Jurnal Pendidik dan Pendidikan, Jil. 24, 33–54, 2009

LANGUAGE AND MALAYSIAN CHILDREN'S SCIENTIFIC UNDERSTANDING

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Abstract: Despite scores of studies examining various factors influencing Malaysian students' understanding of science concepts, very few have actually looked into how the meaning of a specific concept is formed. This study was carried out to examine language influences on Malaysian children's understanding of concepts relating to germination of seeds. Through the use of interview, concept maps and written test, the author examines how language affects the development of meaning and understanding. Science lessons were also observed to determine how language use in the classroom influences children's understanding. It was found that children possess a myriad of understandings of each of the concepts examined prior to and after instruction, indicating that linguistic elements influence the formation of conceptual understanding as well as the way meaning is assigned to each of the concepts.

Keywords: children's understanding, language influence, science concepts

Abstrak: Walaupun banyak kajian telah dijalankan tentang faktor yang mempengaruhi pemahaman konsep sains pelajar Malaysia, hanya sedikit yang mengkaji bagaimana makna sesuatu konsep sains itu dibina. Kajian ini dijalankan untuk mengenal pasti pengaruh bahasa kanak-kanak Malaysia ke atas pemahaman konsep sains berkaitan dengan percambahan bijih benih. Penulis menggunakan kaedah temubual, lakaran peta konteks dan ujian bertulis untuk mengenal pasti bagaimana bahasa mempengaruhi pembinaan bahasa serta pemahaman kanak-kanak. Pembelajaran sains dalam bilik darjah turut dicerap untuk tujuan yang sama. Dapatan kajian menunjukkan kanak-kanak mempunyai pelbagai pemahaman saintifik dan tidak saintifik tentang konsep yang dikaji sebelum dan selepas pembelajaran. Ini menunjukkan bahawa elemen linguistik memang mempengaruhi pemahaman konsep serta makna yang tersirat dan tersurat di sebalik setiap konsep.

Kata kunci: pemahaman kanak-kanak, pengaruh bahasa, konsep sains

INTRODUCTION

The vital role that language plays in the dissemination and acquisition of knowledge has been highlighted by many researchers. Postman and Weingartner (1971) argue that almost all of what we customarily call 'knowledge' is language. In other words, the key to understanding a subject is to understand the language used. Halliday (1973: 10) further accentuated the importance of language in learning when he wrote,

> Bernstein has shown that educational failure is often, in a very general and rather deep sense, language failure. The child who does not succeed in the school system may be one who is not using language in ways required by the school.

In teaching of science and mathematics, the crucial role that language plays is often sidelined or goes unnoticed. It is not uncommon that a science or mathematics class commences and is carried out with the assumptions that children use and therefore hold relatively similar understandings as those of their teachers.

PREVIOUS LANGUAGE-RELATED ISSUES IN SCIENCE EDUCATION

Although somewhat taken for granted, previous researchers have not totally ignored aspects of language in science learning. Specifically, three main areas related to language in science learning have been examined:

1. Discourse-based aspects of language in science learning

Researchers like Brown and Campione (1990, 1994), Mason (1996), Glasson and Lalik (1993), Halliday and Martin (1993), Hogan and Fisherkeller (1996), Peacock (1991), and Rivard and Straw (1996) were not only in agreement that communication is an integral aspect of inquiry in science by which learners can reach more advanced levels of understanding, but they also stressed the importance of literacy—the ability to read, write and use precise scientific terminologies—in learning science. Osborne (2002: 204) succinctly emphasises the need for students to be able to understand and use language, including scientific terminologies, appropriately when he stated,

> [if] we wish students to gain insights and understanding of the manner and nature of scientific reasoning, we must offer them the opportunity to use and explore that language, i.e. to read science, to discuss the meaning of its texts, to argue how ideas are supported by evidence and to write and communicate in the language of science.

Differences in understanding resulting from the way teachers use language when describing or explaining a science concept during formal lessons have been extensively examined elsewhere, but not locally. Corte et al. (2001) found that students fail to comprehend due to the teacher's inability to clearly describe and clarify the target concept. Learning difficulties will also occur if students find specific science terms difficult to grasp, if inappropriate terminology is employed, and if strategies that enable linking of the text to prior knowledge are not used. Such fragments of understanding, described by diSessa (1988) as p-prims, do not help students see the overall picture of how concepts are related to one another.

2. Language as a psychological tool in science learning

Other than aspects of literacy, researchers have investigated science learning and understanding as the outcomes of intricate processes involving the formation and organisation of individual thoughts and mental structures. Specifically, the works of Piaget (1959) and Vygotsky (1989) spurred great interest in examining the nature of mental representations of science objects as well as the means by which meanings and concepts are produced. In-depth investigations on the meanings and conceptions of diversified science concepts were carried out, followed by studies examining how concepts are exchanged (Hewson, 1981), accumulated (Posner et al., 1982), restructured (Carey, 1985), enriched (Vosniadou, 1994) and modified or replaced (Bruner & Haste, 1987) in response to social change.

3. Language as a cultural tool in science learning

In addition to its role in the construction of conceptual understanding and in the formation of meaning, language in science learning is also viewed as a cultural tool necessary for sharing and developing knowledge. Language mediates thinking by imparting meaning to actions (Duran et al. 1998); it is a medium by which knowledge is transmitted from a more-experienced to a less-experienced member of a given culture (Vygotsky, 1989) as well as a means "for thinking together, for collectively making sense of experience and solving problem" (Mercer, 2000b). In science, the specific use of language is often accompanied by diagrams, pictures, chemical and mathematical symbols and equations, gestures and texts that help inform learners in a meaningful way about a concept or a phenomenon.

