

# Interpreting the use of Technical Language by Undergraduate Students of Physics

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- Rationale for research
- Research objectives
- Methodology
- Data Analysis
- Results
- Conclusions
- Implications for teaching

Popularity of senior cycle Physics has declined from 21% to 15% in last two decades

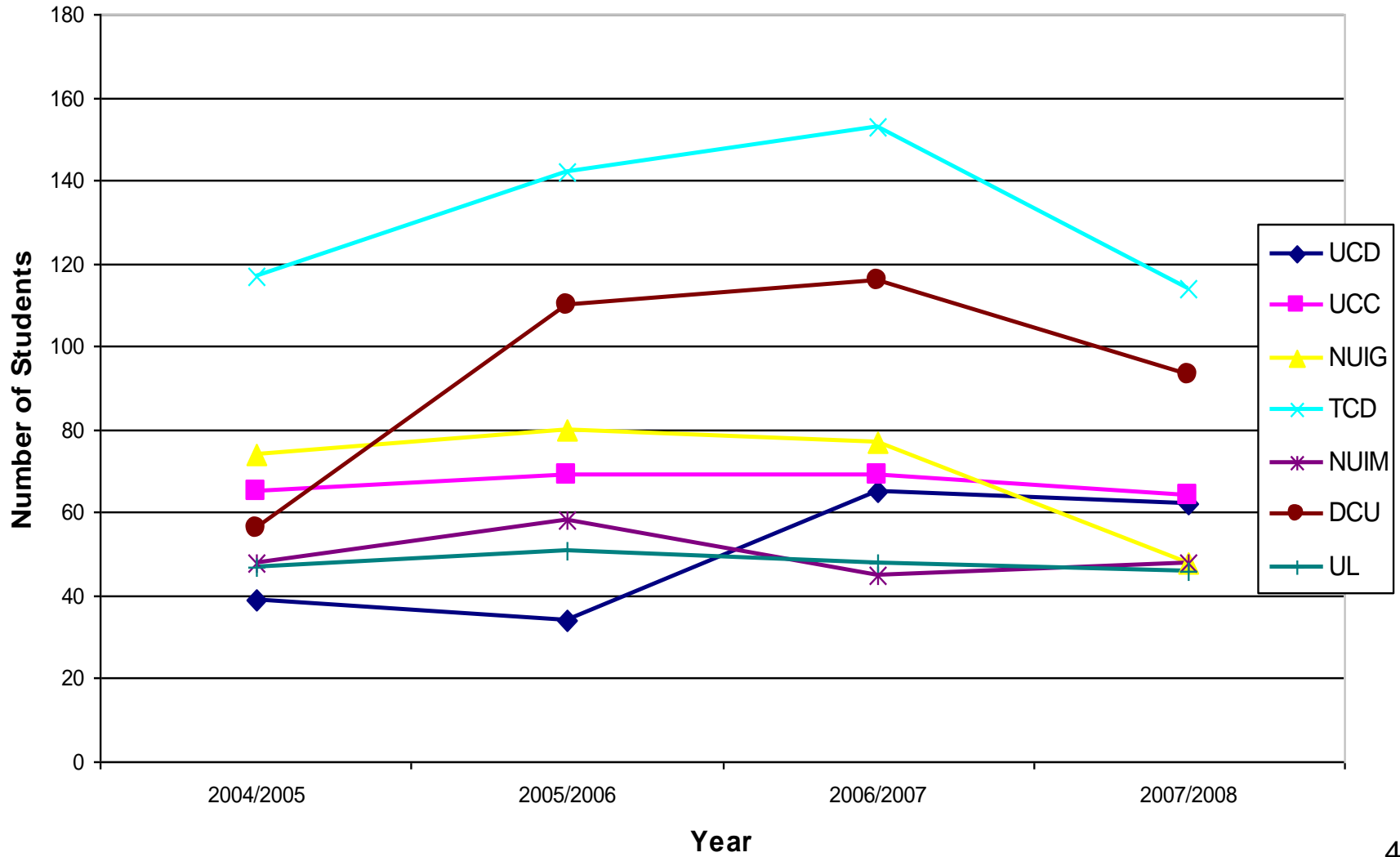


High non-completion rates within the science disciplines, 22.2% fail to complete science courses within the Irish Universities.



Low output of science graduates to pursue careers in the discipline.

## Full-time students Enrolled in Physics courses in Irish Universities



- Students enter third level courses with a system of beliefs and intuitions about physical phenomenon derived from personal experience.
- Students formulate his/her own existing physics structures only if new information or experiences are connected to knowledge already in memory.



