Language in Science Project (LiSP)

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Structure of Presentation

- Brief background of the research project
- Literature review
- Conclusions **Phase 1**
- Conclusions **Phase 2**
- Motivation for **Phase 3**
- Methodology Phase 3
- Results
- Discussion of results
- Conclusions
- Recommendations

Overall Aim of the Research

To **improve** the teaching and learning of science in the Irish **Junior Cycle** by **investigating** the role of language and **addressing** the problem of language in science education.

Background to the Research

Personal Observations of the problem

- During 4th year Teaching Practice (2011)

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Struggling Teacher

- Chemistry Teacher
- 7 out of 11 pupils were non-native English Speakers
- She couldn't find any teaching strategies for the Irish context
- Her colleagues in the science department were also unable to assist her

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Formulated Initial Research Question

Due to the lack of knowledge displayed by these teachers towards the problem:

- **Are Irish teachers aware of the problems caused by the role of language in teaching science?**

Introduction to the Research Project

- The basis of this research is **captured** in Jonathan Osborne's words

*'Science without literacy is like a ship without a sail. So just as it is impossible to construct a house without a roof, it is impossible to build understanding of science without exploring how the **multiple languages** of science are used to construct meaning'* (Osborne, 2002).

Literature Review

Wellington and Osborne (2001) claimed that "*Language is a **major barrier** (if not the major barrier) to most pupils in learning science*" (p. 2).

Science has its **own language** and learning the **language acts as an impediment** to many pupil's acquisition of scientific knowledge and understanding.

It has a specialised, pre… unfa… voca…

Amphoteric

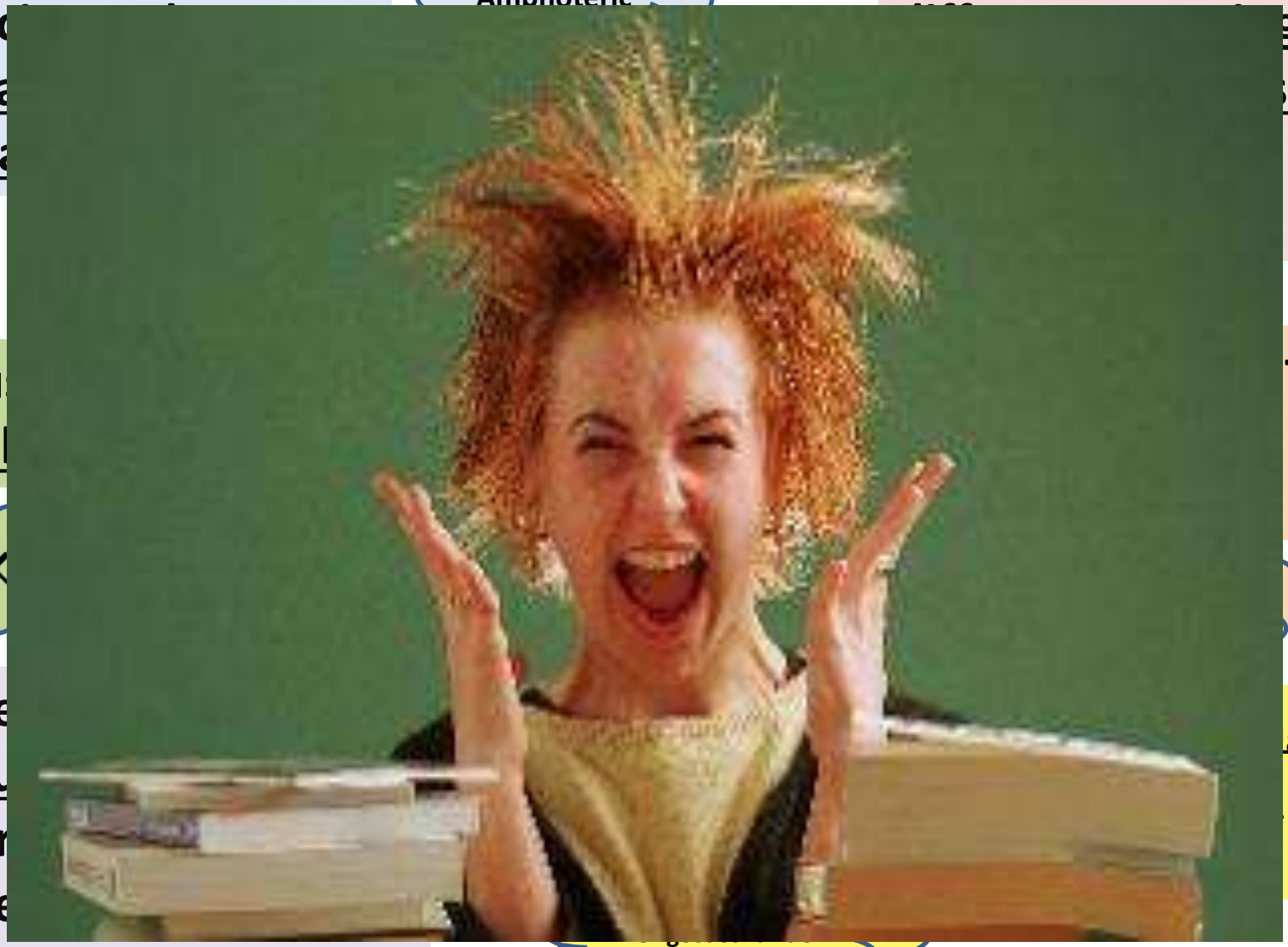
It uses terms with …g in …s to

Its u… Mat…

…f

It use… langu… contr… stude… with science

…g



Phases of the Research

Phase 1

To identify the level of awareness of practising and student teachers of science to the problems created by the complex and multifaceted nature of the language of science in **theory** and **practice.**

Phase 2

a) To assess what facets of the language of science are posing the greatest difficulty to pupils.

b)To develop teaching and learning strategies and materials to make the teaching and learning of science at Junior Cycle level more effective.

Phase 3

a)To implement the developed teaching and learning strategies in second level schools.

b) To evaluate the effect of the developed teaching and learning strategies on the problems caused by the role of language in science teaching.

Conclusions Phase 1

- While **Irish Science teachers are aware** that the language of science is a barrier to pupil's acquisition of scientific knowledge and understanding, their awareness appears to be almost limited to the **technical language** of science e.g. isotope.

- The results of the teacher questionnaire found that **87% of teachers** (75 out of 86) **were aware** that the vocabulary and usage of normal English in a science context was a problem for pupils, however only **11 teachers (41%)** actually highlighted such words in the two extracts from a science textbook (case study **n=27**).

- This raises concern about how **aware teachers are in practice** to these non-technical words or words which a have a dual meaning and as such how are they dealing with these words when met in their own teaching.

- 67% of the teachers felt that they are **not adequately equipped** with teaching methodologies and strategies to deal with this problem especially considering the linguistic diversity of our classrooms

n=86

Summary of Results Phase 2

- Several obvious trends emerge. The first is that very few of the words tested turned out to be satisfactory in all formats. When one compares the results from the current study and the 1985 Cassels & Johnstone study, the results are alarming. The evident deterioration in pupils' understanding of the given words is shocking (-38%).

- Many of the words which science teachers use are not readily accessible to all their pupils.

- Things are at their most dangerous stage when both a learner and teacher know a meaning of a word and each assumes that the other shares the same meaning.

n=159 (Package 1) n=95 (Package 2)

Summary of Results Phase 2

Gender: No significant difference

Age: General misunderstandings diminish with age, but a degree of misunderstanding is still apparent even with third-level student teachers of science and the format of the question does have an effect.

Native or Non-native English Speaker:

Native English speaking pupils outperformed their non-native counterparts with ***69% of native pupils giving correct answers in comparison to 31% of non-native*** English speaking pupils. Similar to the previous factors, the ***format that the word*** was offered in effected performance. Native English speaking pupil's outperformed non-natives based on the average of the four formats but this does not mean that native English speaking pupils did better than non-natives in all of the formats that the word was questioned in.

Motivation for Phase 3

We cannot improve Irish second-level science education without **addressing the underlying problem** of language in science teaching.

The results of phase and 1 and 2 highlight the need for a programme to be devolved to help teachers tackle the problem of the role of language in science teaching and learning and increase their awareness to the problem in its entirety.

Science **teachers are central agents** to achieving this goal, accordingly they need to be aware of the difficulties pupils are presented with when learning science and **equipped with teaching strategies** and methodologies to alleviate and deal with pupils' problems in their own teaching.

Iceberg

Science Content

Multi-faceted Language

Aim of Phase 3

- To alleviate difficulties that Irish pupils have with the use of language in science education at the Junior Cycle;
- To improve pupil's ability to understand and utilise the language used in science education at this level;
- To address the area of the lack of teaching and learning strategies to deal with the problem of language and literacy specifically in science education.

Methodology-Phase 3

The first consideration was to the **level at which the project would be targeted at.** It was decided to focus on the **Junior Science** Syllabus for a number of reasons:

- it is pupils first encounter with science in its entirety
- many pupils are turned off science by the time they reach senior cycle and do not opt to continue studying it
- pupils are faced with numerous highly complex terminologies and words with dual meaning for the first time at this level

Once the Junior Cycle was chosen, the keys aims of science education at this level were established in order to assess how best to achieve them in the context of this project.

Language in Science Project (LiSP)

Many teaching strategies and philosophies, that have been proven successes in the area of developing language and literacy and thinking skills, have been included in this programme and applied to **five Junior Science topics** from the current syllabus.

The steps involved in developing the programme are as follows:

Step 1: *Selection of content to be covered in this intervention programme*

The five topics to be included in the LiSP intervention programme are as follows:

- ***Food***
- ***Digestion***
- ***States of Matter***
- ***Classification of substances; elements, compounds and mixtures.***
- ***Atomic Structure***

These **topics were chosen** for the following reasons:

- Their dense concentration of **new scientific terminologies** and use of non-technical and technical words with a ***dual meaning.***
- These topics are **fundamental topics** in which pupils need to have constructed a good foundation in order to understand more advanced scientific topics at a later stage in both the junior and senior cycle.
- An analysis was carried out with the teachers participating in the project (intervention teachers or control teachers) in order to establish which topics they covered at the beginning of the school year. It was established that the five chosen topics were to be **introduced quite early** in the Junior Cycle by all teachers involved, therefore, they seemed the most logical topics to target due to the time constraints of a project of this nature.