One may learn in isolation. However, knowledge acquisition usually involves other people, and we often learn with and from others. When children learn as a group, it is expected that they share similar understandings of the material being taught. However, the works of Jegede (1997), Ogawa (1995, 1998), Kawasaki (1996, 2003), Cobern (1996, 1998) and Loo (1999, 2001) have shown that learning science involves much subjectivity, largely contributed by the worldview of the learner. Worldview here refers to the common concept of reality shared by people belonging to the same culture. Whilst people from the same culture (often within the same society) may relate to, understand and express similar beliefs to one another, each individual possesses his or her own 'culture in the head' consisting of beliefs that differ from others'. The variations are largely the result of experiences, observations, analyses and actions as well as interpretations of those experiences and the outcomes of experiences. Hence, it would not be surprising to find a group of students from the same classroom, drawn from the same culture, to have diverse understandings of a particular concept despite receiving exactly the same instruction.

THE PRESENT STUDY

The Purpose Of The Research

Using a combination of the case study and grounded theory approaches, the research was carried out with the following purposes: (i) to examine language's influence on Malaysian children's understanding of concepts relating to germination of seeds, (ii) to categorise their conceptions into different patterns of understanding, and (iii) to identify factors influencing their understanding of science concepts. Specifically, three concepts relating to germination of seeds —seeds, germination, and food—were examined. Nonetheless, the author also scrutinised how other science terminologies were used throughout the study.

Participants

A total of 62 ten-year-olds of varying ethnicities and four science teachers participated in this study. The children resided in an urban township located in the Klang Valley and attended Year Four in national primary schools. The children and their teachers were all given pseudonyms in accordance with research ethics.

Conduct of the Research

The study concerned how language influences children's understanding of concepts relating to germination of seeds. Data for this study were primarily obtained through context mapping of germination of seeds and interviews. Each child was asked to draw his or her context map of germination of seeds and interviewed twice, once before and once after formal instruction. All science lessons pertaining to germination were also observed and recorded to determine how teachers' understanding of the studied concept interacted with their pupils' understanding.

This study was also carried out based on the assumptions offered by constructivist theorists, Bloom's (1995) context of meaning and Vygotsky's social semiotic perspective on learning processes. Specifically, the framework (refer to Figure 1) suggests that children's understanding, though it may be expressed in the form of actions as well as psychological tools, is largely dependent on language—that is, the way language is used to communicate—as well as the personal conceptions, namely the meaning and understanding of science knowledge, formed as a result of each individual child's interaction with his or her environment.

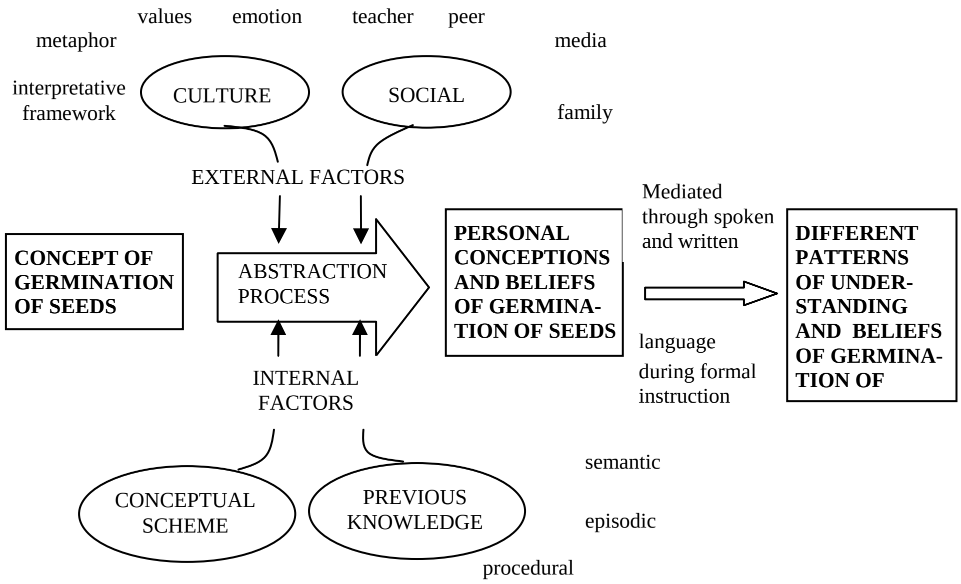

Figure 1. The conceptual framework of the study

RESULTS

The discussions on the meaning of and the children's understanding of the germination-related concepts will be highlighted according to their understanding before and after instruction. Descriptions of the concepts will also be discussed in relation to the patterns of understanding that emerged upon analysis of the data using the grounded theory approach.

Children's Understanding of Concepts Relating to Germination of Seeds Before Instruction

Prior to being asked about their understanding of the 'germination' concept, the children were probed for their understanding of seeds. It was found that 14 pupils (22%) seemed to know very little about seeds. Instead of knowing the technical term *biji benih* (the Malay for 'seed'), they are only familiar with related words like *biji*—a Malay word usually used as an adjective referring to fruits— and 'benih'—a word generally used to refer to fertile seeds. For these children, the lack of understanding of seeds may happen for a couple of reasons, the first of which is the lack of exposure to seeds and other seed-related or seed-producing objects and concepts like fruits and plants. Second, it is likely that they are familiar with fruits and plants but (i) were not exposed to the term 'biji benih' or 'seed' or (ii) may have heard of the terms ('biji benih' and/or 'seed') before but do not know what they refer to.