**It is through the use of language that this new information and experiences can be conveyed and communicated to the students.**

*“One of the most important features of science is the richness of the words and the terms it uses”*

*Jay Lemke, (2001)*

- Teachers and students use language to communicate and to structure learning
- Scientific language is not just specialist language. In fact it is possible to discuss a topic very scientifically without heavy use of technical language. Science language is not unique to science but it is adapted to more specialised purposes in science
- Traditional viewpoint – language plays a passive role; meaning and information are conveyed from one speaker to another
- Current viewpoint – the listener is as active as the speaker in elaborating the context of the message

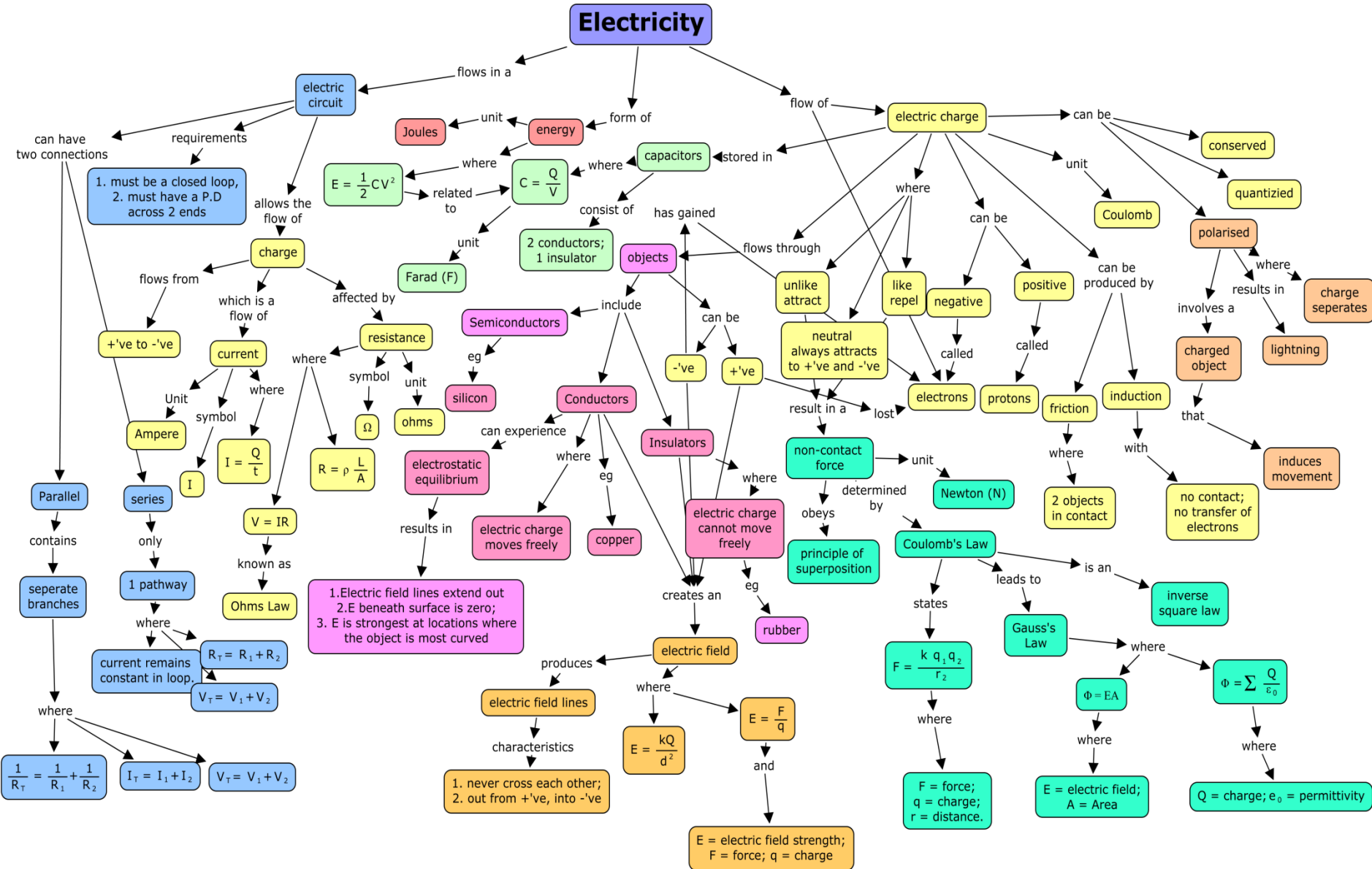
Lemke, J. (2001) Language and Literacy in Science Education. Open Press University