Step 2: *Development of the Intervention Package for teachers*

The five topics that were included in this programme had a similar layout as follows:

-sample ***lesson plan*** which included the key words and concepts of that topic

-an ***introduction to the topic*** and the key concepts and learning outcomes of that topic

-***worksheets*** e.g. cloze tests

-***classroom activities:*** these included games, some of which included the use of word cards. All resources for these games were provided either in the booklet on that topic or in the resource pack which accompanied that topic. Graphic organisers specific to the topic were also included in the booklet.

-***Other teaching ideas:*** In this section of the booklets, teachers were provided with other teaching ideas such as the following:

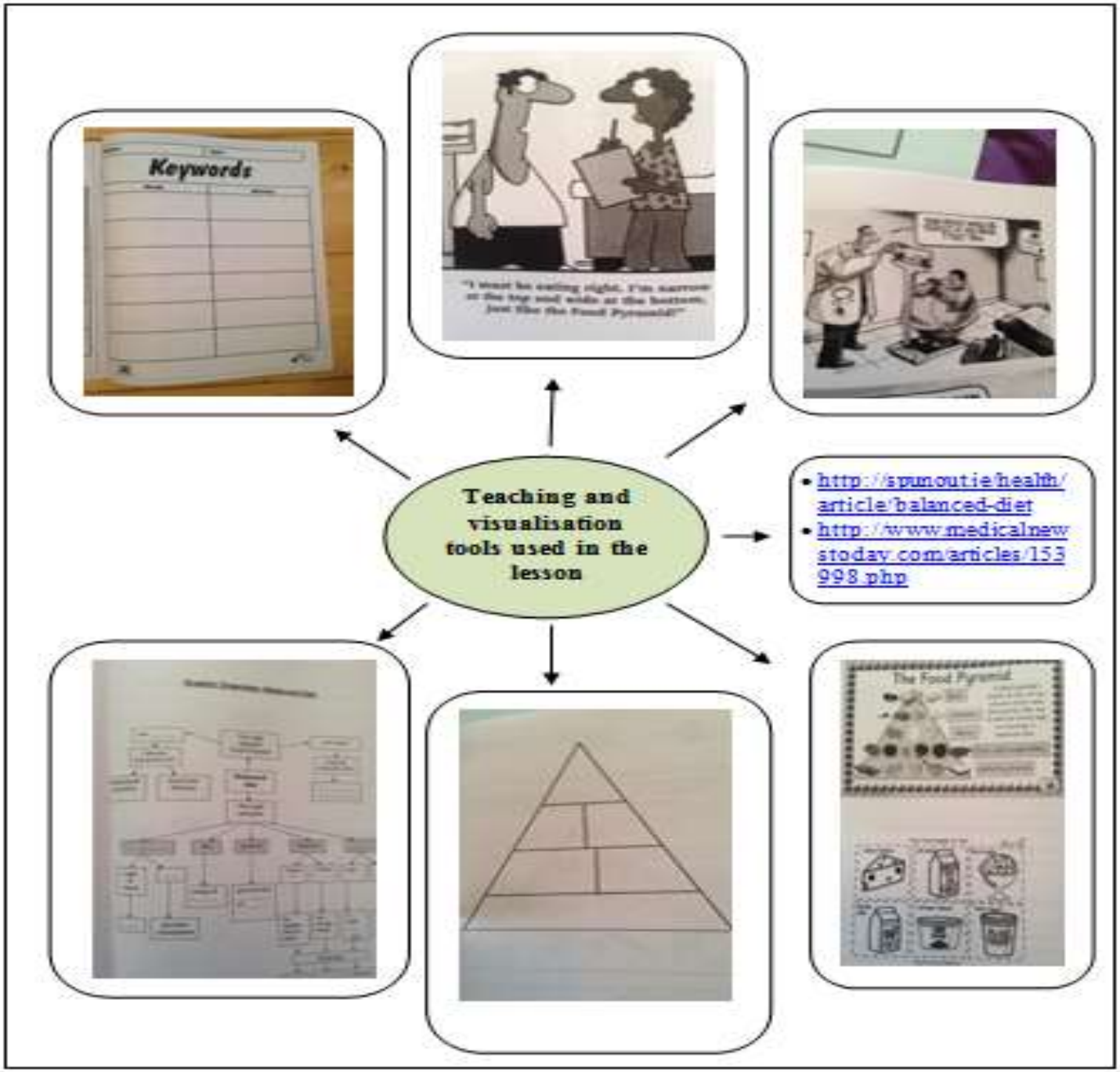
- ***Prefixes and Suffixes***
- ***Use of Science news (web links to newspaper articles on the topic)***

-***Powerpoints***

- The entire LiSP package was distributed to teachers in a **box file** with separate labelled folders for each of the **games packages** which accompanied each topic.

LiSP


LiSP
Language in Science Project
Food
Section 3
Digestion
Section 4
Classificatio
of Matter
Section 5
Elements, Mixtures and Compounds
Section 6
Atomic Structure
Section 7
Toolkit
Section 8


Keywords
Teaching and visualisation tools used in the lesson
• http://spunoutie/health/article/balanced-diet
• http://www.medicalnewstoday.com/articles/153998.php
The Food Pyramid

Step 3: Piloting the Intervention Programme.

- The researcher felt that it would be beneficial to **pilot the intervention programme** in one school in order **to highlight any flaws** in the programme or areas which could be improved.
- **Three** of the science teachers in this school were involved in the pilot. They were provided with training on how to best utilise the resources and teaching ideas after the Easter break of the school year 2012-2013.
- Teachers were asked to **keep a portfolio of their views** on using the programme i.e. the positive and negative aspects of it and the areas which they felt could be improved.
- Following the pilot of the LiSP, the researcher **made the appropriate adjustments** based on the feedback received from the teachers. The LiSP package was then printed on a larger scale and ready for distribution to the Intervention Schools.

Step 4: Distribution of the Intervention Package and training of teachers involved in the Intervention Programme LiSP.

- Teachers were provided with training on how to use the resources and teaching ideas at the start of the school year 2013-2014.

- **11 teachers** from 7 schools were involved in the programme.
- 5 teachers from different schools acted as a **control.**

Step Five: Implementation and Evaluation of the Intervention Programme.

- The LiSP programme was implemented in schools during the school year of **2013-2014** mostly in the first term.
- The researcher remained in regular contact with the Intervention teachers throughout the teaching process, with **classroom observations** and discussion sessions in each school.
- At the beginning of the Intervention programme **all teachers** received a **pre-questionnaire** to establish their level of awareness to the role of language in science education. All teachers also received the **extracts of text** document which aimed to assess how aware teachers are **in practice** to the different facets of the language in science.
- At the beginning of the programme, **all pupils (intervention and control)** received a **standard test** to act as a mode of assessing the effectiveness of the intervention programme.
- **The intervention pupils** were then taught the five topics using the LiSP strategies and materials. At the end of each of the five topics, all pupils **(intervention and control)** completed an end of topic test.

Step Five: Implementation and Evaluation of the Intervention Programme.

- The teachers' views were collected through a **teacher portfolio**, regular contact and the **post-teacher questionnaire** at the end of the project.

- The results of the intervention pupil group **were compared** with those of the control group (taught in the traditional way) in order to **determine if the intervention programme had any effect** on their ability to understand the concepts and main points of each of the five topics. The **standard test** completed by all pupils before the beginning of the programme was used **to add validity** to any deductions that could arise from the results of the end of chapter tests. The standard test and end of chapter tests for the intervention group and control group **were identical.**

Results for Phase 3

Can the intervention and the control groups be compared?

In order to permit the analysis of the effectiveness of the 'LiSP' intervention programme it was important to determine if the intervention and control groups used in phase three of this investigation could be compared with each other. In order to determine this, cross tabulation tests between the two cohorts were carried out using SPSS 21 for Windows.

Results of significance tests should have **p-values greater than 0.05** to allow for these two groups to be compared with each other.

n=269 (Intervention pupils) **n=144** (Control pupils)

Intervention pupil status versus various factors

	p-value
Intervention pupil status(yes or no) versus gender	**0.055**
Intervention pupil status(yes or no) versus native or non-native English speaker	0.162
Testing the understanding of the words in the standard test with regard to the pupil status (intervention pupil or control pupil)	
Intervention pupil status(yes or no) versus **percentage**	0.165
Intervention pupil status(yes or no) versus excite	**0.012**
Intervention pupil status(yes or no) versus **capable**	0.789
Intervention pupil status(yes or no) versus repel	**0.009**
Intervention pupil status(yes or no) versus **average**	0.609
Intervention pupil status(yes or no) versus **abundant**	0.144
Intervention pupil status(yes or no) versus **component**	0.058
Intervention pupil status(yes or no) versus **consecutive**	0.833
Intervention pupil status(yes or no) versus contrast	**0.040**
Intervention pupil status(yes or no) versus **convention**	0.151
Intervention pupil status(yes or no) versus **constituent**	0.201
Intervention pupil status(yes or no) versus crude	**0.042**
Intervention pupil status(yes or no) versus **displace**	0.348
Intervention pupil status(yes or no) versus **initial**	0.165
Intervention pupil status(yes or no) versus **probability**	0.069

Results for Phase 3

- The results of the standard test highlighted that overall **it is possible to compare the two cohorts of pupils; intervention and control; for phase three of this investigation as the majority of the p-values did not differ significantly.** An extensive amount of data was collected and analysed in phase three of this investigation, all of which cannot be stated in this presentation. The following table highlights the results of the intervention and the control group **for one of the end of chapter tests.** The p-values for the two cohorts of pupils are also stated in order to highlight if there is a significant difference between the two groups.

