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**Perceptions
of
Physics**

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Abstract:

How do students actually perceive Physics and Physics-related careers? How does this perception develop? As a Physics teacher these are intriguing questions that established a motivation and curiosity to research how students and the wider community perceive Physics.

The increasing urgency with which governments, industry and academia both nationally and internationally are pressing for a greater number of Physics students and graduates further fuelled the desire to research this issues and contribute to the discussion.

The research project has three aims and stages:

- 1. establish what is the current status of student and teacher perceptions of Physics and Physics-related careers*
- 2. evaluate the methods that promote a positive image of Physics and Physics-related careers within the school community.*
- 3. create sustainable strategies for informing the community of the nature of Physics and the opportunities within Physics-related careers*

The focus of the study is on state and independent schools from Queensland's Sunshine Coast. The cohort consists of all Year 11 students, those that have and those that have not selected Physics.

Introduction

Throughout 2005/2006 there seemed to be plethora of articles and reports^{2,4,8,10} that seemed to be painting a picture of doom and gloom regarding the number of students studying Physics at all educational levels. This picture had been in progress for several years (if not decades) with the Institute of Physics (IOP) in the UK the Australian Institute of Physics (AIP) and many educational researchers highlighting the plight of the Physics student (and Physics teacher) as if they were a dying breed!! Equally alarming was the supposed dire consequences this dearth of students and consequent lack of skilled employees was having on the nations (indeed global) economy.

The educational press was running hot (and still is....) about what should be done to solve this issue and address the falling numbers. In the UK the issue of the lack of Physics teachers had become so hot that it has been elevated to the political stage – with the government looking to supplement university fees for those students who chose to enter Physics teaching courses and schools given the freedom to enhance salaries to attract and retain quality Physics teachers. In Australia there did not seem to be the same political urgency or was it that the situation not as acute – there were rumblings in the political arena^{1,12}; however, no concrete action had been taken on a national scale to attract Australian students to Physics rather the government migration regulations had changed to accommodate skilled migration Was this the answer?? Individual States had commenced addressing the recruitment of Physics students by evolving new contextual Senior Physics courses, seemingly making Physics more accessible and relevant to generation Y; would this be the Physics saviour??

As a Queensland high school Physics teacher there was the motivation and curiosity to research what was happening in Queensland and pose a range of interrelated questions. Are the numbers of Physics students in Queensland schools declining? How do these figures compare to the other States in Australia? Can more students be encouraged to study Senior Physics and subsequently study Physics at University? Do we need more Physics students? What factors influence students to study (or not to study) Physics? Had the experiences of those students and teachers on the pilot contextual Physics syllabus had positive experiences and resulted in the expected increase in enrolments?

This cloud of ideas or thoughts generated the original research question of “*How can more high school students be encouraged to study senior Physics?*”

Methodology and Methods

An integration of quantitative and qualitative approaches were utilised in the overall research methodology, based on consideration of the strengths and weaknesses of each methodological paradigm, and a realistic appraisal of the usefulness of each to assist in answering the research questions raised. Both approaches also acted as a form of triangulation as supported by Walter (2006)¹⁵ and Hoyle (2002)³, thereby enhancing the reliability and validity of the research findings.

The decision to be pragmatic on a ‘mixed methods’ approach to gather data was based on the acceptance that neither paradigm had superiority over the other and that the research question should dictate the research methods (Tashakkori and Teddie, 1998)¹⁴. The arbitrary choice of one method exclusively is detrimental to the research process. The pragmatic approach of choosing the most appropriate method and acknowledging each has its merits reflects a personal philosophical stance that there is no one all encompassing ‘method’ that is superior to all others.

