SCIENCE EDUCATION RESEARCH SEMINAR

ARGUMENTATION IN SCIENCE PRIMARY LESSONS: AN EXPERIENCE WITH PRE-SERVICE PRIMARY TEACHERS

INTRODUCTION

THE STUDY

THE INTERVENTION

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15th September 2014
University of Limerick

UNIVERSIDAD DE MÁLAGA

Prezi

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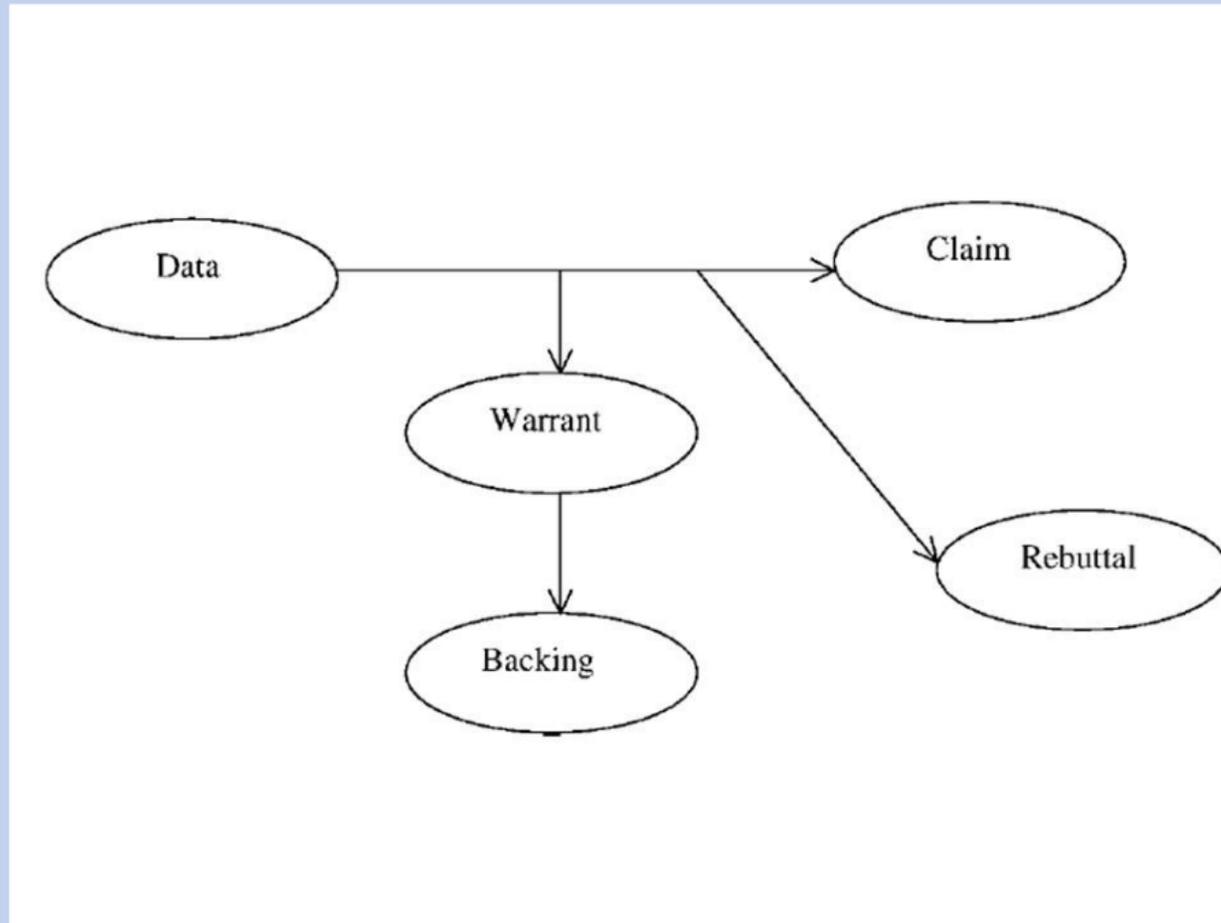University of Limerick

Argumentation in science

Way for students' development of conceptual understanding in science

(Erduran & Jimenez-Aleixandre, 2012; Driver, Newton, & Osborne, 2000; Jimenez-Aleixandre et al., 2000; Von Aufschnaiter, Erduran, Osborne, & Simon, 2008).