# Why is Science Language Important?

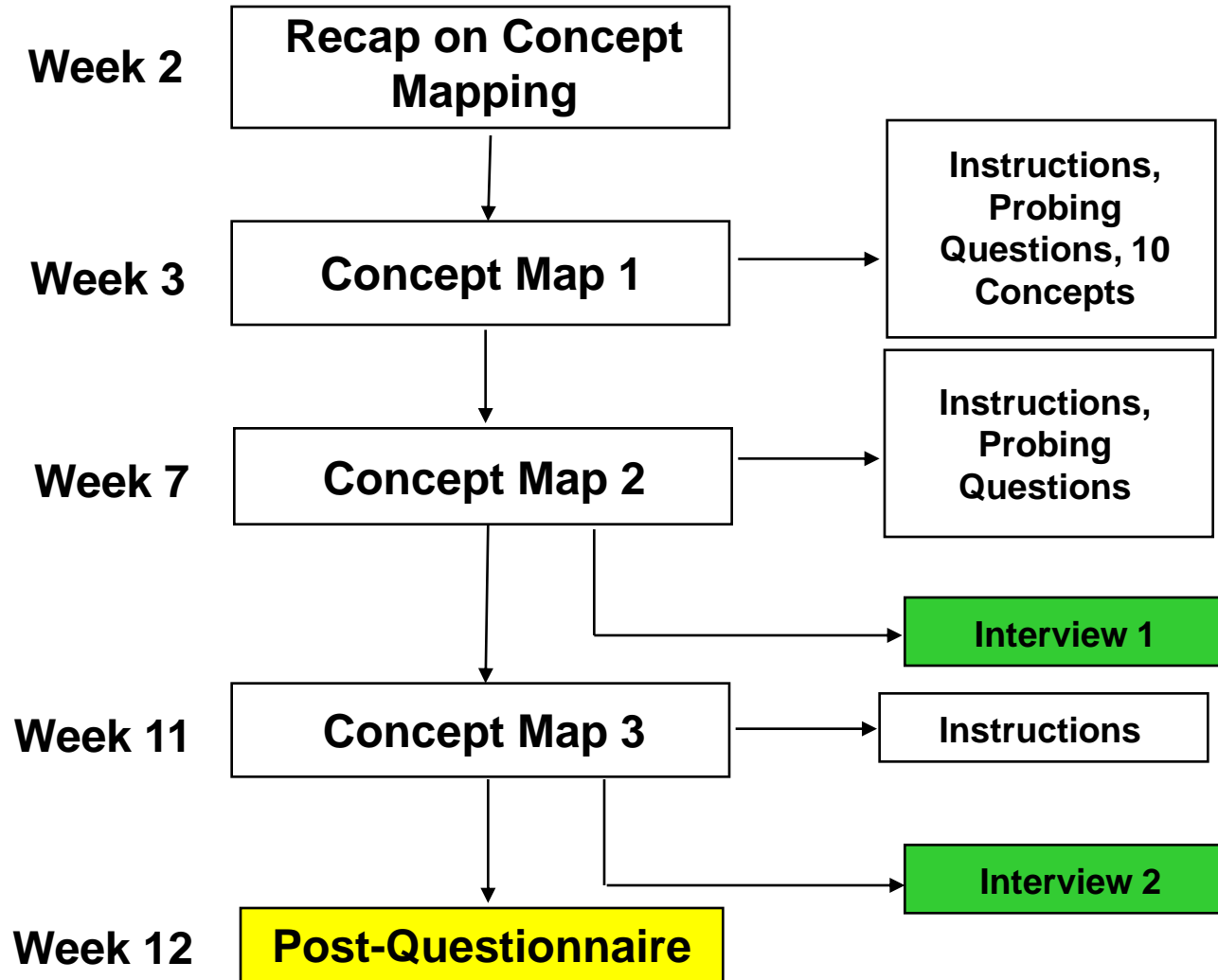
- Almost all teaching and learning takes place using the medium of **language**, verbal and non-verbal
- In science we teach and learn by combining **language** with pictures, diagrams, charts, tables, graphs and other specialised scientific and mathematical symbols.
- Knowledge is **language** – the key to understanding a subject is to understand its language
- In order for students to read about science they need to be aware of the **language** of science
- Scientific ways of talking support more scientific ways of reasoning

- To implement an educational initiative, identified as Concept Mapping in undergraduate physics modules at the University of Limerick.
- To generate physics problems from student concept maps and to carry out semi-structured interviews on the problems.
- To examine the students use of technical language during problem solving.
- To determine if there is a significant difference between 'experts' and students use of technical language.

# What are Concept Maps?



- Year-long study, began in spring semester of first year and continued into autumn semester of second year.
- Carried out over two physics modules: Light and Sound (Phase 1) and **Electricity and Magnetism (Phase 2)**
- 15 weeks in each phase/semester.
- Students involved represented two courses:
  - Biological Science Education
  - Physical Science Education
- 75% of cohort had **NOT** studied Physics at Leaving Certificate level.



## Student Concept Maps

- The student's maps were analysed to check for misconceptions and lack of information.
- The propositions used in the student concept maps formed a basis for the interviews.

## Interviews

- Two interviews - carried out after Concept Map no. 2 and no.3
- Interview 1 = 8 questions (6 theory & 2 mathematical)
- Interview 2 = 6 questions (2 theory and 4 mathematical)
- 6 experts were also interviewed.

For the purpose of this study an 'expert' is defined as someone who is in the process of or completed a PhD in an area of physics.