A preliminary study was established that incorporated;

1. A statistical analysis of the quantitative data of students studying senior Physics at high school (in all Australian States) over the past 10 years. This analysis was performed to identify any specific trends that may exist and establish the premise for the research¹⁰.
2. A student questionnaire was trialled that included questions aimed at generating quantitative data about students perception of Physics and the influence this had on subject selection.
3. Qualitative data was gathered by means of several focus groups – with the main aim of developing a deeper understanding of the thought process of the students' during subject selection. Additionally, the purpose of this focus groups was to have an open discussion about the questions asked in the questionnaire and if the questions cover all aspects of the subject selection process and perceptions of Physics. The focus groups and preliminary research was instrumental in producing a modified student questionnaire.

The above philosophical methodology is one of pragmatism and embraces several methodologies, with the primary focus being that of phenomenological research. The prime phenomenological methodology is trying to share the students lived experience. The method that generates the phenomenological data will be primarily that of the varied focus groups but it is hoped that this data will produce a triangulation with the quantitative data generated by the modified student questionnaire. From a phenomenological point of view, the aim is to collect examples of experiences in order to reflect on the meanings that may be inherent in them and produce a holistic and deeper description and understanding of students' thoughts and perceptions of Physics. In this way, the combination of a quantitative method that produces an overall structure and the qualitative approach that allows one to investigate the social issues of subject choice and the perceptions of physics produces a comprehensive and multilayered representation of the factors relating to students choosing senior physics.

Modifications to the Original Research Question

It was evident from the preliminary pilot study, especially the focus groups that the students' Perceptions of Physics (and Physics related careers) played a key role in the decision to study Physics. This aspect of the perception of Physics (and Physics related careers) and where have these perceptions originated seemed to be an area to explore. Indeed, although there has been some research into the general perceptions of Science and the influence into subject selection process^{6,7}, there did not seem to be any research that specifically targeted Physics and based on Queensland and more specifically the Sunshine Coast. Hence the original research title and question was modified to be:

“Perceptions of Physics (of students on the Sunshine Coast)”

Can students' perception of Physics and Physics related careers be modified?’

Science Centres for Innovation and Professional Practice (SCIPP)

Coincidentally a fortuitous encounter with Dave Thompson Head of Research and Discovery at Chancellor State College and member of the Sunshine Coast SCIPP¹¹ brought about the expansion of the sample cohort and further develop the research to encompass teachers' perceptions and extend to an additional 2 stages as listed below;

- **Cohort:** All high schools of 400+ students on the Sunshine Coast (23 schools); All Physics teachers at these high schools
- **Partnership:** USC and SCIPP via Dave Thompson @ Chancellor State College
- **Stage One:** What is the current status of perceptions of Physics and Physics related careers?
- **Stage Two:** Intervention – implementing selected actions based on the findings from Stage One
- **Stage Three:** Have perceptions altered and awareness of Physics related career pathways been enhanced?

Summary of the quantitative data from the research

Research cohort:

- Cases: 212 – 20.5% return: 8 Schools (3 state, 5 Independent)
- Gender: Male - 81 (38.2%); Female - 131(61.8%)
- Physics Students: 31% of cohort studying Yr11 Physics
- Gender of Physics students: Male - 69.2%; Female -30.8%
- % of Gender selecting Physics: Male-55.6%; Female-15.5%

Perception of Physics as a subject:

- **Challenging – 93.3%**
- Interesting – 71.1%
- Relevant to everyday life – 72%
- Rewarding – 72.3%
- Not many career opportunities – 79.7% (31.8%) unsure
- Useful in the future -72%
- **Required to think in class to understand – 92.7%**
- **Time and effort required outside class – 91.2%**
- **Yr10 Mathematics at least grade B – 85.2%**

Perception of Physics as a career

Description	% of Males	% of Females	% of Total cohort
Unattainable	9.9	16	13.7
Unaware of Career opportunities	19.8	30.8	26.5
Rewarding	50.6	40	43.6
Challenging	69.1	75.4	73
Interesting	67.9	39.2	50.2
Boring	16	27.7	23.2
Difficult	37	56.9	49.3