The remaining 48 children possessed a partial understanding of seeds. 40 (65%) of them claimed that seeds refer to anything that will grow if planted, while another eight (13%) described seeds as something that contains a miniature plant. These understandings of seeds are probably to be expected from the children had they acquired the definition of 'biji' as 'the part of a fruit that...can be planted' or 'benih' as 'something that can spawn a living being'. Other than the above descriptions of seeds, the children's knowledge of seeds was also limited to descriptions according to:

- size
  They are " *not too big…nor too small*"
- shape
  Seeds " *are round in shape*", "*ovalish*"
- colour
  Seeds are " *brown*", " *they are green*", " *black*"
- content
  Seeds *"got small plant inside", "have something inside that grow…but don't know what". "the anak…It's the, like a small a little tiny, really, really tiny woods inside there"*
- (seed) structure
  "*they have green skin and have opening*"
- origin
  Seeds come " *from tree*",
  " *inside fruit got seed*", *"we get them from supermarket. Got sell there*"

However, their notion of seeds as 'anything that grows if planted' is also dependent on their previous encounters (be it through personal experience in handling seeds, reading about them, or watching others) with the growing objects. Among the items identified as seeds include objects that reproduce by asexual means, such as onion, potato and ginger. Fruits such as lime and parts of a fruit/vegetable like a corn cob were classified as seeds as well because the children believed that they can generate a plant if sown in the soil.

When asked what they understood about the term 'germination' (or percambahan in Malay), 14 children (24%) reported that they knew nothing about how plants grow. These children's pattern of understanding of germination has been termed as the *tabula rasa* understanding. This understanding exists largely due to minimal or nonexistent interactions with others about seeds and other germination-related concepts, as well as a lack of observations of or personal engagement in seed-planting activities. To borrow from Vygotsky (1989), the lack of the interpsychological level (interaction with other people; refer to dotted box in Figure 2) within the context of exposure to seeds and plants actually prevented the formation and internalisation of any understanding of those concepts.

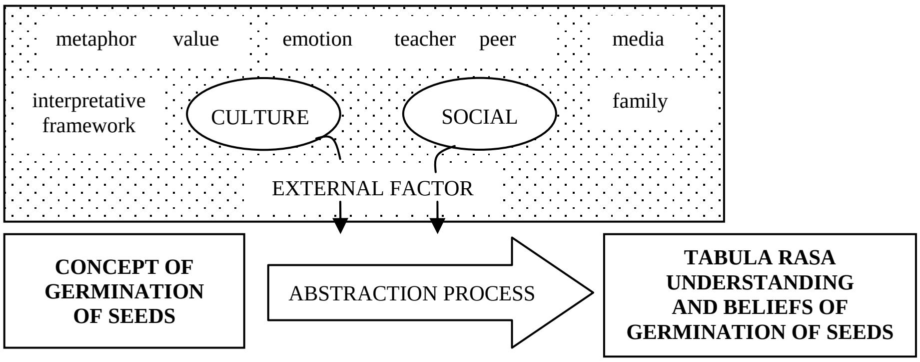

Figure 2. *Tabula rasa* understanding relating to germination of seeds

Another 46 respondents (74%) were found to have a *partial understanding* of germination, viewing the growth of a plant as when (i) something deemed as a seed is planted or when (ii) something inside a seed grows. The items perceived as seeds may include the bulb, shoot, root, fruit, etc., while the 'thing' inside seeds that eventually grows is identified as either a miniature version of a fully-developed plant or something else inside the seed of an unknown nature. Among those who believed that there is a miniature version of a plant waiting to emerge from a seed were the following students:

> *"actually the roots will come out first…then the stem, then the leaves, then the batang…and the branches"* (Alex)

> *"the seed is broken" to allow "the akar (root…and long woods to come out and eventually grow into a big plant"* (Eron)

On the other hand, others who were less certain of the nature of seeds listed "small stuff," "tiny, tiny thing", "root", "spora", "seed", "cotyledon", "round, round things," "something whitish", "white colour thing" and "don't know how to tell" as items that ultimately grow into new plants.

There are multiple explanations of how children arrive at different perceptions of the nature of things that grow. Behavioural and social cognitive theorists have highlighted that children's understanding of germination is reinforced upon successful attempts to personally sow seeds and while learning through actual handling, planting and watching seeds grow, respectively. Children also learn enactively by observing other people. In the context of this study, it was discovered that the sources of partial understanding include observation of other people in person, explanations offered by others, electronic sources and printed materials. The children probably wrongly scrutinised the way seeds were handled and misinterpreted the language used to describe aspects of seeds and the germination process. In other words, unlike the children with *tabula rasa* patterns of understanding, those with a *partial* understanding of concepts relating to germination of seeds have acquired information directly or indirectly through observation or talking to others, after which this information was internalised. Figure 3 highlights the partial understanding of concepts relating to germination of seeds.