- Qualitative data was transcribed and quoted verbatim.
- It was through the use of the interviews that the students and experts use of technical language was evaluated.
- The language was evaluated using a criterion referencing method.
- The criterion standards used during assessment of student language was based on three university textbooks, all of which are on the list of recommended reading for the module.
- Categories of scientific language were generated

## Scientific

- Qualitatively explains the concepts as is in the criterion books

## Intermediate

- Qualitatively explains the concepts using language which is not the criterion language but uses language which correctly explains the phenomenon
- Language used is similar to that of transitional language; showing some level of understanding and influence of education
- The students are a step towards the correct response

## Instinctive

- Qualitatively explains the concepts correctly using non scientific Language
- Descriptions students would use prior to instruction; use of intuitive natural, colloquial language

## Question 3: Van der Graff Generator.

Look carefully at the diagram and describe it.

Explain what is happening.

Why is it important that the student stands on a plastic mat insulated from the ground?



# Breakdown of Question 3

1. Describe the movement of charge in the Van der Graff

## Student

- running
- going
- travelling
- flowing through
- passes
- flowing through
- -
- spreads out/going through
- runs through
- passing

## Expert

- transfers
- transferring
- inducing a charge
- Running
- goes up
- transferring/spreads out



**Scientific**

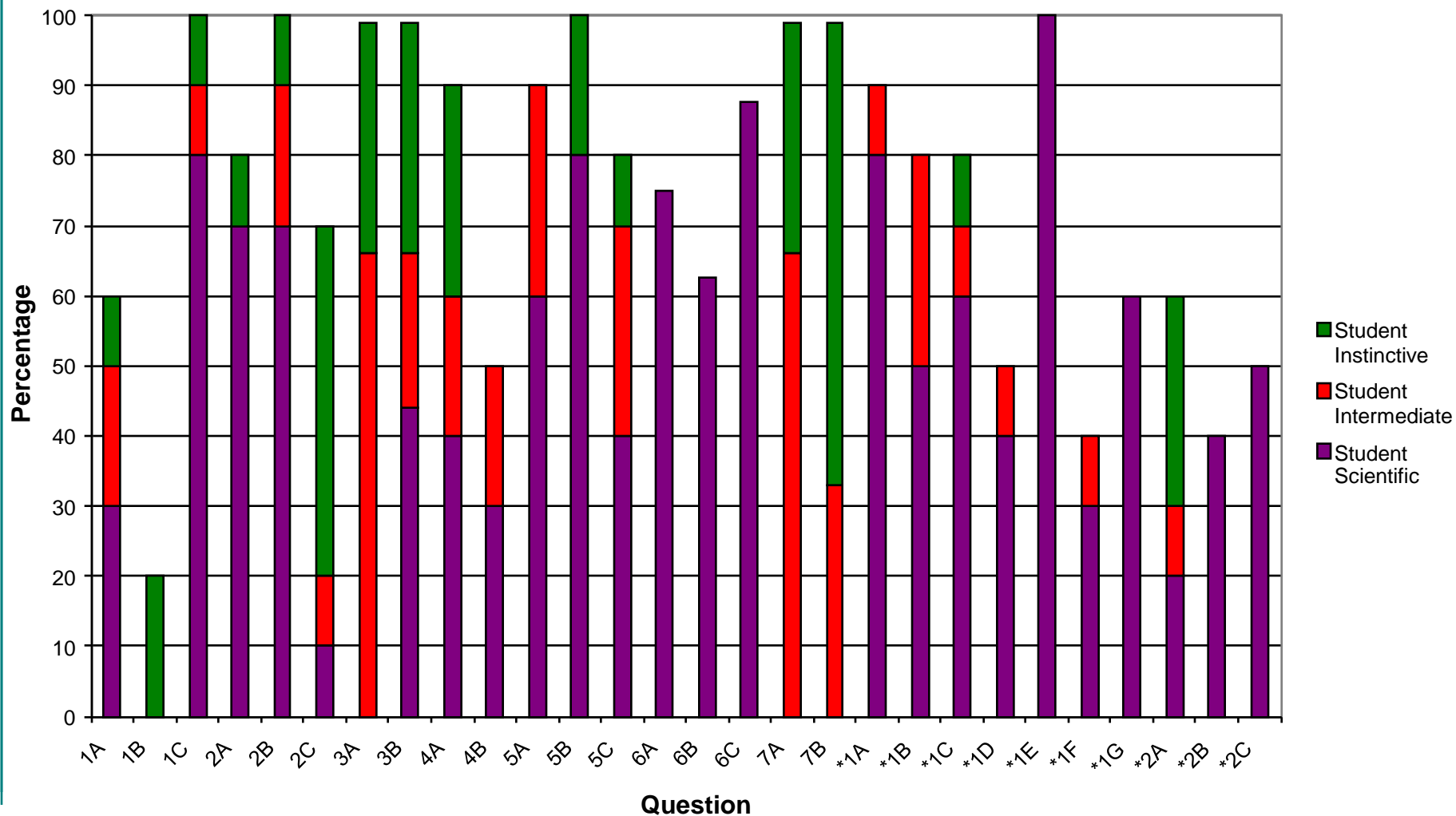


**Intermediate**

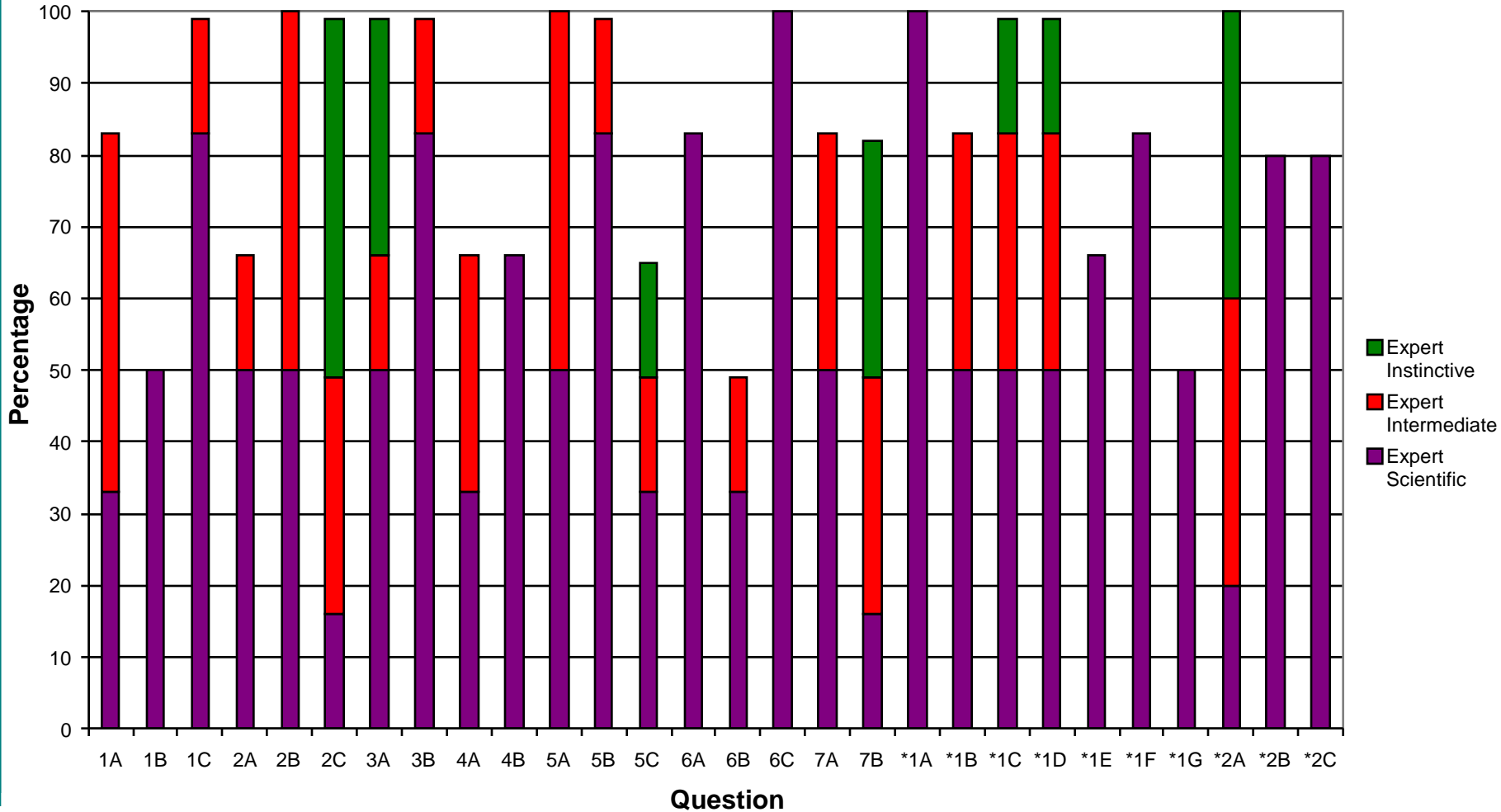


**Instinctive**

# Percentage breakdown of Language used by Students during Problem Solving

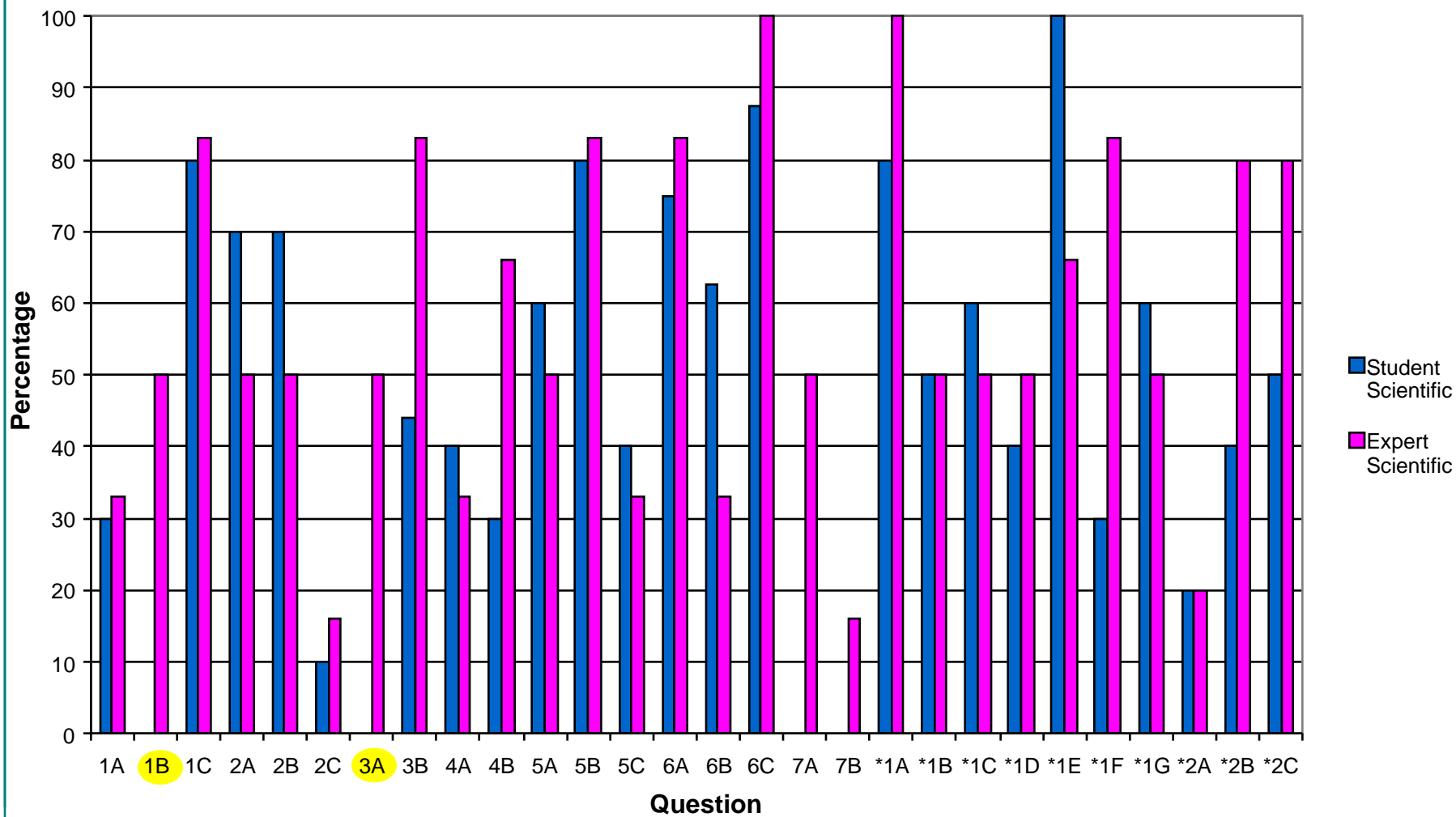