Toulmin's argument model

Toulmin (1958)

Students' difficulties in constructing arguments:

Teachers' limited pedagogical skills in organizing activities supporting argumentation discourse.

(Newton, Driver, & Osborne, 1999; Duschl & Osborne, 2002)

Teachers have difficulties managing discussions

(Newton et al. 1999)

Very limited work on how teachers themselves perceive argumentation in science classrooms
(Erduran, Dilek, Yakmaci-Guzel, 2006; Kaya, Cetin and Erduran, 2012)

Need to acquire knowledge to question and modify their perceptions

Acting from teacher training

Influence of their beliefs and perceptions on their teaching
(Salinas y Jaén, 1995; Solís y Porlán, 2003; Porlán y Martín del Pozo, 2004)

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THE STUDY

Research Questions and context

Q1. What are pre-service teachers of primary school level understandings of argumentation?

Q2. How do pre-service teachers of primary school level perceive the role as well as the teaching and learning of argumentation in science classrooms?

Q3. How do pre-service teachers of primary school level perceive the role as well as the teaching and learning of discourse in science classrooms?

Q4. Are there changes in their perceptions when they participate in an intervention with activities based in the argumentation?

Q5. How are pre-service teachers interpreting argument lessons for their teaching? Are they using the strategies promoted in the training sessions?

Grade of Primary Teacher of University of Malaga
"Science Education" (2014-15)

Q1, Q2, Q3	Q4 and Q5
160 Pre-service primary teachers in initial questionnaire. (Pre-test)	60-70 Pre-service primary teachers to the intervention. (Post-test and final activity)

Q1. What are pre-service teachers of primary school level understandings of argumentation?

Q2. How do pre-service teachers of primary school level perceive the role as well as the teaching and learning of argumentation in science classrooms?

Q3. How do pre-service teachers of primary school level perceive the role as well as the teaching and learning of discourse in science classrooms?

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Grade of Primary Teacher of University of Malaga
"Science Education" (2014/15)

Q1, Q2, Q3
360 Pre-service primary teachers in initial
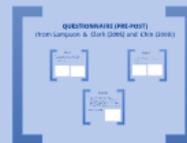questionnaire
(Pre-test)

Q4 and Q5
60-70 Pre-service primary teachers in the
intervention
(Post-test and final activity)

Methodological approach

Collection and analysis of data qualitative and quantitative

Questionnaire
(pre-post)
Adapted from
Sampson & Clark (2006)
and Chin (2008)
Q1, Q2, Q3, Q4 and Q5

Activity
as a final work
(Erduran, Dilek,
Yakmaci-Guzel,
2006)
Q4 and Q5

QUESTIONNAIRE (PRE-POST)
(from Sampson & Clark (2006) and Chin (2008))

Part I

To determine what pre-service teachers of primary school level think counts as a good argument.

This part has three questions.

Part II

To determine what pre-service teachers of primary school level think counts as a good challenge to an argument.

This part has three questions.

Part III

To know that the participants think about:
- On importance of discourse and quality of discourse.
- The classroom activities encouraging scientific discourse and promoting argumentation and students' attitudes to these activities.
- The significance of argumentation in science education

This part has ten questions.

Part I

To determine what pre-service teachers of primary school level think counts as a good argument.

This part has three questions.

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ARGUMENTATION TEST (from Sampson & Clark, 2006)

Part I: Making a Scientific Argument

Introduction:

Once a scientist develops an explanation for why something happens, he or she must support their claim with some type of reason. The explanation and the supporting reason is called an argument. Scientists use arguments to convince others that their claim is indeed true. How do you think people could create a convincing argument?

Directions:

The first three questions are designed to determine what you think counts as a good argument. In each question you will be given a claim. Following the claim are 6 different arguments. Your job is to rank the arguments in order using the following scale:

1. This is the most convincing argument
2. This is the 2nd most convincing argument
3. This is the 3rd most convincing argument
4. This is the 4th most convincing argument
5. This is the 5th most convincing argument
6. This is the least convincing argument

Your task is to rank the 6 different arguments in terms of how convincing you think they are. Remember that you can only rank one argument as 1, one argument as 2, one argument as 3, and so on.

Question 1. The agency of energy in Málaga is thinking a project to implant solar panels in the communities of neighbors without them to obtain hot water. Suppose someone makes the following claim about the solar energy, which reason makes the most convincing argument?

Claim: Solar energy is cheaper than another type of energy as butane because...