For the purposes of reporting the results of the two groups of pupils the **following colour keys** will be used:

- **No Colour i.e. in black writing =** The intervention group achieved a higher percentage of correct answers than the control group. The difference between the two cohorts is not significant i.e. p-value >0.05.
- **Shaded in Khaki =** The difference between the two cohorts is significant i.e. ***(p value <0.05 = significant)***
- **Red Writing** = The control group out-performed the intervention group

End of Chapter Test on the Atomic Structure:

Place in Test	Words	Intervention Pupil (Total=27)	Control Pupil (Total=27)	p-value
Question 1:				
Space 1	Element	26(96%)	23(85%)	.528
Space 2	Nucleus	26(96%)	21(78%)	.100
Space 3	Protons	26(96%)	21(78%)	.063
Space 4	Nucleus	26(96%)	18(67%)	.000
Space 5	Electrons	26(96%)	22(81%)	.000
Space 6	Neutral	26(96%)	22(81%)	.228
Space 7	Smallest	26(96%)	20(74%)	.118
Space 8	4.00	26(96%)	19(70%)	.044
Space 9	2	25(93%)	17(63%)	.042
Space 10	2	26(96%)	16(59%)	.000
Space 11	Outside	25(93%)	17(63%)	.073
Space 12	Nucleus	26(96%)	21(78%)	.000
Question 2				
Silver		26(96%)	18(67%)	.019
Question 4:				
Proton		25(93%)	22(81%)	.145
Positive		24(89%)	12(44%)	.002
Neutron		25(93%)	16(59%)	.015
Inside		25(93%)	20(74%)	.169
Negative		27(100%)	16(59%)	.001
Outside		26(96%)	15(56%)	.000
Question 5:				
A		25(93%)	20(74%)	.187
B		24(89%)	17(63%)	.017
C		25(93%)	22(81%)	.224
D		25(93%)	12(44%)	.001
E		27(100%)	16(59%)	.001
Question 6:				
Li Protons		26(96%)	20(74%)	.066
Li Neutrons		24(89%)	16(59%)	.027

Discussion of Results

A higher percentage of the intervention pupils opted for the correct answer to the questions in the end of chapter test in comparison to the control group pupils. It is important to state that **none of the results were written is red** writing as this would have signified that a higher percentage of correct answers were achieved from the control group rather than the intervention group. This alone is a very positive indicator of the effectiveness of the 'LiSP' intervention programme.

Discussion of Results

The positive variance between the two groups in favour of the intervention pupils indicates that **participation in the 'LiSP' intervention programme has been successful in promoting the correct understanding and use of language in science education.**

This deduction was made based on how comparable the two cohorts of pupils were when they completed the **standard test** and secondly, it was based on the lack of a significant difference between **the intervention and control teacher pre-questionnaires** prior to the commencement of the intervention programme.

Conclusions

- It was observed that pupils in the intervention group for this phase of the investigation were **stronger** than pupils in the experimental group, based on the results of the end of chapter tests and the standard test.
- Participation in the 'LiSP' intervention programme was shown to have **a positive effect in promoting pupils' correct understanding and use of language in science education.**
- According to observations and the responses to the teacher interviews/portfolio, the pupils who participated in the programme **enjoyed** the groupwork and competitive elements of the package the most. **Pupil participation level in class increased** as a result of using the intervention programme package and teaching ideas.
- **The teachers** who participated in the intervention programme were **very positive about it** and felt that it was **very appropriate for Junior Cycle pupils.**
- The teachers who participated in the intervention programme stated that they will **use the intervention programme package again** and will incorporate the teaching ideas and materials into the teaching of other chapters.

Recommendations arising from this study

- **All pupils in Irish Second-level schools should to be assessed** in terms on their ability to understand and utilise the language in science education and manipulate words to suit the context that they are used in. This would increase teacher awareness to the level that each pupil is at in a class and allow them to teach the entire class more effectively and target problem areas.

- The 'LiSP' intervention programme materials that have been developed for this project need to be **edited and altered** according the recommendations made by the participating teachers and made available for teachers to use e.g. colour code questions and answers.

- A similar approach to the one taken in the 'LiSP' intervention programme should be taken to the **other chapters on the Junior Certificate Science syllabus**. Teachers need to be made aware of the project and the advice and resources that it offers.

- A set number of **command words** should be assigned to state and in-class examinations. The repeated use and exposure of this set of command words will make pupils confident in their understanding of use of these words. This will help minimise the confusion that many pupils have with what the **wording of exam questions** and what they are being asked to do rather than the **science content itself.**

Recommendations arising from this study

- Current practicing teachers need to be **exposed to the problem of the language of science in its entirely** i.e. all the different facets to the problem, in order to increase their level of awareness to the problem and initiate a change in their practice.

- **Student teachers** need to be exposed to the different aspects of the problem during the course of their teacher education. Their level of awareness to the problem and their exposure to the resources and teaching strategies that help alleviate the problem need to be increased. Student teachers need to start their teaching career with confidence that they are equipped to deal with the language barrier that many pupils are presented with.

Thank you for your attention

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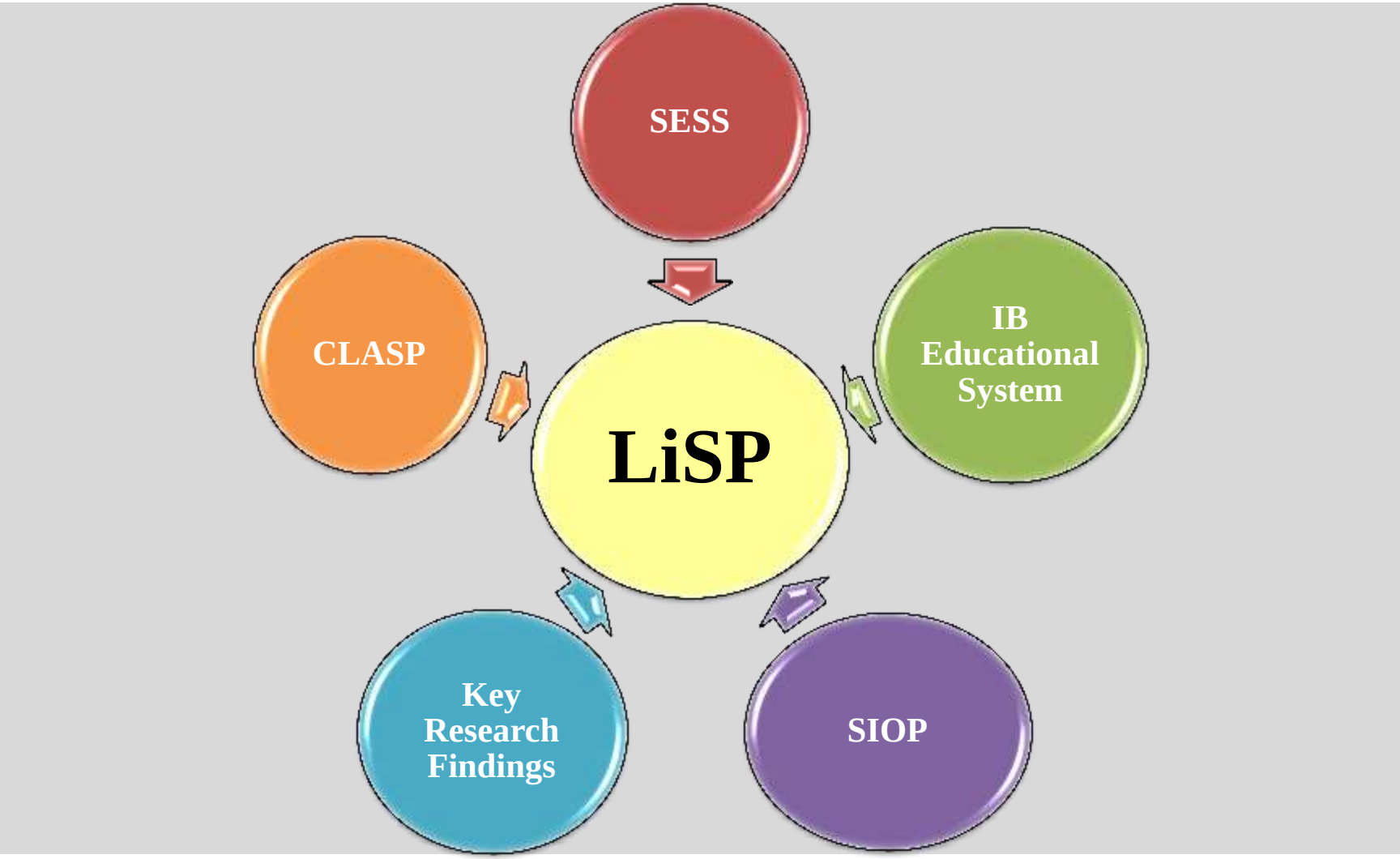
Appendix

The inspiration for the content of the 'LiSP' intervention programme came from a number of different sources as outlined in the diagram below:



Intervention Pupils

	1	2	3	4	5	6	7
School Type	Community and Comprehensive	Secondary	Secondary	Vocational School	Secondary	Community College	Secondary School
DEIS School	Yes	No	No	Yes	Yes	No	No
Location	County Kerry – Rural	County Kerry- Rural	Limerick City-Urban	County Tipperary- Rural	Dublin - Urban	Dublin- Urban	County Limerick- Rural
Gender	Mixed	All Boys	All Girls	Mixed	Mixed	Mixed	Mixed
No. of students involved	93	55	34	34	30	55	57
Total Student Cohort							**358**

Table1.1: Summary of the Experimental Schools that participated in phase three of this investigation.

It must be noted that not all of the 269 pupils from the intervention schools were taught using the intervention programme. 3 of the 7 intervention schools had both intervention and control pupils which allowed for triangulation of the results.

Control Programme Schools

	1	2	3	4	5
School Type	Secondary	Vocational	Secondary	Community and Comprehensive	Secondary
DEIS School	Yes (High proportion of non-nationals)	No	No	No	No
Location	Limerick city-Urban	County Limerick-Rural	County Cork-Rural	County Kerry-Rural	County Tipperary-Rural
Gender	All girls	Mixed	All boys	Mixed	Mixed
No. of students involved	32	28	27	31	26
Total Control student Cohort					144

Table 1.2: Summary of the Control Schools that participated in phase three of this investigation.

