

Scientific thinking in elementary school: Children's social cognition and their epistemological understanding promote experimentation skills

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ONLINE SUPPLEMENT

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The scientist ...

Task 1: Trees (U1)







A scientist travels to a faraway planet, to planet Ogi. There, he observes that all trees are very small.	
The scientist develops a tree medicine that he believes will help the trees grow. He calls this medicine Supergrow. The scientist wants to find out whether his Supergrow works and whether it really makes the trees grow. Therefore, he performs an experiment. He gives his Supergrow to all trees on planet Ogi.	
Six months later, the scientist travels back to planet Ogi. He observes that all trees are huge now. He is convinced: "My Supergrow works!"	
Was this a good experiment?	
<input type="checkbox"/> Yes	<input type="checkbox"/> No

... and the trees




Sarah, Lisa, and Vera are talking about whether or not this was a good experiment.		
Who is right and who is not?		
	is right	is <u>not</u> right
 1. Sarah says: "It was not a good experiment because the scientist does not know how big the trees would have grown without the Supergrow."	<input type="checkbox"/>	<input type="checkbox"/>
 2. Lisa says: "It was a good experiment because the scientist found that all trees have grown huge after receiving the Supergrow."	<input type="checkbox"/>	<input type="checkbox"/>
 3. Vera says: "It was a good experiment because you can only see whether things work if you test them."	<input type="checkbox"/>	<input type="checkbox"/>
Which of the three girls has the <u>best</u> answer?	No. _____	

The math teacher...

Task 2: math textbook (U2)

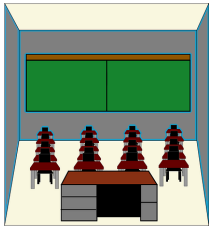
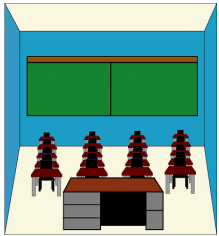
On planet Kroxon, all students learn mathematics at school.	
<p>Their math teacher has two different textbooks.</p> <p>Textbook 1 and Textbook 2.</p>	  <p>Textbook 1 Textbook 2</p>
<p>He wants to find out whether his students learn faster with Textbook 1 or Textbook 2.</p> <p>He performs an experiment and teaches his students with Textbook 1 during 2 weeks.</p>	  <p>Textbook 1 2 weeks</p>
<p>After these 2 weeks, he gives his students a math exam. All students get an A.</p> <p>The math teacher is convinced: "My students learn faster with Textbook 1."</p>	
Was this a good experiment?	
<input type="checkbox"/> Yes	<input type="checkbox"/> No

... and his students




Paul, Mark, and Luke are talking about whether or not this was a good experiment.		
Who is right and who is not?		
	is right	is <u>not</u> right
 <p>1. <i>Paul</i> says: "It was a good experiment because all students got an A on the exam."</p>	<input type="checkbox"/>	<input type="checkbox"/>
 <p>2. <i>Mark</i> says: "It was not a good experiment because he did not try out Textbook 2."</p>	<input type="checkbox"/>	<input type="checkbox"/>
 <p>3. <i>Luke</i> says: "It was a good experiment because he tested Textbook 1 with many students."</p>	<input type="checkbox"/>	<input type="checkbox"/>
Which of the three boys has the <u>best</u> answer?		No. _____

The headmaster ...

Task 3: Classroom (U3)



On planet Mawi, the Mawi children learn in grey classrooms. The Mawi children write an exam. All students get very bad grades.	
The principle of the school believes that his students all got very bad grades because they do not learn well in grey classrooms. Therefore, he performs an experiment and paints all classrooms blue.	
After 4 weeks, the Mawi children take the same exam again. Now all students get very good grades. The principle is convinced: "My students learn better in blue classrooms."	
Was this a good experiment?	
<input type="checkbox"/> Yes	<input type="checkbox"/> No

... and the classroom




Sarah, Lisa, and Vera are talking about whether or not this was a good experiment.		
Who is right and who is not?		
	is right	is <u>not</u> right
 1. Sarah says: "It was a good experiment because the principle painted all classrooms blue and not just one."	<input type="checkbox"/>	<input type="checkbox"/>
 2. Lisa says: "It was a good experiment because all students got better grades on the second exam."	<input type="checkbox"/>	<input type="checkbox"/>
 3. Vera says: "It was not a good experiment because the principle does not know how the students would have performed on the second exam if they had been taught in grey classrooms."	<input type="checkbox"/>	<input type="checkbox"/>
Which of the three girls has the <u>best</u> answer?	No. _____	

The scientist ...