☐ Depending on different house systems to produce energy people spend more or less money. A person who panels solar in your house pay 56€ per year and other without them, have to pay 336€ per year to wrn water. **(explanation and data)**

☐ The panels solar used the sun to produce energy to warm water. The sun it's free and you don't have to pay anything to have energy. **(explanation only)**

☐ Two people, one with panels solar in your home and other without them, use the same number of bottles of butanes in one year. **(contradictory)**

☐ A person with panels solar at home need 20 bottles of butanes less that another without them. **(data only)**

☐ A person who use in your house energy solar to warm water, usually use 4 bottles of butane per year to the days without sun. Other person that don't have them in their house, consume 24 bottles of butanes. The sun is a energy resource free and thus, if the first person hadn't had solar panels, he/she woudn´t have saved 280 euros in a year. **(data, explanation and rebuttal)**

☐ The companies that install panels solar say this type of energy is cheaper. **(appeal authority)**

Part II

To determine what pre-service teachers of primary school level think counts as a good challenge to an argument.

This part has three questions.

ARGUMENTATION TEST (from Sampson & Clark, 2006)

Part II: Challenging an Argument

Introduction: Once a scientist develops an explanation for why something happens, he or she must support the explanation with the reasons for why they think their explanation is correct. The explanation along with its supporting reasons is called an argument. Sometimes other scientists agree with the argument; sometimes they do not. When they disagree, they challenge the accuracy of the argument. How do you think people could challenge the arguments of other people?

The last three questions on this test are designed to determine what you think counts as a good challenge to an argument.

Directions: In each question you will be given an argument. Following the argument are 6 different challenges. Your job is to rank the challenges using the following scale:

1. This comment is the strongest challenge to this argument
2. This comment is the 2nd strongest challenge to this argument
3. This comment is the 3rd strongest challenge to this argument
4. This comment is the 4th strongest challenge to this argument
5. This comment is the 5th strongest challenge to this argument
6. This comment is the weakest challenge to this argument

Question 4. Alvaro, Claudia, Francis y Carlota are neighbors that are discussing install solar panels in their building. They have looking for information and they are meeting to adopt a decision. Suppose Alvaro suggests that:

"I think we shouldn't install solar panels because it is more expensive that use bottles of butanes. If we install the solar panels I should pay around 1.120 € and now I am paying 280 € per year."

Claudia disagrees with Alvaro. Your task is to rank the 6 different challenges given by Claudia in terms of how strong you think they are.

Claudia: *I disagree...*

☐ "...because you haven't done enough calculations. How can you be sure that to warm up water by solar panels is more expensive that by bottles of butane if you only have compared the data of the first year? *(Rebuttals with only claim)*

☐ "...Because Francis y Carlota disagree with you and we are majority."

☐ "... It's true we have to do an initial inversión but you can't compare only the initial inversion with the cost in bottles of butane that you pay in one year. You should think in a large period of time, you will pay the same during four years and from the fifth year you won't have to pay anything." *(Rebuttals against grounds with grounds (bakings))*

☐ "...Because people save money with solar panels. My cousin installed solar panels six years ago and he has saved 560 €. According to your claim nobody could save money with solar panels. How can my cousin have saved money with them?" *(Rebuttals against thesis with no grounds (data with argument))*

☐ "...To warm water by solar panels are cheaper than by bottles of butane because they used a resource of energy that it is free." *(Rebuttals against thesis no grounds (argument with claim))*

☐ "...Because you haven't valued in a long period time. Have you thought how much money that you could save in 10 years?" *(Rebuttals against grounds no grounds (warrant))*

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ARGUMENTATION TEST (from Sampson & Clark, 2006)

Part II: Challenging an Argument

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Claudia: *I disagree...*

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Part III

To know that the participants think about:
- On importance of discourse and quality of discourse.
- The classroom activities encouraging scientific discourse and promoting argumentation and students' attitudes to these activities.
- The significance of argumentation in science education

This part has ten questions.

PERCEPTION OF ARGUMENTATION TEST (from Chin, 2008)

PART I (Classroom Discourse)

1. What are the different kinds of activities which you would
use in your classroom in order to encourage scientific discourse inside the classroom?
You are allowed to tick more than one.