Intervention Pupil versus various factors:

	p-value
Intervention pupil status(yes or no) versus gender	**0.055**
Intervention pupil status(yes or no) versus native or non-native English speaker	0.162
Testing the understanding of the words in the standard test with regard to the pupil status (intervention pupil or control pupil)	
Intervention pupil status(yes or no) versus **percentage**	0.165
Intervention pupil status(yes or no) versus excite	**0.012**
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Intervention pupil status(yes or no) versus repel	**0.009**
Intervention pupil status(yes or no) versus **average**	0.609
Intervention pupil status(yes or no) versus **abundant**	0.144
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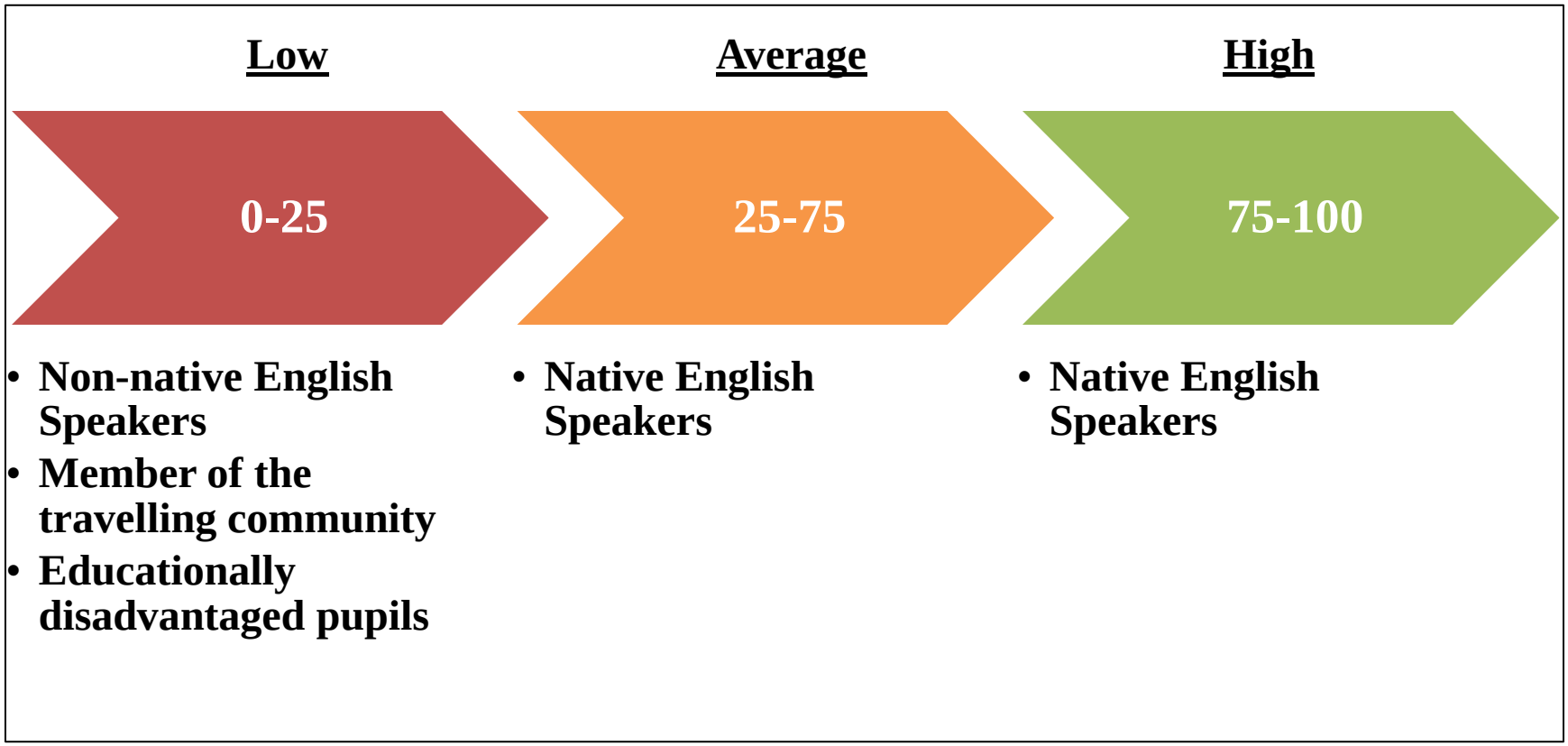
Intervention pupil status(yes or no) versus **convention**	0.151
Intervention pupil status(yes or no) versus **constituent**	0.201
Intervention pupil status(yes or no) versus crude	**0.042**
Intervention pupil status(yes or no) versus **displace**	0.348
Intervention pupil status(yes or no) versus **initial**	0.165
Intervention pupil status(yes or no) versus **probability**	0.069
Intervention pupil status(yes or no) versus relative	**0.018**
Intervention pupil status(yes or no) versus **standard**	0.098
Intervention pupil status(yes or no) versus **source**	0.103
Intervention pupil status(yes or no) versus **sequence**	0.059
Intervention pupil status(yes or no) versus **tabulate**	0.090
Intervention pupil status(yes or no) versus control	**0.046**
Intervention pupil status(yes or no) versus **alphabet**	0.187
Intervention pupil status(yes or no) versus **cow**	0.293
Intervention pupil status(yes or no) versus **actor**	0.155
Intervention pupil status(yes or no) versus **baby**	0.450
Intervention pupil status(yes or no) versus **lead**	0.139
Intervention pupil status(yes or no) versus **feather**	0.801

2. Proficiency in Language Use

- **English language proficiency** underpins the use of language in science education but **science has its own problems.**

- In order for a pupil to effectively negotiate the language used in science education, they must first have reached an **acceptable level of English language proficiency.**

English Language Proficiency Scale



Non-native English speakers with a low proficiency level in English have **relatively disadvantaged educational outcomes** in comparison to pupils who are competent in the English language.

The Irish Context

This is very pertinent to Ireland's school population which is becoming increasingly **more culturally and linguistically diverse** (Lee, 2000; NCCA, 2006), a trend which continues to persist according to a survey conducted by *Irish Times* (30 March 2012, p. 62).

In 2009 is was estimated that about 10% of students in primary schools and **8% of students in post-primary schools** have nationalities other than Irish (OECD, 2009). According to the Dail Eireann Debate series in July, 2012, **12% of pupils** in post-primary education have nationalities other than Irish (Dáil Éireann , 2012).

As stated by the ESRI's report, "Adapting to Diversity: Irish Schools and Newcomer Pupils" (Smyth *et al.,* 2009), over 75% of newcomers at primary level and approximately **70% of newcomers** at post-primary level are **non-English speaking pupils**.

NCCA- National Council for Curriculum and Assessment
OECD-Organisation for Economic Co-operation and Development
ESRI- The Economic and Social Research Institute

The Irish Context

Ireland has the **most evenly distributed spread of migrant students** across schools within the country of any of the participating OECD countries (approximately **90% of post-primary schools in Ireland** record migrant students) (OECD, 2009).

However, the multi-faceted nature of the language of science is also a problem for native English speakers as well as **non-native English speakers,** although it is **intensified** for the latter group (Childs and O'Farrell, 2003) and is enhanced in mixed-ability teaching.

Summary of Result of Phase 2 and 3

- Results from phase one of this investigation showed that teachers have a level of awareness to the problems caused by the use of language in science education, however, this awareness appears to be almost limited to the technical language of science e.g. isotope. This phase also highlighted that teachers would like to get more support on how to deal with the problems presented by the language of science especially in the form of teaching and learning resources and materials.

- Results from phase two of this project showed that the majority of the pupils involved in this study did not have a comprehensive understanding of the words tested regardless of the context or the format the word was presented in. An evident deterioration in pupils understanding of the given words in comparison to the Cassel and Johnstone study conducted in 1985was noted. Another important outcome of this phase was that many of the words which teachers of science use at all levels (second and third-level) are not readily accessible to all their pupils.

- Results from phase two indicate that Junior Certificate science pupils possess difficulty in understanding or comprehending scientific concepts which underpin Science due to the language that is used in the classroom and in textbooks.

Influence of Phase 1 Results on Phase 2

Phase one highlighted that teachers:

1. are aware in theory of the problems posed by the role of language
2. this awareness was predominantly based on their recognition of the complex and technical language of science and not necessarily the everyday words with dual meanings for example

Phase two therefore set out to do three things:

- determine the particular areas of need of pupils through the pen and paper test instrument (diagnostic test);
- establish if there is any notable difference in the results with regard to gender, class year and whether the pupil is a native or non-native English speaker;
- highlight to teachers that non-technical words can also be problematic in the science classroom and must not be overlooked especially dual-meaning words.

Extract 2: Isotopes!

In the periodic table, elements are arranged in order of increasing atomic number. All atoms of the same element have the same number of protons. However, some atoms of the same element have different mass numbers and, as a result, have different numbers of neutrons. These are known as isotopes.

A popular pair of isotopes are carbon-12 and carbon-13 which are used in carbon dating. Both of these atoms have an atomic number of 6 which means that are both carbon. However, they have different mass numbers and, as a result, different numbers of neutrons in their nucleus.

In Ireland				
Secondary Schools	Vocational Schools	Community and Comprehensive Schools	Total	DEIS*
403	247	91	742	202
54%	33%	13%	100%	27%

Table 1: Breakdown of Post-primary Schools in Ireland according to School type

In Munster				
Secondary Schools	Vocational Schools	Community and Comprehensive Schools	Total	DEIS*
122	70	24	212	47
57%	33%	11%	100% in Munster, 29% of total schools in Ireland	22%

Table 2: Breakdown of Post-primary Schools in Munster according to School type

DEIS: Delivering Equality of Opportunity in Schools

Systematic stratified sampling approach

School Type	No. of Schools who received the questionnaires (n=100)	No. of Schools who returned questionnaires (n=29)	% of Schools who returned questionnaires	% of school type in study (ideal)	% of school type in study (actual)
Secondary School	57	16	28%	**57%**	55%
Vocational School	33	9	27%	**33%**	31%
Community and Comprehensive School	11	4	36.4%	**11%**	14%

The 212 schools, excluding the four schools used in the pilot study, were then divided into strata according to school type and each were assigned a number which was recorded. The appropriate number of schools were then randomly selected using the online research tool of Research Randomizer accessed via http://www.randomizer.org.