Task 4: Light bulb (U4)


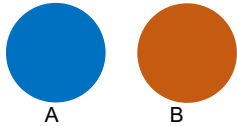
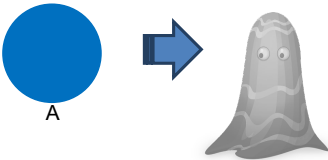

<p>A scientist develops a special machine.</p> <p>He believes that this machine can make broken light bulbs glow again.</p> <p>He wants to find out whether the machine really works and therefore, he performs an experiment.</p>	
<p>He travels to planet Bulby and tells the Bulbians: "Bring me 50 light bulbs. I want to show you something."</p>	
<p>The Bulbians bring him 50 light bulbs. The scientist puts them in the machine. Then he starts the machine.</p>	
<p>The Bulbians take the light bulbs, bring them to their homes, and try them out. All light bulbs work.</p> <p>Now the scientist is convinced: "My machine works."</p>	
<p>Was this a good experiment?</p>	
<input type="checkbox"/> Yes	<input type="checkbox"/> No

... and the machine




<p>Sarah, Lisa, and Vera are talking about whether or not this was a good experiment.</p>		
<p>Who is right and who is not?</p>		
	is right	is <u>not</u> right
<p> 1. <i>Sarah</i> says: "It was a good experiment because all light bulbs work again after they have been in the machine."</p>	<input type="checkbox"/>	<input type="checkbox"/>
<p> 2. <i>Lisa</i> says: "It was a good experiment because he put many light bulbs in the machine."</p>	<input type="checkbox"/>	<input type="checkbox"/>
<p> 3. <i>Vera</i> says: "It was not a good experiment because he does not know whether or not the light bulbs worked before he put them in the machine."</p>	<input type="checkbox"/>	<input type="checkbox"/>
<p>Which of the three girls has the <u>best</u> answer?</p>	<p>No. _____</p>	

The scientist ...

Task 5: Krogi (U5)




The scientist travels to planet Krogi. There he meets the Krogians.	
He observes that the Krogians are all very sick and very pale.	
The scientist wants to help the Krogians. He knows that there are two medicines that might cure the disease of the Krogians: Medicine A and Medicine B.	
The scientist wants to find out which medicine works better: Medicine A or Medicine B? Therefore, he performs an experiment. He gives Medicine A to 100 Krogians.	
After a week, he observes that all Krogians have recovered from their disease.	
The scientist is convinced: "Medicine A works better!"	
Was this a good experiment?	
<input type="checkbox"/> Yes	<input type="checkbox"/> No

... and the Krogians




Chris, Mark, and Luke are talking about whether or not this was a good experiment.		
Who is right and who is not?		
	is right	is <u>not</u> right
 <p>1. <i>Chris</i> says: "It was a good experiment because all Krogians who have received Medicine A have recovered."</p>	<input type="checkbox"/>	<input type="checkbox"/>
 <p>2. <i>Mark</i> says: "It was not a good experiment because the scientist does not know if Medicine B works just as well."</p>	<input type="checkbox"/>	<input type="checkbox"/>
 <p>3. <i>Luke</i> says: "It was a good experiment because you find out about things when you test them."</p>	<input type="checkbox"/>	<input type="checkbox"/>
Which of the three boys has the <u>best</u> answer?	No. _____	

The hair dresser ...

Task 6: Hair dresser (U6)

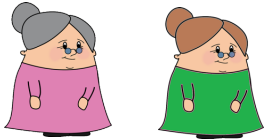
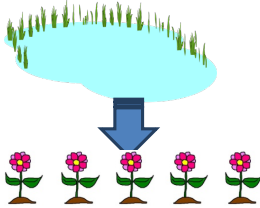
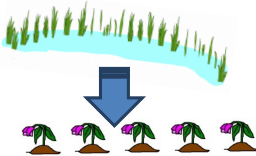
Mr. Tousle-Head is a hairdresser. He has developed a shampoo that he believes to help against hair loss.	
He performs an experiment to find out whether the shampoo really works. He gives his shampoo to 50 people. During an entire year, they use his shampoo always when they wash their hair.	
After a year, Mr. Tousle-Head asks all 50 people whether or not they have hair loss. Nobody has hair loss. Mr. Tousle-Head is convinced: "My shampoo works just fine!"	
Was this a good experiment?	
<input type="checkbox"/> Yes	<input type="checkbox"/> No