- ☐ Group work
- ☐ Pair work
- ☐ Pair discussion
- ☐ Group discussion
- ☐ Open discussion
- ☐ Debate
- ☐ Drama (Role Play)
- ☐ Practical
- ☐ Experiment
- ☐ Lecture
- ☐ Other activities (please state:_____)

2. What do you think that should be the participation of the students in the talks inside the classroom of science?

- ☐ Every lesson
- ☐ Often
- ☐ Sometimes
- ☐ Seldom
- ☐ Never
- ☐ Others (please state:_____)

3. From your view of point, is discourse important during science lessons? Please explain. _____
_____

4. How can be increased the quality of the talks that take place inside the classroom?

_____
_____

ACTIVITIES DESIGNED BY PARTICIPANTS
(Erduran, Dilek, Yakmaci-Guzel, 2006)

(a) The aims
(b) The learning goals of the activity
(c) Teaching points which highlight aspects of background knowledge or what knowledge the students may need for the activity
(d) Teaching sequence which suggests how the materials might be implemented in the classroom

THE INTERVENTION

SESSIONS

Adapted from Osborne, Erduran, Simon (2004)

Session 1: Introducing Argument

Aims

- To Explore the component of an argument
- To develop the participants' knowledge and understanding of the language of argument.

Timings (150 min)

1.1 An argument lesson (30 min.)
1.2 What is the evidence? (45 min.)
1.3 Argument in science (35 min)
1.4 Constructing arguments (40 min)

Resources
Activities A1.1, A1.2, A1.3, A1.4.1, A1.4.2.

Session 2: Managing small group discussion

Aims

- To consider the value of small group discussion for learning science.
- To understand the most effective uses of small group discussion
- To know how the small groups should be organised.
- To learn strategies for using small group work.

Timings (130 min)

2.1 The value of small group discussion (45 min.)
2.2 Strategies for organising small group discussion (40 min.)
2.3 Running group work in the classroom (45 min)

Resources
Activities A2.1 y A2.2.

Session 3: Teaching argumentation

Aims

- To learn a model of argumentation.
- To explore and reflect about strategies for starting and sustaining argument activities.
- To evaluate procedures for argument lessons

Timings (150 min)

3.1 A model for argument (35 min)
3.2 Introducing argument in the classroom (40 min)
3.3 Getting argument started (30 min)
3.4 Keeping argument going (20 min)
3.5 Counter arguing (25 min)

Resources
Activities A3.1, A3.2, A3.3, A3.4 y A3.5.

Session 4: Resources for argumentation

Aims

- To know a range of resources for supporting argumentation.
- To understand of how written argument can be supported.

Timings (130 min)

4.1 Ways of initiation argumentation (50 min)
4.2 Using written argument (50 min)
4.3 Teaching strategies to support written arguments (30 min)

Resources
Activities A.2.1, A1.4.1, A3.5, A3.3.3, 3.3.4, A4.1, A4.2, A4.2.1.

Session 5: Evaluating arguments

Aims

- To know ways in which students' written and spoken arguments can be evaluated.
- To understand of how feedback can improve students' ability to argue.

Timings (150 min)

5.1 Evaluating written arguments (60 min)
5.2 Evaluating spoken arguments (90 min)

Resources
Activities A1.4.1, A1.4.2, A2.2, A3.3.4.

Session 6: Modelling argument

Aims

- To explore ways in which weak arguments can be modelled with students.
- To understand of how to model counter argumentation.

Timings (130 min)

6.1 Modelling arguments (35 min)
6.2 Constructing model arguments (35 min)
6.3 Modelling counter arguments (60 min)

Session 1: Introducing Argument

Aims

- To Explore the component of an argument
- To develop the participants' knowledge and understanding of the language of argument.

Timings (150 min)

1.1 An argument lesson (30 min.)
1.2 What is the evidence? (45 min.)
1.3 Argument in science (35 min)
1.4 Constructing arguments (40 min)

Resources

Activities A1.1, A1.2, A1.3, A1.4.1, A1.4.2.

Session 2: Managing small group discussion

Aims

- To consider the value of small group discussion for learning science.
- To understand the most effective uses of small group discussion
- To know how the small groups should be organised.
- To learn strategies for using small group work.

Timings (130 min)

2.1 The value of small group discussion (45 min.)
2.2 Strategies for organising small group discussion (40 min.)
2.3 Running group work in the classroom (45 min)

Resources
Activities A2.1 y A2.2.

Session 3: Teaching argumentation

Aims

- To learn a model of argumentation.
- To explore and reflect about strategies for starting and sustaining argument activities.
- To evaluate procedures for argument lessons

Timings (150 min)

3.1 A model for argument (35 min)

3.2 Introducing argument in the classroom (40 min)

3.3 Getting argument started (30 min)

3.4 Keeping argument going (20 min)

3.5 Counter arguing (25 min)

Resources

Activities A3.1, A3.2, A3.3, A3.4 y A3.5.

