> Teacher & tabula rasa approach

> Poor collaboration of first year and sixth class teachers

Contributions

- Evidence-based approach to the academic transition
- Lost Year in mathematics
- Failure of the CIC
- Emotional disposition towards mathematics
- Extensive research which adds to knowledge for mathematics education generally and is in support of national priorities
- International dimension

Recommendations

What do you think would prevent academic decline in mathematics over the transition?

Recommendations

1. Increase instruction time.
2. Improve female performance.
3. Increase focus on basic mathematical skills.
4. Collaboration between sixth class and first year teachers.
5. Tackling student self-beliefs in particular female self-efficacy and anxiety.
6. Ensure the best teachers teach first year students & that teachers are made aware of the impact of transition on mathematics learning.
7. Use of the Calculator in First Year.
8. Special implementation group of stakeholders.
9. Increase the role of parents in post-primary mathematics.
10. More research into bridging framework & common introductory course.

Future Research

- Data bank- subjected to further analysis.
- Constructing transition curricula for mathematics.
- Evidence based research- causes and remedies for identified shortcomings.