... and his shampoo




Sarah, Lisa, and Vera are talking about whether or not this was a good experiment.		
Who is right and who is not?		
	is right	is <u>not</u> right
 <p>1. <i>Sarah</i> says: "It was a good experiment because nobody had hair loss after a year."</p>	<input type="checkbox"/>	<input type="checkbox"/>
 <p>2. <i>Lisa</i> says: "It was a good experiment because he investigated many people."</p>	<input type="checkbox"/>	<input type="checkbox"/>
 <p>3. <i>Vera</i> says: "It was not a good experiment because he does not know whether or not the people had hair loss in the first place."</p>	<input type="checkbox"/>	<input type="checkbox"/>
Which of the three girls has the <u>best</u> answer?	No. _____	

The grannies...

Task 7: Grannies (U7)

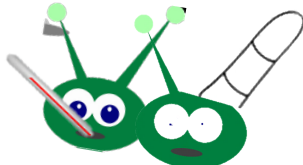




Granny Bubu and Granny Kiki live on planet Iber. Both grannies love flowers. They want to find out what makes their flowers bloom beautifully. Therefore, they perform an experiment.	 Granny Bubu Granny Kiki
Granny Bubu waters her flowers with lake water. Granny Bubu's flowers bloom beautifully.	
Granny Kiki waters her flowers with river water. Granny Kiki's flowers are withered.	
Granny Bubu is convinced "It's the lake water that makes my flowers bloom so beautifully."	
Was this a good experiment?	
<input type="checkbox"/> Yes	<input type="checkbox"/> No

... and their flowers




Nick, Thomas, and Simon are talking about whether or not Granny Bubu and Granny Kiki made a good experiment.		
Who is right and who is not?		
	is right	is <u>not</u> right
 1. <i>Nick</i> says: "It was a good experiment because all flowers that have been watered with lake water bloom beautifully."	<input type="checkbox"/>	<input type="checkbox"/>
 2. <i>Thomas</i> says: "It was not a good experiment because the grannies do not know whether they do anything else differently, apart from the water they use ."	<input type="checkbox"/>	<input type="checkbox"/>
 3. <i>Simon</i> says: "It was a good experiment because you can only find out how good something works if you try it out."	<input type="checkbox"/>	<input type="checkbox"/>
Which of the three boys has the <u>best</u> answer?		No. _____

The hospital ...

Task 8: The Molans (U8)


On planet Mola, many Molans are sick.	
In the hospital, a scientist wants to find out whether the Molans recover faster if they are allowed to receive visitors.	
He performs an experiment: 20 Molans who have a heat disease are allowed to receive visitors for 2 hours per day during 2 weeks.	 2 visiting hours
20 Molans who have a broken antenna are not allowed to receive visitors during these 2 weeks.	 no visiting hours
He compares both groups and finds out: After 2 weeks, all Molans with heat disease have recovered.	
All Molans with a broken antenna, who have not received visitors, are still sick after 2 weeks.	
The scientist is convinced: "Whether or not the Molans recover fast depends on the visiting hours."	
Was this a good experiment?	
<input type="checkbox"/> Yes	<input type="checkbox"/> No

... on planet "Mola"




Sarah, Lisa, and Vera are talking about whether or not this was a good experiment.		
Who is right and who is not?		
	is right	is <u>not</u> right
 <p>1. Sarah says: "It was not a good experiment because the scientist should have compared 2 groups of Molans with the same disease."</p>	<input type="checkbox"/>	<input type="checkbox"/>
 <p>2. Lisa says: "It was a good experiment because he investigated many Molans."</p>	<input type="checkbox"/>	<input type="checkbox"/>
 <p>3. Vera says: "It was a good experiment because 20 Molans have recovered from their disease."</p>	<input type="checkbox"/>	<input type="checkbox"/>
Which of the three girls has the <u>best</u> answer?		No. _____

Ms Mef ...