Development of students' Perception of Physics

Person / Factor	% of Males	% of Females	% of Total
Science Teacher	81.5	67.2	72.7
Family member	44.4	38.3	40.7
Older Physics student	34.6	41.4	38.3
Personal Experience	59.3	50.8	54.1
A close friend	34.6	25.8	29.2
Careers Councillor	11.1	7	8.6
Another teacher	14.8	12.5	13.4
Work Experience	6.2	1.6	3.3
Careers Literature	12.3	7.8	9.6
General public image	25.9	40.6	34.9
Another person	4.9	7.8	6.7

Influences during Subject selection process

Influence	% of Total
Parents	45.8
Best Friend	34.4
A Relative	28.7
An Older Student	39.4
Careers Councillor	29.2
Science Teacher	56.0
Another Teacher	38.25
Internet/TV	12.5
Careers Literature	33.0
Someone working in a Physics related career	27.0

Reasons for not studying Senior Physics

Reason	% of Males	% of Females	% of Total
Not Interested	56.8	67.6	64.9
Not required for degree	54.1	73	68.2
Physics concepts in Yr10 too hard	35.1	40.5	39.2
Science teacher	5.4	4.5	4.7
Another teacher	8.1	3.6	4.7
Parents	21.6	11.7	14.2
Careers Councillor	5.4	4.5	4.7
By an older Physics student	5.4	16.2	13.5
Mathematical skills too difficult	43.2	43.2	43.2
Too much time	56.8	40.5	44.6
Too theoretical	37.8	42.3	41.2
Another reason	46	44	44.3

Summary of other reasons:

- Physics clashed with other subjects
- Prior conceptions that I had built up from movies etc. where physics was depicted as the subject for the elite
- I was told that the subject was very time consuming and difficult to do well in
- I didn't know what physics was about
- The concepts of physics that were covered in junior school I found boring and hard to grasp
- Too hard
- Have to do Maths B to do Physics

- It was way too time consuming and I found some concepts hard to grasp
- My teacher in Yr 10 was terrible at explaining Physics concepts. I did not want to have this problem in Yr 11 and 12.
- Older students said Physics was hard
- I found it hard to be interested when the teaching method was boring and the mathematics appeared complex. My brother also said I would have enough logic!
- I don't really understand what is exactly involved in physics which is why I didn't choose it. I only know it's "a really hard subject"
- There is the reputation of poor physics teachers at the school

Reasons for studying Senior Physics

Reasons	% of Males	% of Females	% of Total
Interested	86.4	90.5	87.7
Good results in Yr 10 Physics/Science	65.9	66.7	66.2
Good Science teacher in Yr 10	54.5	47.6	52.3
Required for degree	56.8	52.4	55.4
Encouraged by Science teacher	40.9	33.3	38.5
I felt I could succeed	77.3	81	78.5
Parents advised	43.2	45	43.8
Enjoy Experiments	54.5	30	46.9
Enjoy the contextual nature	53.6	60	62.5
Careers Councillor	13.6	15	14.1
An older Physics student	11.4	0	7.8

Selection of qualitative comments given on the student questionnaire – all are direct quotes - have not started to process focus groups

- My entire life I have been told and had the impression that senior Physics was very difficult and not useful for everyday life. Mainly because of friends that had previously studied it
- Whether you understand the concepts in Physics depends very much on the standard of the teacher. I think the only reason I did fairly well last year was because I had an excellent teacher.
 - I think it is a shame that such an interesting and useful subject has been cast under a heavy, fake shadow of difficulty and boredom. My dream is to have a large class, even spread of males and females