212 schools in total, **100 schools** were targeted

- ❖57 schools will be Secondary
- ❖33 will be Vocational and
- ❖11 will be Community and Comprehensive

Secondary Schools

Set #1:

3, 4, 5, 6, 8, 9, 10, 11, 13, 14, 16, 18, 19, 22, 25, 26, 28, 31, 35, 36, 38, 41, 42, 46, 48, 49, 51, 52, 53, 54, 58, 60, 62, 66, 68, 70, 74, 76, 77, 79, 82, 84, 88, 91, 94, 96, 97, 102, 105, 106, 111, 113, 114, 117, 118, 121, 122

- Numbers randomly selected by research randomizer
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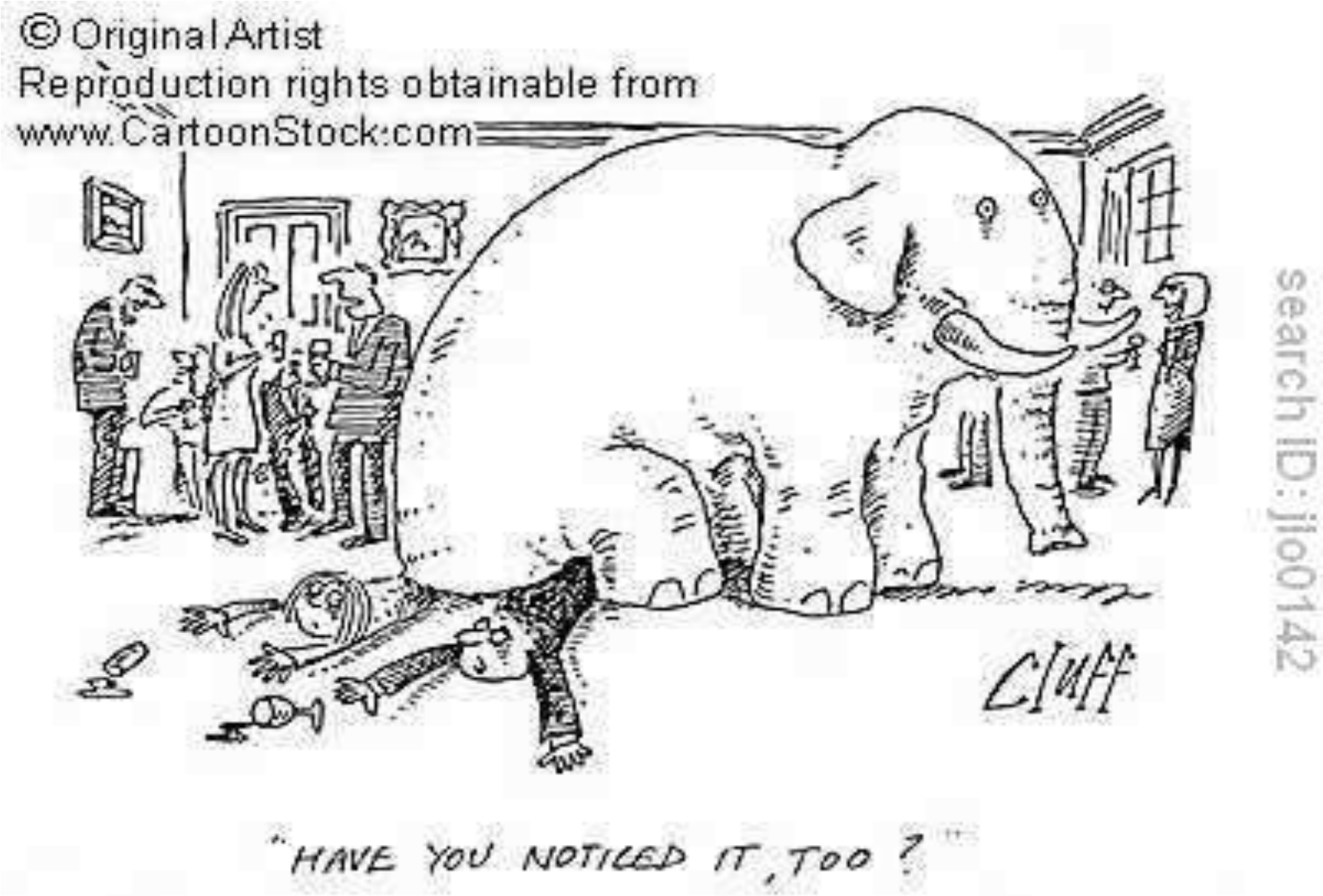
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CLIFF
"HAVE YOU NOTICED IT, TOO?"

- "**Elephant in the room**" is an English metaphorical idiom for an obvious truth that is being ignored or goes unaddressed. The idiomatic expression also applies to an obvious problem or risk no one wants to discuss (Cambridge University Press,2009).

- It is based on the idea that an elephant in a room would be impossible to overlook; thus, people in the room who pretend the elephant is not there have chosen to avoid dealing with the looming big issue.

The Montillation of Traxoline

It is very important that you learn about traxoline. Traxoline is a new form of zionter. It is montilled in Ceristanna. The Ceristannians gristerlate large amounts of fevon and then brachter it to quasel traxoline. Traxoline may well be one of our most lukized snezlaus in the future because of our zionter lescelidge.

- Directions: Answer the following questions in complete sentences. Be sure to use your best handwriting.

- 1. What is traxoline?
- 2. Where is traxoline montilled?
- 3. How is traxoline quaselled?
- 4. Why is it important to know about traxoline?

It must show low mammalian toxicity and phytotoxicity.

(Kirkman 1966: 152)

- Most readers will be exasperated at such a statement, which will only be understood by the specialist concerned at first reading.

- But what the writer means is not more than ***"It must be harmless to animals and plants".***

- The second version, accordingly, is much more communicative because it is shorter and uses more familiar words; most readers will find it easier to digest than the stiffer, more scientific version.

Number of Full-time Students in Institutions Aided by the Department of Education & Skills, 2010-2011Level	No. of Students
Second Level	356,107
Secondary	186,622
Vocational	114,761
Community and Comprehensive	54,724
8% Non-native students	**28,489**

Non-native English Speakers

- For many of these students, **their exposure to English is limited to their school environment**, which in the majority of cases is not sufficient for them to gain an acceptable command of the English language. This is a particular problem in Science as **unless one masters the language one cannot understand the science.**

- Lemke (1997) reported that English as a second language (ESL) learners have **to immerse themselves simultaneously in two social practices when learning science:** one which has to do with learning a new language (i.e. English) and the other which has to do with learning science (i.e. language of science).

Methodology

- According to Borg and Gall (1983, p.241), the first stage in sampling is to define the target audience.

  - **practising Irish science teachers**

  However, “the cost of sampling an entire population to answer a specific question is usually prohibitive in terms of time, money and resources” (Lunsford &Lunsford, 1995). Therefore, it was essential to select a subset of subjects which are **representative** of the target population (Lunsford &Lunsford, 1995).

In Ireland				
Secondary Schools	Vocational Schools	Community and Comprehensive Schools	Total	DEIS*
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Table 1: Breakdown of Post-primary Schools in Ireland according to School type

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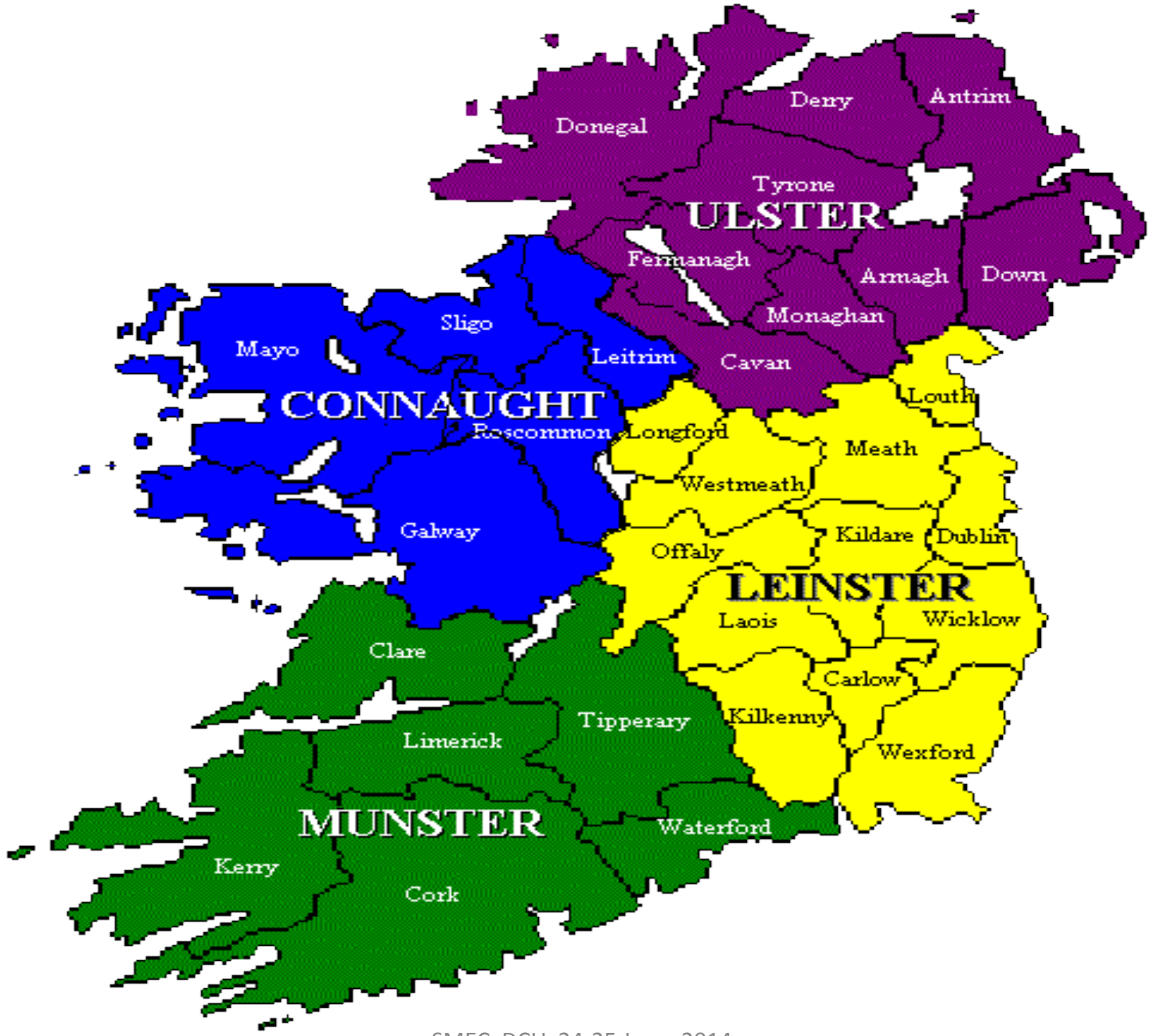
DEIS: Delivering Equality of Opportunity in Schools


Donegal
Derry
Antrim
Tyrone
ULSTER
Fermanagh
Armagh
Down
Monaghan
Cavan
Sligo
Mayo
Leitrim
CONNAUGHT
Roscommon
Longford
Louth
Meath
Westmeath
Galway
Offaly
Kildare
Dublin
LEINSTER
Laois
Wicklow
Clare
Carlow
Kilkenny
Tipperary
Limerick
Wexford
MUNSTER
Waterford
Kerry
Cork

Systematic stratified sampling approach

School Type	No. of Schools who received the questionnaires (n=100)	No. of Schools who returned questionnaires (n=29)	% of Schools who returned questionnaires	% of school type in study (ideal)	% of school type in study (actual)
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Types of Secondary Schools

The main difference between them lies in how they are managed, who owns them and how they are funded.