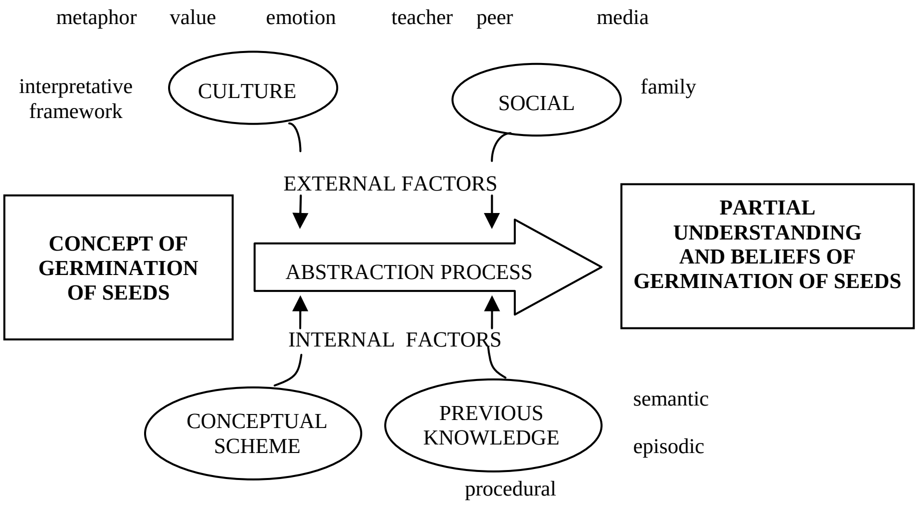

Figure 3. Partial understanding relating to germination of seeds

Two remaining children were discovered to possess a *supernatural* understanding of plant germination. A supernatural pattern of understanding refers to the unscientific understanding that germination of seeds occurs as a result of other external forces beyond the natural realm. This pattern takes into account religious aspects such as God's role *("air,...the cahaya matahari, it's also from God)* in the sprouting of seeds or the 'karmic notion' of seed germination, in which the plant will emerge only after the 'death' of the seed *("The seed grows, then the seed becomes purple, then the leaf come out...The seed dies and leaf grows)*. Again, these conceptions were acquired through the children's interaction with their social and cultural environment, particularly with the way they were indoctrinated into their religious and cultural beliefs.

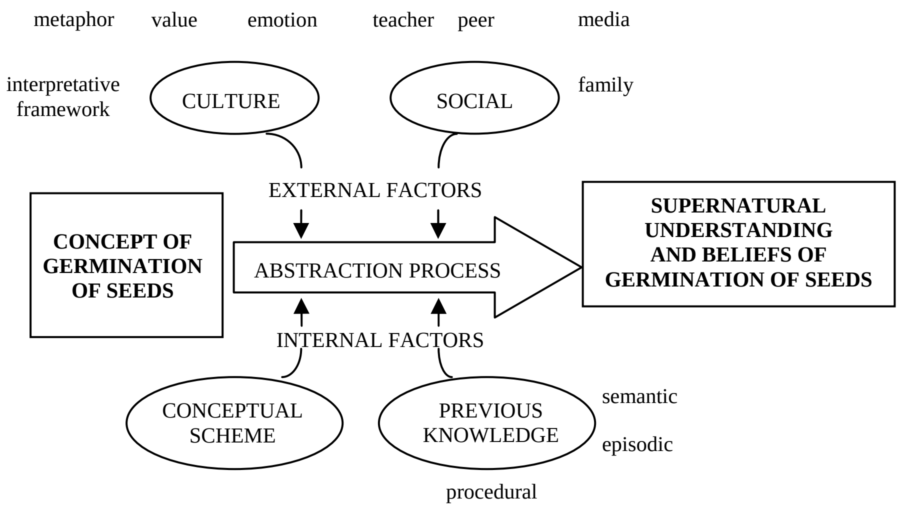

Figure 4. Supernatural understanding relating to germination of seeds

With respect to their understanding of the 'food' required for seeds to grow, 41 children (66.1%) did not realise that the developing plant embryo within a seed requires food during the initial stage of its growth process, while 14 (22.6%) other respondents claimed that seeds obtain food externally. Among the responses given by these 14 children include the ideas that seeds obtain food:

- from fertilisers while germinating
- from the sun, which *"makes food"* for the seed
- from water – the rain *"feeds"* seeds with food and supplies them the necessary things for growth, and the seeds *"drink"* water to develop
- from the ground via roots (which absorb food from the ground to allow seed growth) and
- from worms that *"give them [the seeds] food"*

Seven other children believed that food for seeds is stored internally and is used up by the seed as the seed grows, as delineated by one of them:

> *But once when it's got some air, water, oxygen…err, once it got water, and sunlight and all, it will, it will start to…in one or two days it might finish; you know, eat the food [in the seed]...and then it will start to grow* (Eron).

To summarise, the children's understanding of concepts relating to germination of seeds before formal instruction varied according to their exposure and experience dealing with seeds. Specifically, three patterns of understanding relating to germination of seeds were uncovered: the *tabula rasa*, *partial* and *supernatural* understandings.

Children's Understanding of Concepts Relating to Germination of Seeds After Instruction

The children's understanding of seeds improved after formal instruction. They were in agreement that seeds refer to something that will grow and become plants given the right resources and environment. They were also more aware of seeds' origin and knew that besides seeds, plants have different procreation mechanisms, namely using bulbs, seedlings, stem cuttings, etc. However, none of the children provided the scientific understanding of seeds as the product of the success or failure of pollination. Neither were they aware that in a viable seed is a living embryo consisting of undifferentiated cells that will start to differentiate and develop during the germination process. The majority of the children remained uncertain about the nature of the thing inside seeds that eventually grows. In short, the two misconceptions—the belief that there is something inside seeds that will eventually grow into a plant or a tree and the notion that there is a miniature plant residing in a seed, waiting to emerge when the seed obtains its basic requirements for germination – still prevail.