Task 9: Ms Mef (U9)





Ms Mef lives on planet Ballinki with her 6 children.	
Ms Mef has an old family recipe for a juice that she believes to be good for her children's teeth. She wants to find out whether the juice really works, and therefore, she performs an experiment.	
Three of her children drink the juice every night. They have good and healthy teeth.	
Three of her children never drink the special juice. They have bad and ill teeth.	
Mrs Mef is convinced: "The juice makes your teeth healthy!"	
Was this a good experiment?	
<input type="checkbox"/> Yes	<input type="checkbox"/> No

... and her family recipe




Sarah, Lisa, and Vera are talking about whether or this was a good experiment.		
Who is right and who is not?		
	is right	is <u>not</u> right
 1. Sarah says: "It was a good experiment because all children who drank the juice have good teeth."	<input type="checkbox"/>	<input type="checkbox"/>
 2. Lisa says: "It was not a good experiment because Ms Mef does not know whether the children with the bad teeth have had other kinds of bad food or drinks."	<input type="checkbox"/>	<input type="checkbox"/>
 3. Vera says: "It was a good experiment because Ms Mef can only find out whether her family recipe works if she tries it out."	<input type="checkbox"/>	<input type="checkbox"/>
Which of the three girls has the <u>best</u> answer?	No. _____	

The principle...

Task 10: The principle (U10)





<p>On planet Iber, all Iber children have to go to school. However, they all get very bad grades. The principle of their school has three different ideas about why his students get such bad grades:</p>	
<p>1. Iber teachers have too high standards. 2. Iber children do not work hard enough. 3. The Iber school is too small and the children cannot concentrate in the small rooms.</p>	
<p>The principle makes a scientific study. He takes a look on the neighboring planet where children get very good grades.</p> <p>He finds that indeed classrooms on the neighboring planet are much bigger.</p>	
<p>The principle is convinced: "The Iber children get bad grades because the classrooms on planet Iber are too small."</p>	
<p>Was this a good study?</p>	
<p><input type="checkbox"/> Yes</p>	<p><input type="checkbox"/> No</p>

... and his school




<p>Nick, Thomas, and Simon are talking about whether or not this was a good experiment.</p>		
<p>Who is right and who is not?</p>		
	<p>is right</p>	<p>is <u>not</u> right</p>
 <p>1. <i>Nick</i> says: "It was a good study because the principle can only find something out when he thinks a lot about it and when he checks his ideas."</p>	<p><input type="checkbox"/></p>	<p><input type="checkbox"/></p>
 <p>2. <i>Thomas</i> says: "It was not a good study. It might also be that Iber children get bad grades because Iber teachers are too demanding or Iber children too."</p>	<p><input type="checkbox"/></p>	<p><input type="checkbox"/></p>
 <p>3. <i>Simon</i> says: "It was a good study because the children on the neighboring planet get good grades."</p>	<p><input type="checkbox"/></p>	<p><input type="checkbox"/></p>
<p>Which of the three boys has the <u>best</u> answer?</p>		<p>No. _____</p>

The flowers ...

Task 11: Flowers (U11)

All flowers on planet Blossom are sick and withering. A scientist thinks that there may be three reasons for why the plants are getting sick:		
1. They do not get sufficient sunlight. 2. There is too much wind. 3. The soil is not fertile.		
The scientist performs an experiment. He takes 50 flowers and takes them to a different spot where they receive much more sunlight.		
Indeed, the flowers are not getting sick in their new location.		
The scientist is convinced: "The reason for why the flowers got sick is that they did not get sufficient sunlight."		
Was this a good experiment?		
<input type="checkbox"/> Yes	<input type="checkbox"/> No	

... on planet Blossom

Nick, Thomas, and Simon are talking about whether or not this was a good experiment.		
Who is right and who is not?		
	is right	is <u>not</u> right
 1. <i>Nick</i> says: "It was a good experiment because he took many plants to a different spot and observed them."	<input type="checkbox"/>	<input type="checkbox"/>
 2. <i>Thomas</i> says: "It was not a good experiment because he does not know whether the wind or the type of soil would have made a difference."	<input type="checkbox"/>	<input type="checkbox"/>
 3. <i>Simon</i> says: "It was a good experiment because the flowers are not sick anymore."	<input type="checkbox"/>	<input type="checkbox"/>
Which of the three boys has the <u>best</u> answer?		No. _____