- Science and Physics aren't touched on well in years 8 or 9 or even primary school for that matter. The three strands of science need to be distinguished at an earlier age. They mightn't due to the difficulty of science
- The transition between junior and senior science is a big jump. I believe people are discouraged because they see it as too hard or they don't know what it is about. Even junior schooling may cover an area of physics but they don't even know that it actually relates
- I believe I made a mistake in my subject choices as Physics does greatly interest me, but the Mathematics component deterred me away
- I think it'll be easier to get a job once you have a Masters degree or a PhD. Well this depends on the area of physics studied for example I want to do astrophysics and it'll be hard to get a job I think until I get a higher degree especially in Australia. Maybe it'll be easier in America or Russia.
- The old teacher was excellent, but we got a new physics teacher this year (actually 2 new teachers) which has made it a lot harder as I don't understand their teaching style which has made me dislike physics as we don't do any experiments and have to teach myself at home with the textbook. I think that it's hard to get a good physics teacher!
- I think who the teacher is makes a huge impact on your perception of physics and whether it is fun interesting, or easy
- I would have liked to do Physics but didn't think I could handle three science subjects as I thought they would be hard. As Biology and Chemistry were pre-requisites for more courses and I thought Physics was the hardest, I didn't do Physics. People tell me that Physics isn't that intense now, so I could probably handle it.
- Many students from our school, as is myself, was and/are still interested in doing Physics in Year 11; but it says that Maths B is a suggested requirement due to its ? type mathematical equations. The thing that changed students' minds was the mathematical side of things.
- I believe that teachers are incredibly important in shaping our perceptions of Physics. If your Physics teacher is inadequate/boring, then the subject itself becomes boring. Physics is a subject that desperately needs to be taught by competent, passionate, patient teachers.
- I love Physics!! I find that it is easier to learn through practical experiments and visually!
- I really enjoy Physics it's my favourite area of study, but I am really unsure what career I can make out of it.

Where does this lead?

Acknowledgement of the present perceptions of Yr11 students' on the sunshine coast

As a Subject:

- Challenging – 93.3%
- Need to think – 92.7%
- Time and effort needed outside class – 91.2%
- Yr10 Mathematics at least grade B – 85.2%
- Not many career opportunities – 79.7% (31.8%) unsure

As a Career

- Challenging - (73%) yet Interesting - (50.2)
- Difficult - (49.3) yet Rewarding - (43.6)
- Unaware of the career opportunities - (26.5)
-

Awareness of the factors informing students' perception of Physics

How perception of Physics developed?

- Science Teacher - (73.7%)
- Personal Experience – (54%)
- General public image influenced females (40%): males (25%)
- Family (40.7) and older students (38.3)

Major factors contributing to the students' subject selection increased

Influenced Science subject selection

- Science teacher - (55%)
- Parents - (45%)
- Older Physics students - (39%)
- Advertising on internet and TV – only (12%)

Major reasons for selecting (or not) Senior Physics

Reasons to select Senior Physics

- Interested – F(88%): M(84%)
- Felt could succeed – F(80%): M(78%)
- Good Yr 10 results – F(64%): M(64%)
- Good Science teacher in Yr 10 - F(46%): M(54%)
- Contextual nature - F(60%): M(50%)
- Required for degree - F(57%): M(57%)

Reasons why not to select Senior Physics

- Not required for degree - F(73%): M(54%)
- Not Interested – F(67%): M(57%)
- Too much time - F(40%): M(57%)
- Maths too difficult - F(43%): M(43%)
- Too theoretical - F(42%): M(38%)
- Physics in Yr 10 too hard - F(40%): M(34%)

Timeline Research in the Future

- **Completion of Stage One:**

December – February 2008: Focus group analysis; Physics teachers' questionnaire;
Interim Report

February – April 2008: Complete student and teacher questionnaires with
remaining 15 schools on the Sunshine Coast.
Final report on stage one

- **Stage Two:**

March – April 2009: Secondary ethics application

April – September 2009: Implement the suggested actions at selected
schools

- **Stage Three:**

September – November 2009: Complete student and teacher
questionnaires in schools

November – December 2009: Collate and submit final SCIPP report.

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