Secondary Schools

- 55% of students attend these schools
- Generally denominational
- Traditionally very academically oriented.

Vocational Schools

- Non-denominational
- Managed by VEC'S
- Mainly dedicated toward the development of manual skills and the preparation of young people for trades.

Community/ Comprehensive Schools

- Denominational
- Managed by the Board of management representative of local interest.
- Combination of both academic and vocational subjects in a wide curriculum.

212 schools in total, **100 schools** were targeted

- ❖57 schools will be Secondary
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Secondary Schools

Set #1:

3, 4, 5, 6, 8, 9, 10, 11, 13, 14, 16, 18, 19, 22, 25, 26, 28, 31, 35, 36, 38, 41, 42, 46, 48, 49, 51, 52, 53, 54, 58, 60, 62, 66, 68, 70, 74, 76, 77, 79, 82, 84, 88, 91, 94, 96, 97, 102, 105, 106, 111, 113, 114, 117, 118, 121, 122

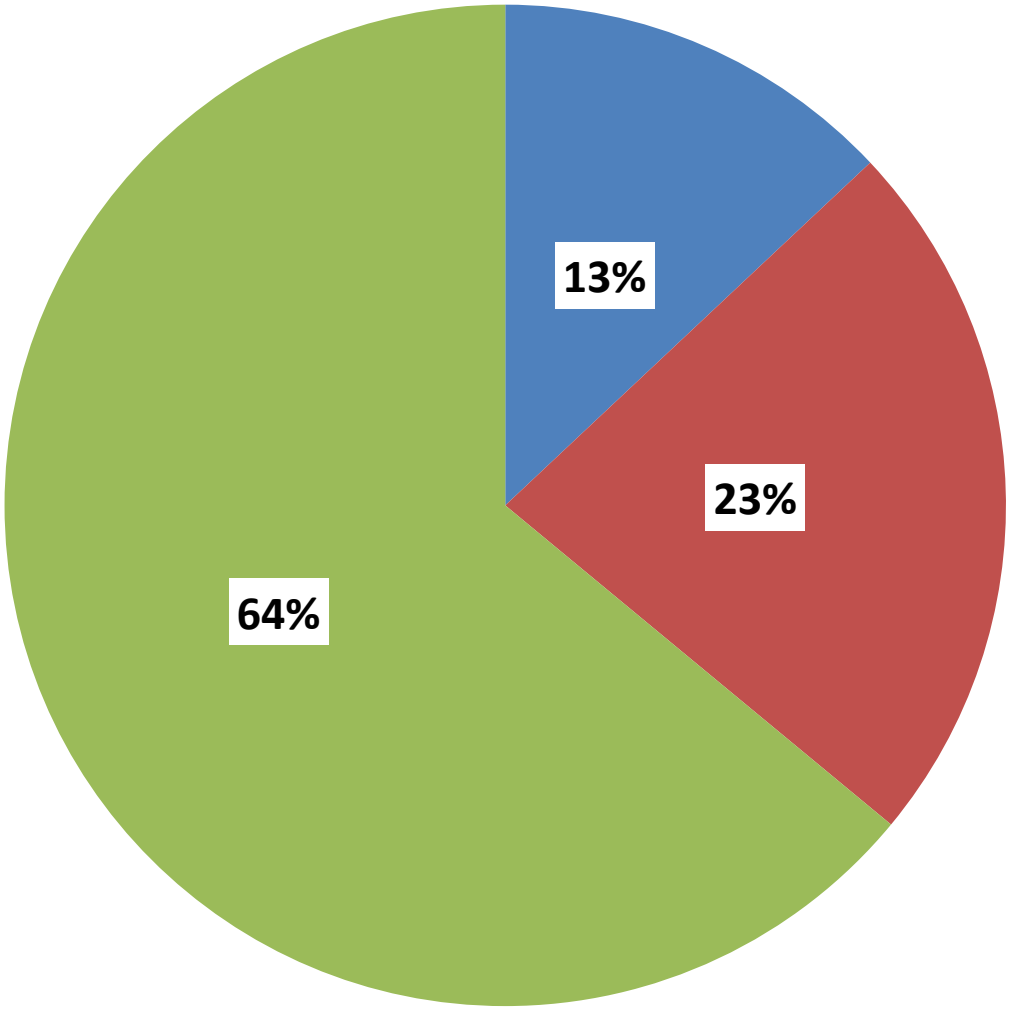
- Numbers randomly selected by research randomizer
- http://www.randomizer.org/form.htm

- The language used in written materials including exam papers is often too complicated for pupils to understand **– 57 (66%) 'Agreed'**

- Pupils for whom English is not their first language and also pupils with a low literacy level are presented with a dual barrier with regard understanding science- **73 (85%)of teachers 'agreed'**

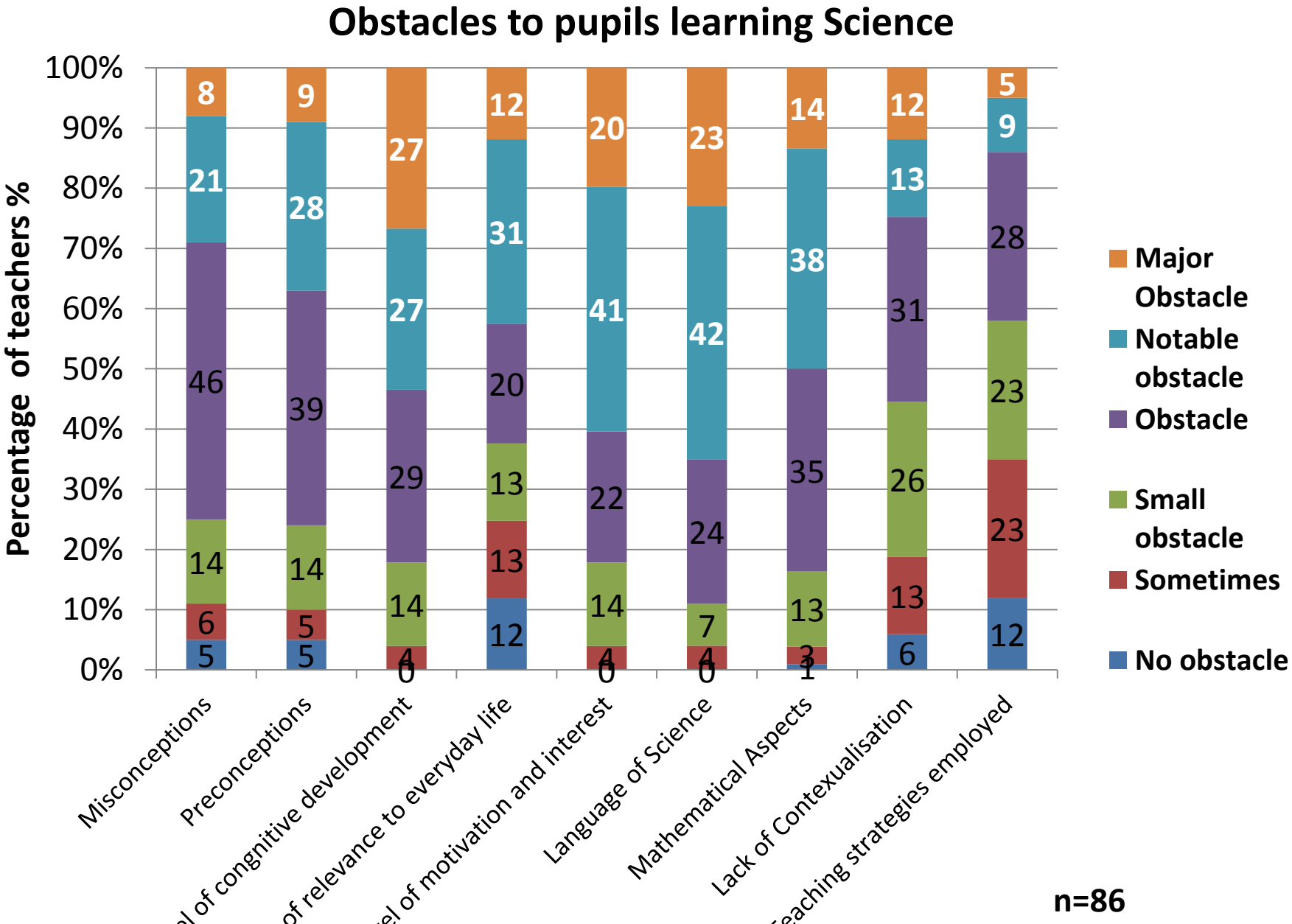
- I am more cognisant of the problems posed by the language of science to these cohorts of pupils- **57 (66%) of teachers also 'agreed'.** However, they are aware that it is a whole school problem.