# Percentage breakdown of Language used by Experts during Problem Solving



# Results – Scientific Language

Percentage of Scientific Language used by Students and Experts



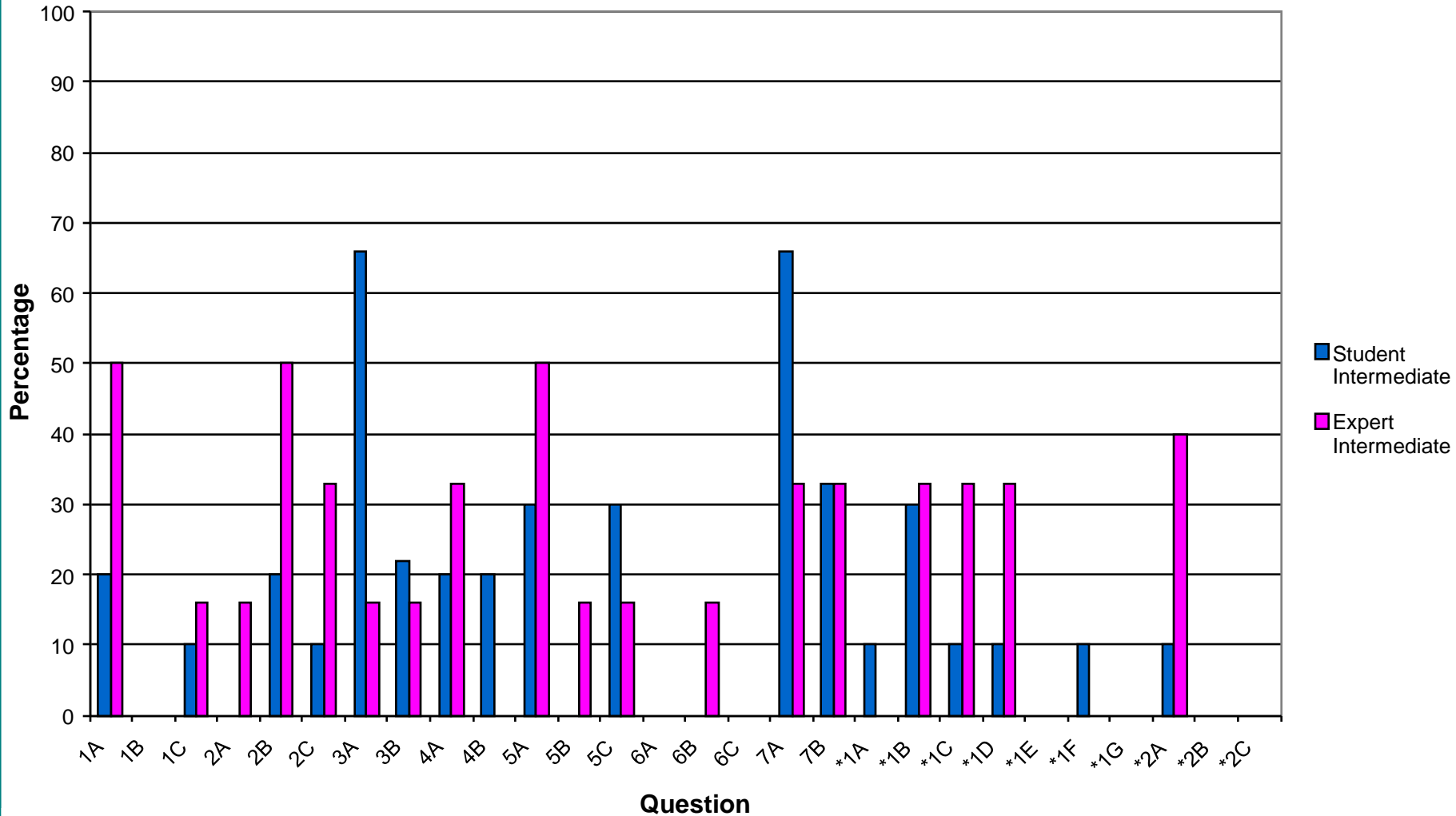
- Question 1B and 3A  
Both questions concerned the movement of charge
- 1B: How does charge move from a charged object to an uncharged object?

<b>Student</b>	<b>Expert</b>	<b>Criterion</b>
goes	transfers	move
jumps	migrates	transfers

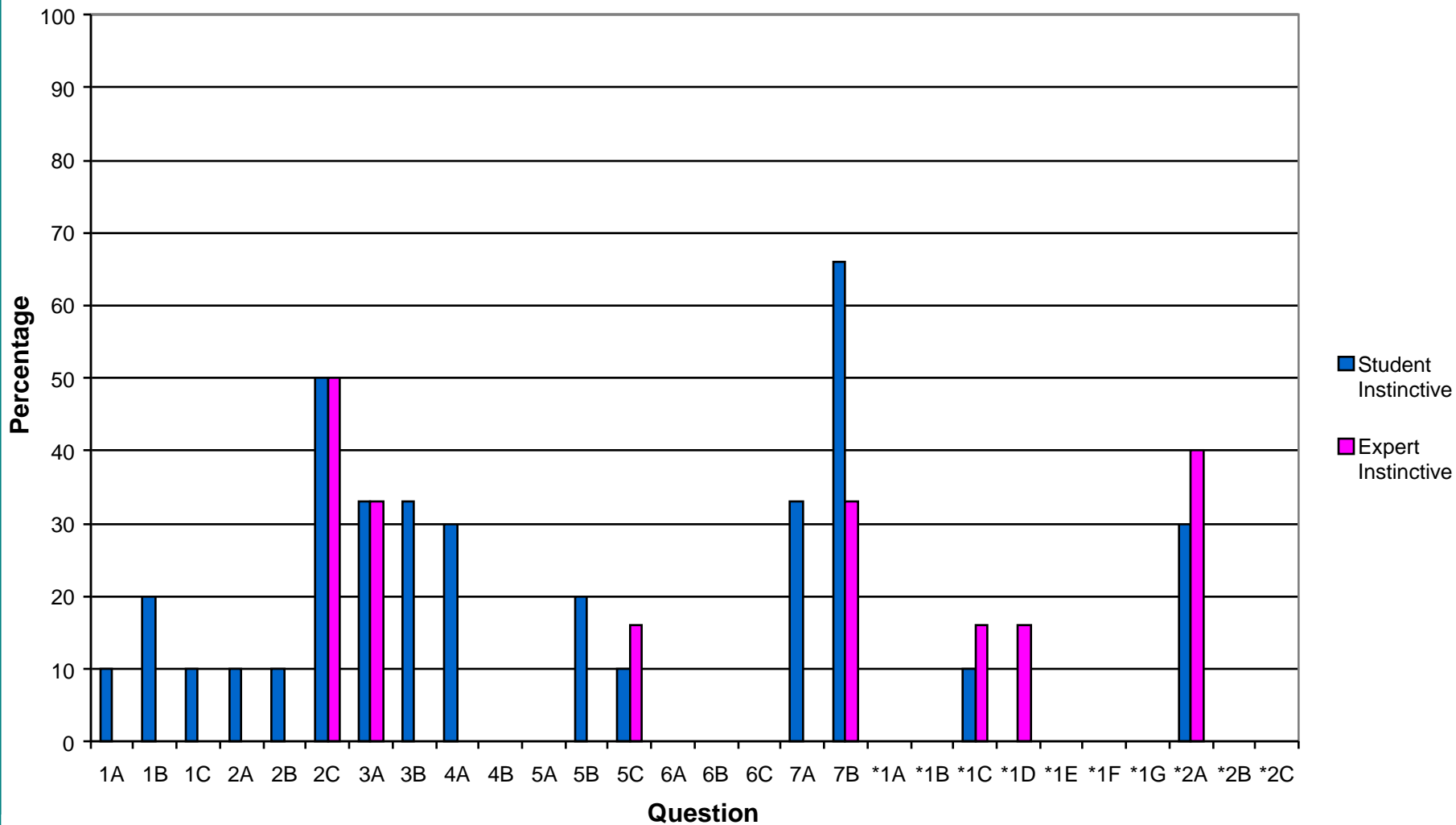
- 3A: Describe the movement of charge in the Van der Graff Generator