Session 4: Resources for argumentation

Aims

- To know a range of resources for supporting argumentation.
- To understand of how written argument can be supported.

Timings (130 min)

4.1 Ways of initiation argumentation (50 min)

4.2 Using written argument (50 min)

4.3 Teaching strategies to support written arguments (30 min)

Resources

Activities A.2.1, A1.4.1, A3.5, A3.3.3, 3.3.4, A4.1, A4.2, A4.2.1.

Session 5: Evaluating arguments

Aims

- To know ways in which students' written and spoken arguments can be evaluated.
- To understand of how feedback can improve students' ability to argue.

Timings (150 min)

5.1 Evaluating written arguments (60 min)
5.2 Evaluating spoken arguments (90 min)

Resources
Activities A1.4.1, A1.4.2, A2.2, A3.3.4.

Session 6: Modelling argument

Aims

- To explore ways in which weak arguments can be modelled with students.
- To understand of how to model counter argumentation.

Timings (130 min)

6.1 Modelling arguments (35 min)

6.2 Constructing model arguments (35 min)

6.3 Modelling counter arguments (60 min)

ACTIVITIES FOR PRIMARY BASED IN ARGUMENTATION
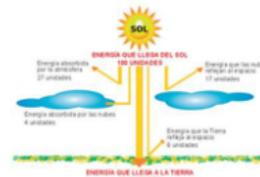
Activity 1: A classification activity

A2.1 Vertebrates (fish, amphibians, reptiles, birds, mammals) or invertebrates animals (worms, molluscs, arthropods)? (A classification activity)

Animals	Type of animals	Defend your group decisión by using evidence
1.		
2.		
3.		
4.		
5.		

Evidence card for animal 1
- You can find it in a terrestrial environment
- If you touch your body, will be rough to the touch
- It was born from eggs
- It has four pins
- It has internal skeleton

Evidence card for animal 2
- It has internal skeleton
- If you touch your body, will be soft to the touch
- It has two pins and a peak
- You can find it in a terrestrial environment and in the sea.
- It was born from eggs

Evidence card for animal 3
- It hasn't pins
- It moves crawling
- In their body has a something hard that protects its body.
- It has soft body.
- You can find it in a terrestrial environment.

Evidence card for animal 4
- You can find it in a terrestrial environment.
- It hasn't pins.
- It moves crawling
- It has soft body.
- It has a long body and divided in rings

Evidence card for animal 5
- It has a lot of pins.
- You can find it in a terrestrial environment.
- It moves jumping and flying.
- If you touch your body, you can appreciate it is rigid.
- It hasn't internal skeleton

Activity 2: Analyzing and interpreting data and contrasting theories

A.2.2 Why is important the atmosphere? (Analyzing and interpreting data and contrasting theories)

Alvaro y Claudia are classmates and one day their teacher give them the following drawing:

Their teacher ask them why they think is important the atmosphere and the clouds.
Alvaro answer:

"If we hadn't a clouds, the earth would receive less solar energy"

Claudia answer:

"I think if we had only atmosphere, the earth would receive more solar energy"

Which one do you think has a good argument? Explain your answer.

Activity 3: Predicting, observing and explaining

A4.2.1 What happens when the air is heated?

Take two little plastic bottles and two balloons. Fill up two bowls, one of them with cold water and the other with heat water. Follow the next steps.

1. Take the balloons and put them in the top of the bottles.
2. Introduce each bottle in each bowl.

What do you think that will occur in the cold water bowl? Explain your answer.

What do you think that will occur in the heat water bowl? Explain your answer.

Additional Evidence

- The particles in a gas are more separated than liquids.
- A gas tend to fill a recipient that contains it.
- Water is denser than air.
- Two bodies in contact tend to balance their temperaturas.
- The hot particles move faster than cold particles.

A2.1 Vertebrates (fish, amphibians, reptiles, birds, mammals) **or invertebrates animals** (worms, molluscs, arthropods)? **(A classification activity)**

Animals	Type of animals	Defend your group decisión by using evidence
1.		
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Evidence card for animal 4

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- It has a long body and divided in rings

Evidence card for animal 5

- It has a lot of pins.
- You can find it in a terrestrial environment.
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