Similar to their understanding of seeds, the children's general understanding of germination after formal instruction also improved. All unanimously agreed that germination refers to the growth of something from within the seeds upon fulfilment of germination's basic requirements, but their opinions differed with respect to the nature of the 'thing' that grows. Children's uncertainty about the 'thing' that grows from within the seed during germination remains. Their responses included *"small stuff"/ "tiny, tiny thing"/ "something small"* (n = 7); *"root"* (n = 5); *"seed"* (n = 3); *"something extra, passed on from tree to seed"* (n = 1); *"something whitish/white colour thing*" (n = 7) and *"don't know how to describe" / "don't know how to tell"* (n = 23). Fifteen of the children also believed that each seed that grows has a miniature version of a fully grown plant inside it. The change from no understanding at all *(tabula rasa)* to a form of misconception is depicted in Figure 5, while the change from one misconception to another misconception is highlighted by Figure 6.

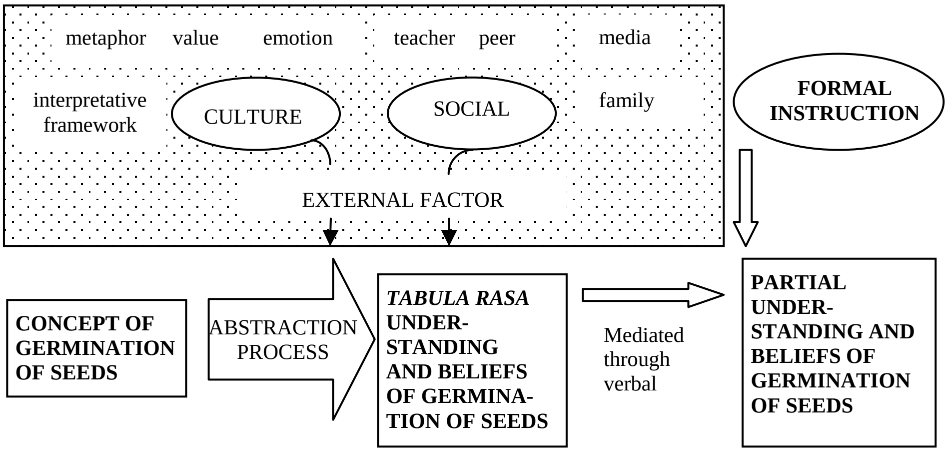

Figure 5. Change from *tabula rasa* to partial understanding of germination of seeds

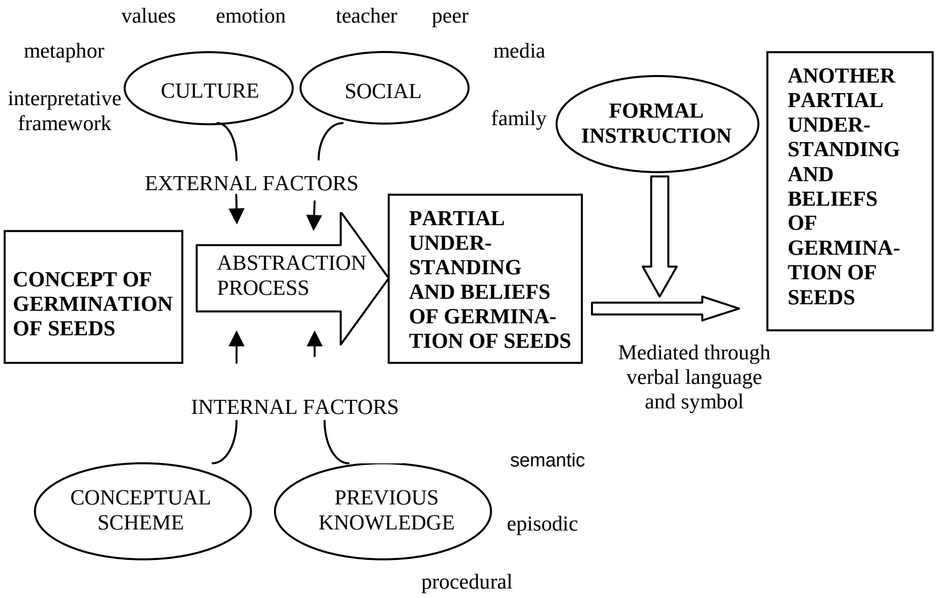

Figure 6. Change from one partial understanding of germination of seeds to another

One child was discovered to possess a somewhat scientific understanding of germination of seeds. Eron realised after classroom instruction that there was no any tiny, tiny plant with *"the akar (root)…and long woods"* inside a seed as he had originally thought. Though he knew there was something else that eventually grew into a plant, he was uncertain of the nature of the thing inside a seed, which led to him ask his father and read other science texts at home. As a result, he came not only to know that there are cells in the seed, but he also understood that those cells would develop into a plant as would the cells in a chicken egg into a chick. When asked to describe what cells are, Eron said:

> *"It is something like.. like things that will grow. It will divide, just like inside an egg. The yolk, the yellow coloured thing in the egg. That… there are also cells there that will grow into a chick. But the cells in the seed will grow into a plant."*

His illustration of the above idea has been translated into the drawing in Figure 7.