<b>Student</b>	<b>Expert</b>	<b>Criterion</b>
runs	transfers	transferred
goes	travels	
passes		
flows		

Percentage of Intermediate Language used by Students and Experts

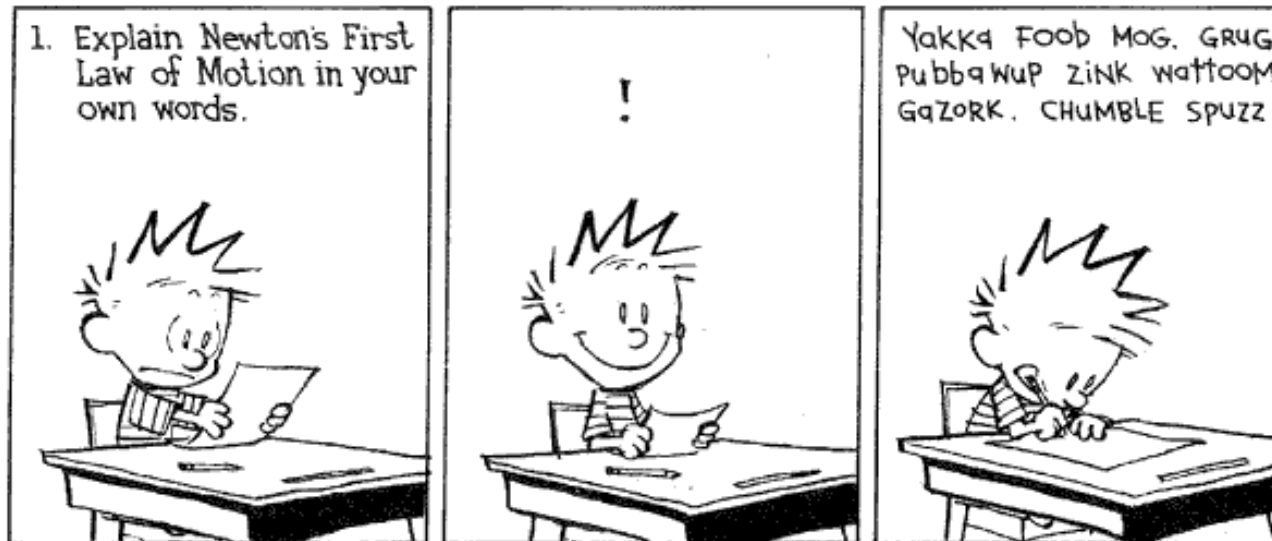


Percentage of Instinctive Language used by Student and Expert



- One of the most important features of science is the richness of words and the terms it uses therefore it is important that students are aware of and are able to use scientific language in the science classroom
- Three levels of language can be identified from student responses
  - Scientific
  - Intermediate
  - Instinctive
- Students do use scientific language when problem solving. Overall there is not a major significance difference in the language used by experts and students
- The only questions that generated significantly difference ( $P < 0.05$ ) results were concerned with that of the movement of charge
- The use of language used in the teaching of science by the teacher is fundamental to students understanding of science.

- The language used by educators in the teaching of science can influence the students understanding of science and lead students to understand science in different ways.
- It is essential that teachers present science subject matter to their students using precise language.



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