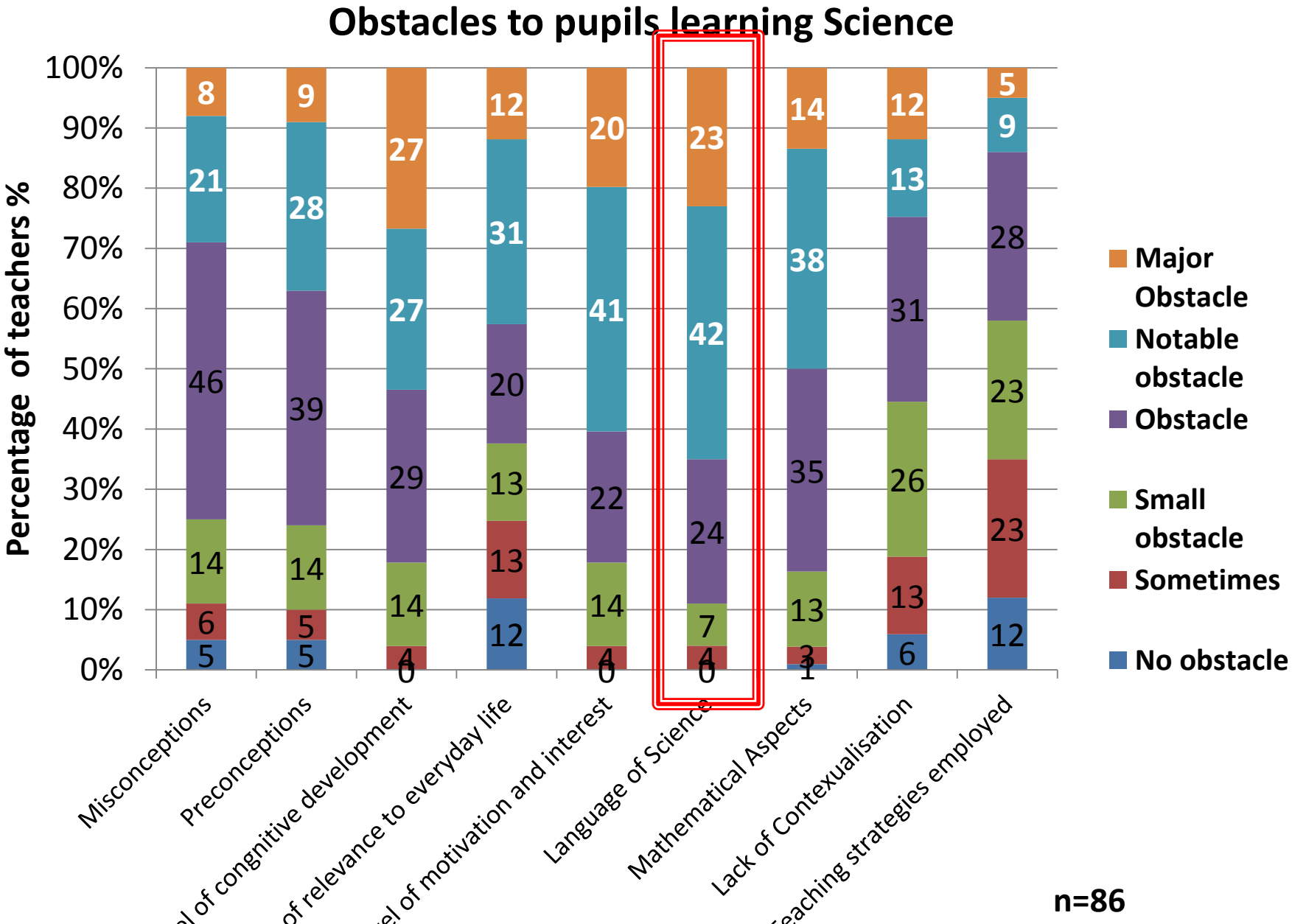
Where do you feel that the problem posed by the language of science lies?



- Technical language of science
- The vocabulary and usage of normal English in a science context
- Both 1 and 2

n=86


Obstacles to pupils learning Science
Percentage of teachers %
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Misconceptions
Preconceptions
Level of congnitive development
Lack of relevance to everyday life
Level of motivation and interest
Language of Science
Mathematical Aspects
Lack of Contexualisation
Teaching strategies employed
8
21
46
14
6
5
9
28
39
14
5
5
27
27
29
14
4
0
12
31
20
13
13
12
20
41
22
14
4
0
23
42
24
7
4
0
14
38
35
13
3
1
12
13
31
26
13
6
5
9
28
23
23
12
Major Obstacle
Notable obstacle
Obstacle
Small obstacle
Sometimes
No obstacle
n=86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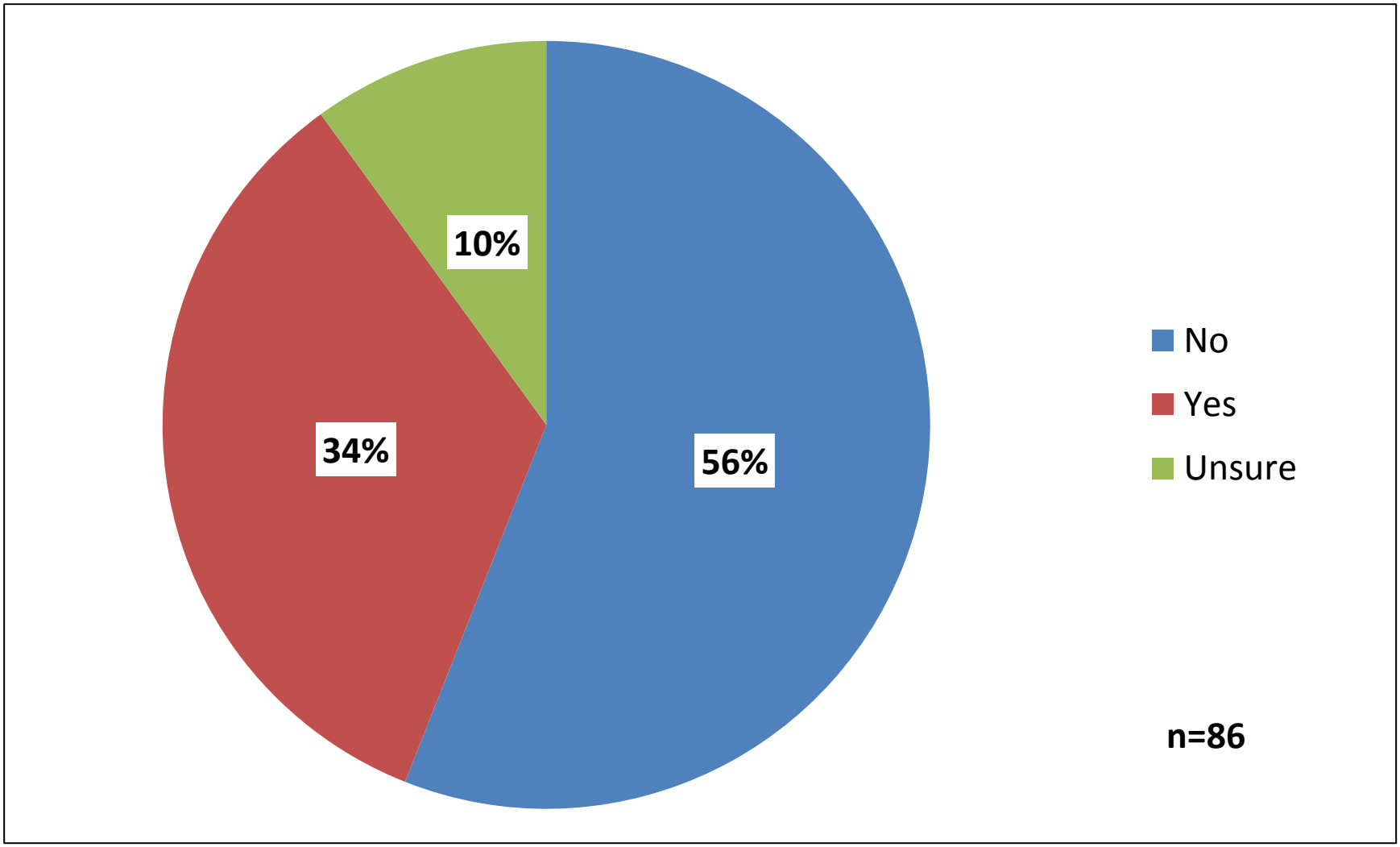
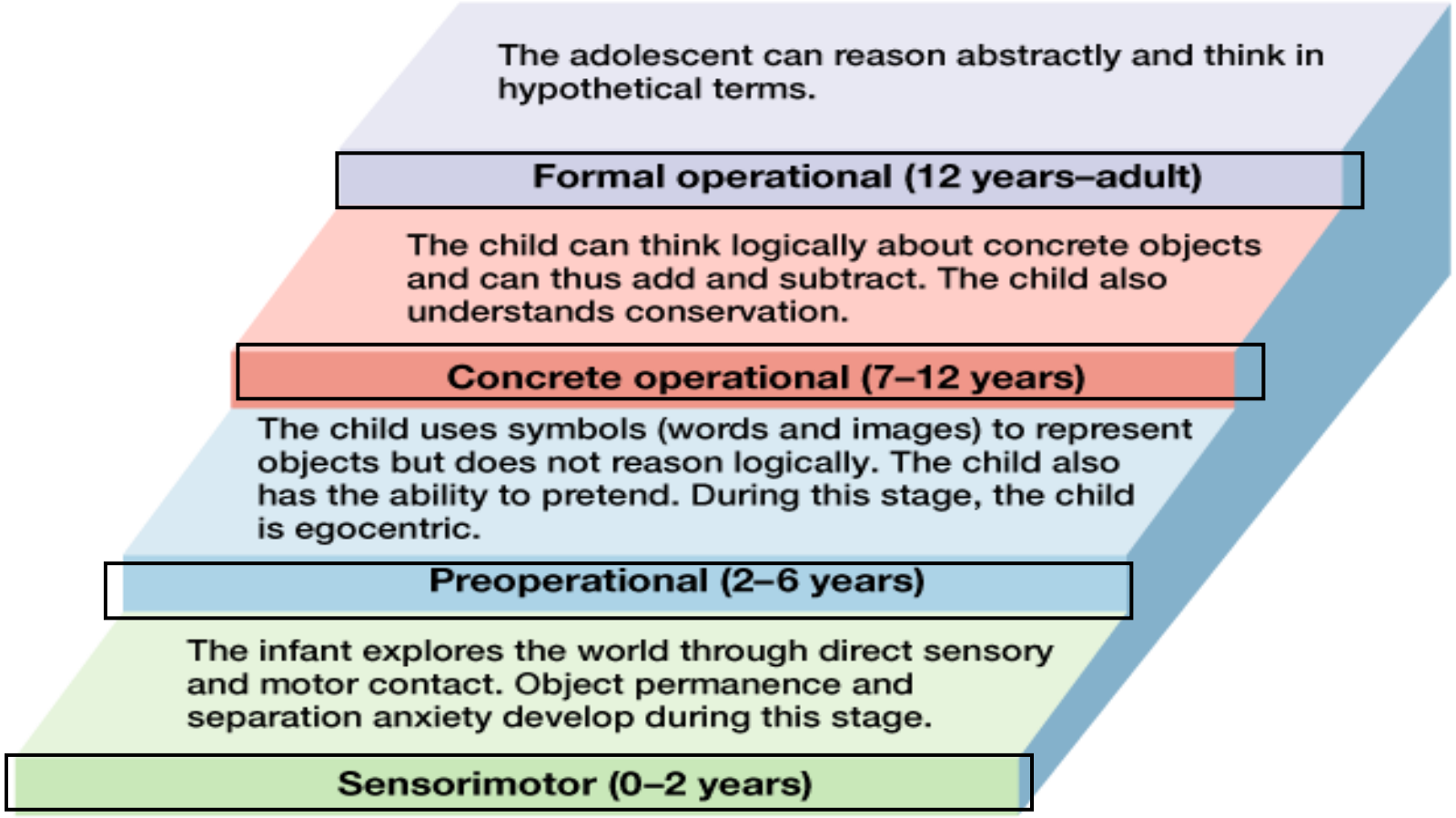
Teaching strategies employed
8 21 46 14 6 5
9 28 39 14 5 5
27 27 29 14 4 0
12 31 20 13 13 12
20 41 22 14 4 0
23 42 24 7 4 0
14 38 35 13 3 1
12 13 31 26 13 6
5 9 28 23 23 12
Major Obstacle
Notable obstacle
Obstacle
Small obstacle
Sometimes
No obstacle
n=86