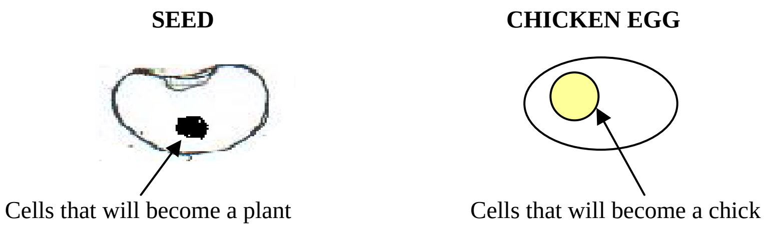

Figure 7. Eron's analogy of a seed's contents to those of an egg.

Although his understanding about the yolk turning into a chick is erroneous, the very fact that Eron was able to describe cells as things that "divide" to form a plant is commendable since most children his age have difficulty understanding concrete objects, let alone something as abstract as divisible cells. As a result of formal instruction as well as informal inquisition, his partial understanding of germination has changed to a scientific understanding of the concept.

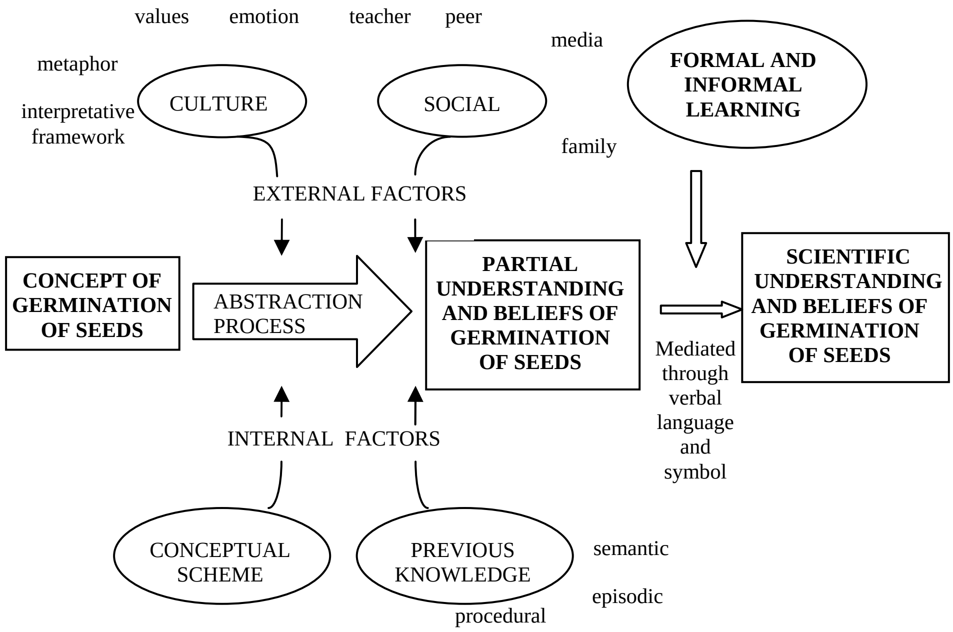

Figure 8. Change from partial to scientific understanding of germination of seeds

Factors Influencing Children's Understanding of Concepts Relating to Germination of Seeds

Among the factors that influenced the children's understanding of concepts relating to germination of seeds are the following:

1. Human and media factors

The conceptual understandings formed by the children in this study are largely due to how language is used to describe the studied concepts. Learning may also take place nonverbally via observation of others handling seeds or plants, as highlighted in Table 1.

An important aspect of human factors that influence understanding deals with the formal instruction children get in schools. Two of the teachers in this study were not only found to possess misconceptions, but were also guilty of transferring those unscientific conceptions during science lessons, (refer Table 2).

Table 1. Social factors influencing children's understanding of concepts relating to germination of seeds

Social factors	Total (%)	Example of responses
Parents	24 (38.7)	• *Arr…my father teach me. Grow by water it.* (Andy) • *Nope. But I asked my parents. My parents told me, maybe if I am not mistaken, it must be some…round, round things like you know, when we break the pea, it would be like that. I heard.* (Gina)
Teachers		• *My tuition teacher said...Biji benih, they need…err…not need sunlight when the thing is still there. So, it does not need sunlight because that one is the food.* (Edmond) • *I did it before when I was in preschool.* (Fazana)
• Pre/school	6 (9.7)	
• Tuition	13 (21)	
• Religious	0 (0)	
Peers	1 (1.6)	
Other persons		• *Soil. I am not sure what will happen if there is no soil because my sister usually…aaa… I don't know. She always said she, I feel like she is lying to me. She said she used cotton.* (Balqis)
• Siblings	10 (16.1)	
• Other People	7 (11.3)	
Media		• *From books. Seed needs air, water... Something soft like cotton.* (Faris) • *I learn from Jack and the Beanstalk movie...on TV.* (Edrus)
• Books	24 (38.7)	
• Television	10 (16.1)	

Table 2. Two teachers' alternative understanding of germination of seeds

Teacher	Alternative Conceptions Pertaining to Seed Germination Process
FA	• Seeds will expand once they receive the three requisites for germination, namely water, air and the right temperature. • Other than via photosynthesis, seedlings (or plants) also obtain food from soil and water.
MP	• Seeds do not need air in order to germinate. • Only water is needed for seeds to germinate. • Seeds will become enlarged when water is absorbed prior to the germination process. • Food is not required during germination. Food is only needed once the seeds have sprouted, particularly after the leaves have emerged from the seed.