Was the use of language in science ever highlighted as a problem to you during the course of your teacher education?



Cognitive Ability of the learner.



Piaget (1964)

Formal Operational Level

U.K.

Percentage operating at the formal stage has decreased from 1976 – 2003.

- 30% of learners at age 16 are at the early formal stage (2003).
- 10% of learners at age 16 are at the late formal stage (2003).

(Shayer et al. 2007)

Ireland

Percentage operating at the formal stage:

- **<10% of pupils at Junior Cycle in second level.**
- **< 20% of pupils at Senior Cycle in second level.**
- **< 40% of students at third level.**

(Childs and Sheehan 2010)

Phase 1

To identify the level of awareness of practising and student teachers of science to the problems created by the complex and multifaceted nature of the language of science.

- **ACTION:**
- Exploration of the attitudes and views of both practising and student science teachers towards the role of language in science education.

- **METHOD:**
- Questionnaires- to practising (n=86) and student science teachers (3^{rd} and 4^{th} year in U.L) (n=)

Phase 1

To identify the level of awareness of practising and student teachers of science to the problems created by the complex and multifaceted nature of the language of science.

ACTION:

Exploration of the attitudes and views of both practising and student science **teachers towards the role of language in science education.**

METHOD:

Questionnaires- to practising (n=86) and student science teachers (3^{rd} and 4^{th} year in U.L) (n=)

Phase 2

a) To assess what facets of scientific language are posing the greatest difficulty to pupils

b)To develop teaching and learning strategies and materials to make the teaching and learning of science at Junior Cycle level more effective and to reduce the rate of attrition from the scientific field at this level.

- **a) ACTION:**
- Both Junior Cycle science pupils and third level science education students will be examined in order to establish what aspects of the language utilised in science education are posing the greatest difficulty to them.
- **METHOD:**
- Diagnostic test and focus groups- pupils and students.

- **b) ACTION:**
- Science teachers' opinions on what area of Junior Certificate science syllabus (Biology, Chemistry or Physics) is causing the greatest difficulty will be established.
- **METHOD:**
- Survey/ interview - Junior Cycle science teachers

- **ACTION:**
- Teaching and learning strategies will be developed based on the findings of the diagnostic test and teacher survey on the area of science which is posing the most difficulty.

Phase 3

a)To implement the developed teaching and learning strategies in second level schools

b) To evaluate the effect of the developed teaching and learning strategies on the problems caused by the language of science

- **a) ACTION:**
- Teachers who are willing to participate in the programmes will be identified. Control teachers will also be identified. Teachers will be trained on how to effectively utilise the strategies and methodologies.
- **METHOD:**
- Consent forms will be sent to schools, In-service day

- **b) ACTION:**
- Both participating pupils and control pupils will be assessed for significant differences in the results of various examinations. Teachers' views and opinions on the strategies will be established.
- **METHOD:**
- Pre and post interview with teachers, observations of classroom practices, post-diagnostic test to pupils

Diagnostic Test

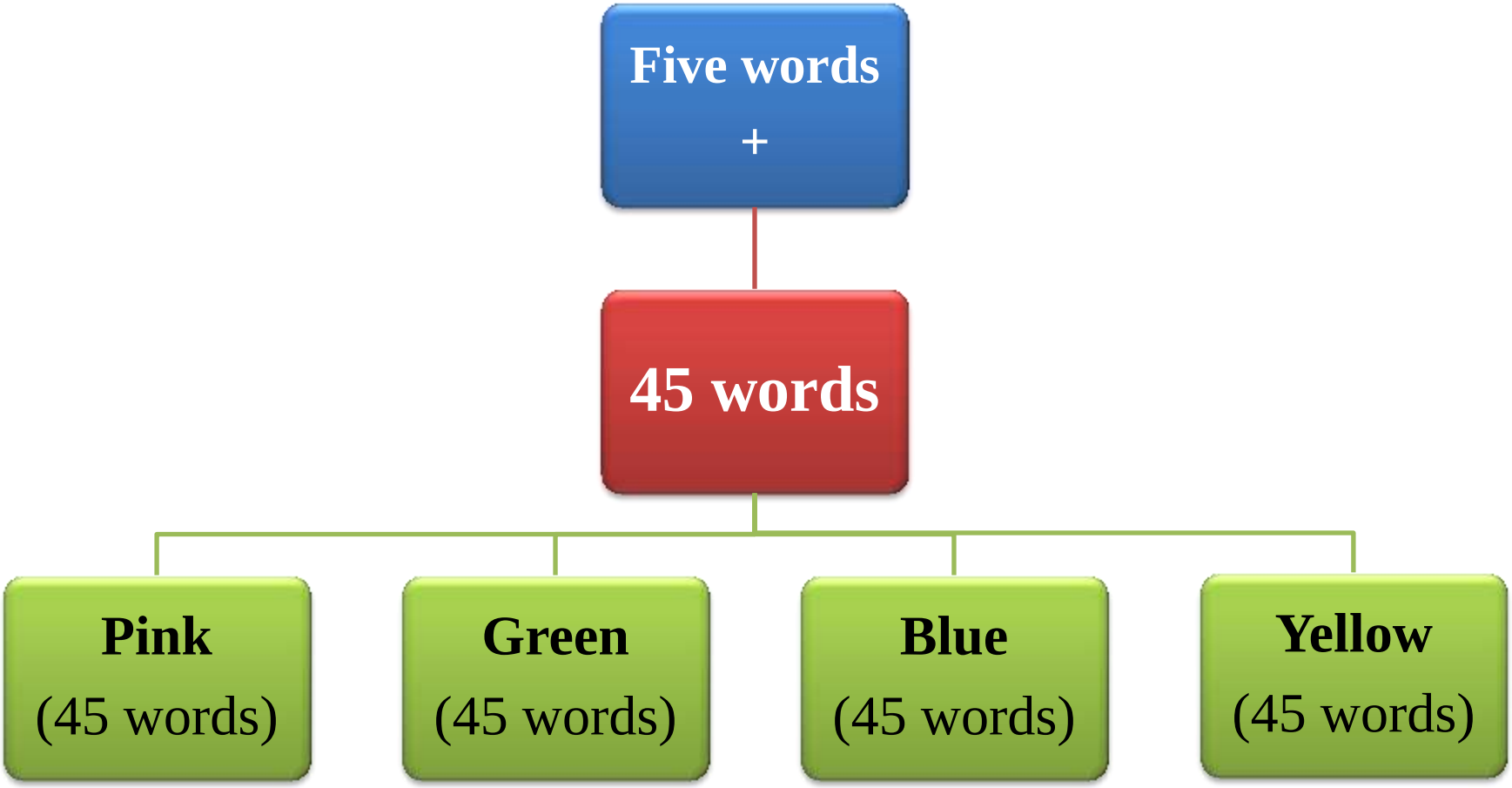
Experimental Design:

Two packages were prepared each containing five words in common and forty-five different words in four formats.

The following are the five words which were common to both package A and package B.

- **Percentage**
- **Excite**
- **Repel**
- **Average**
- **Characteristics**

These 5 words were presented in the same format in order to verify that the sample cohorts were randomly selected


Five words
+
45 words
Pink
(45 words)
Green
(45 words)
Blue
(45 words)
Yellow
(45 words)

The Four Formats:

- One word synonym without context
- Used in an everyday setting
- Used in science context
- Used in a sentence in a non-science context

By tabulating the experimental results for each acid, the pupil was able to <u>contrast</u> them. This means the pupil was able to

- point out differences.
- point out similarities.
- indicate trends.
- identify them.

Which sentence uses the word <u>constituent</u> correctly?

- The pupil was constituent about the exam results.
- By repeating the experiment, constituent results were obtained.
- The constituent of the club said you had to be 16 years old to join.
- Waste paper is a constituent of household rubbish.

‘Diagnose’ can mean

- know.
- infer.
- cut across.
- go round.

The joiner is a <u>capable</u> workman. This means he

- never leaves a mess.
- works very hard.
- can do his job.
- always takes his time.