Notes: FA– Female teacher observed in morning session
MP – Male teacher observed in evening session

All four teachers, nonetheless, were accountable for inadvertently contributing alternative (incorrect) elements of the science concepts while communicating with the children in class. One example of the teacher's influence that may have led children to a false understanding has to do with the drawings and notes written on the board, as depicted in Figure 9. The picture on the left is of a plant emerging from inside a seed, which suggests that there is indeed a 'fully-developed miniature plant' inside each seed that is waiting for the right conditions to surface and that the seed remains (continues to exist) long after germination ceases and growth has taken place. The picture on the right, on the other hand, highlights three basic requirements for plant life with an additional requirement added, namely food. By having the word 'food' written on the diagram, the teacher may have given the impression that food needs to be externally given (i.e., fertiliser). She also did not elaborate on the fact that plants use sunlight, carbon dioxide and water to make their own food via photosynthesis.

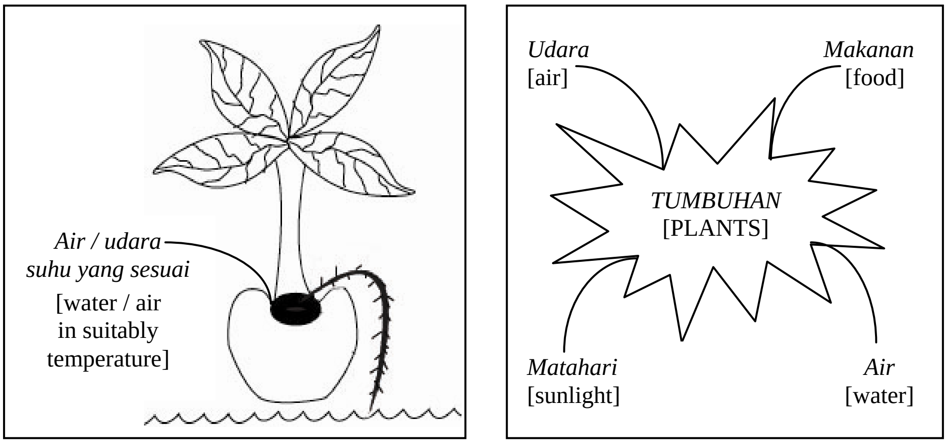

Figure 9. Pictures drawn by science teachers during formal instruction

Figure 10 highlights yet another avenue that may possibly contribute to misunderstanding of the concepts being studied. Here, the teacher failed to use precise terminologies as well as to describe the germination process correctly and with sufficient detail.

In short, the way information is communicated – verbally as well as symbolically – in science classes would almost certainly lead to the varying schemata and understandings formed by the children.

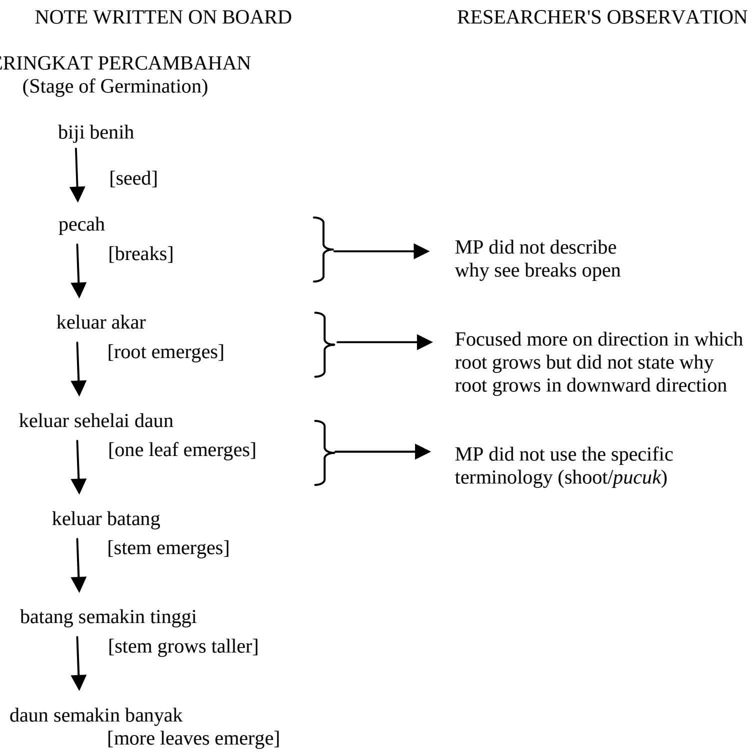

Figure 10. A flowchart showing stages of seed growth drawn during formal instruction

2. Terminologies with everyday meaning

There are many science terms that have both scientific and everyday meanings. Besides 'food', other terms with both specific (scientific) and everyday meanings were used. One glaring example is the word 'leaf'. It was discovered that some of the children used the words 'shoot' and 'leaf' interchangeably to refer to 'leaf', having little understanding that 'shoot' specifically refers to the first or the primary leaf that emerges during germination. The same misunderstanding was observed in the responses of the children, regardless of the language used during the interview. For instance, those who predominantly used the Malay language when responding to the interview questions used the word 'daun' (leaf) to describe 'tunas' or 'pucuk' (shoot). Several other children also used the word 'batang' (stem) to refer to the plant’s stem, bark and even the branch, possibly because there is no specific word to differentiate the stem and the bark in the Malay language (Malay refers to both stem and bark as 'batang').

3. Cultural factors

Cultural aspects were also found to have an influence on children's understanding. Two specific aspects discussed herein are metaphor and interpretative framework. Metaphors are comparative mechanisms that link different types of information and are used in description and interpretation (Bloom, 1992). There are many types of metaphors, but the germination-related metaphors provided by the children are highlighted in Table 3.

Table 3. Examples of metaphors used by children when describing germination of seeds

Metaphor Type	Example
Action link	• The plant breath out oxygen and breath in CO_2…is *just like a bicycle going around* [Ashok] • Biji benih [seeds]…*grow up* [Badariah]
Attribute comparison	• Seed *grow big*…like human [Arun] • we pour water onto *the seed's body* [Fauziah]
Structure function	• Inside one seed, they has…*has one kind of thing* that allows it *to feed* [Eddie] • The *line* [*micropyle*] is the thing like *it's growing like a plant* [Ben] • *Biji benih* get [food] from *the root* because the root *can serap air* [Aqil]
Structure attribute	• *Tumbuh tapi kerdil* [kalau biji benih yang bercambah tidak dapat cahaya matahari] • *Grows but stunted* [if the growing seed does not get sunlight] [Gemima]
Attribute function	• Seed like *an egg* [Ben]
Function comparison	• Seed help plant grow…*like fertiliser* [Adam] • Fruit you can eat, a *seed* you *can't eat* [Danielle]
Structure action	• *Liang seni* [seed's opening]…*it suck*, it takes the water from the…the seed uses liang seni to take the water [Alex] • The thing [fertiliser] go down, go down then the *roots make it melt and eat it* [Ben] • Lepas tu nanti dia punya *akar tu, minum*, macam lalu jadi macam besar (Afterwards *the root will drink* and it [the seed] will become big) [Faruk]

The influences of three interpretative frameworks of belief, mostly structural and functional subcategories, were displayed when the children made associations or inferences and were also evident during the interviews.

They are:

- anthropocentrism

  Refers to the mechanism used to understand a science object or concept by examining how useful or personally relevant the object or concept is to a person (i.e., *seed grow...err, when the leaves are big, it will make us healthy* – Basir).

- zoomorphism

  Refers to inference based on knowledge of other animals (i.e., *seed ...gets food from its ownerlah* – Ben)

- anthropomorphism

  Refers to the act of describing an object as possessing human attributes (i.e. *Seeds grow tall…In two to three months, it can already grow about this big (while gesturing to indicate the size) and eventually as high as a chair* – Eron).

DISCUSSION AND IMPLICATIONS

This study revealed that children's varying understandings of germination-related concepts support the constructivist approach to learning whereby children are actively involved in the process of constructing meaning and understanding. The children's conceptions of "seed", "germination" and "food" tended to be based on what was perceivable, intelligible and, perhaps most importantly, familiar. It is also crucial to point out that the meaning one assigns to and the understanding one has of an object are largely the outcome of how language is used to describe the object during one's first and subsequent encounters. The children whose descriptions of "seeds" included "bean", "fruits" and "part of plants" must have acquired those notions of seeds from another person (parents, teachers, peers) or from a different source of information (the media) and have probably used those words before without anyone pointing out to them that their understandings were incorrect. Similarly, those who called the stem, bark and branch of a plant "stem" must have heard others use those terms or read about them, but failed to take note of the exact plant structure being referred to.

Another language-related issue that contributed to the children's varied understanding of the science concepts deals with what Cushing (1994) termed *sending and receiving problems* during the delivery of subject content. The problems ranged from failure to impart the information to the information being successfully passed on but not heard, heard but not understood or forgotten. Non-verbal information (i.e., diagrams, graphs, illustrations) could also give incorrect impressions to certain children. This is largely due to the fact that a child's ability to understand what is presented in the text is very much dependent on his ability to deal with, amongst other factors, the conceptual demand (a novel and foreign concept is difficult either to imagine or understand), language demand (i.e., lack of vocabulary, inability to read and write, etc.) and visual demand (difficulty in differentiating between reality and fantasy). In other words, the children used language not only to understand their environment, but also as a tool to communicate their scientific and unscientific ideas.

Due to the important influence of language in the construction of the meaning and understanding of science concepts, a number of proactive measures need to be taken to ensure continuous improvement in the teaching and learning of science. Suggestions include:

1. Teachers

   - must have sound and adequate content knowledge as those with alternative understandings will likely bring those conceptions to the science class, resulting in the acquisition of unscientific and inaccurate understandings by the pupils
   - need to use scientific terminology precisely when teaching
   - must differentiate the meaning of a word with respect to both scientific and everyday terminology
   - ought to ensure that proper elaboration and descriptions are given when symbols, metaphors, pictures and diagrams are used to illustrate a specific concept
   - should take into consideration the children's conceptions prior to formal instruction so that misconceptions can be rectified during science lessons
   - need to make certain that the children are not overwhelmed with too much information and terminology at a given time to prevent cognitive overload

2. Parents

   - ought to provide the necessary support (i.e., time and money) and opportunities (via science camps, instruction, talks and seminars) for their children to learn science concepts in varying contexts
   - should not place the responsibility of educating their children solely on the teacher

3. Textbook writers/courseware developers

    - must take into account children's ability to process information
    - need to carefully choose and explicitly describe the proper terminologies used, symbols deployed, metaphors used, pictures and diagrams drawn, notes written and teaching aids illustrated during science lessons to avoid misunderstandings
    - Bought to ensure that explanations of relationships between concepts be kept simple and direct

CONCLUSION

This study underlines the importance of language in shaping children's conceptions, definitions and understanding of concepts relating to germination of seeds before and after formal instruction. While cultural elements, such as home environment and personal experiences, remained crucial in influencing the children's understanding of science concepts, the teachers' understanding and the manner in which lessons were carried out were equally significant. Further studies should be carried out with children of varying ages so that differences with respect to meaning construction and conceptual understanding can be understood clearly.

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