# Report on the pilot study

## Aims

The qualitative nature of this study, with its two main interpretive and discourse analysis approaches, is the main motive for the piloting stage to be conducted through the planning of this research. I believe that the preparation for a qualitative study, especially for a new researcher, needs to be supported by the trial of the research methods and tools in real settings. This is not just to examine the validity of these methods and tools practically, but also to have a more realistic idea of what is there in the real situation and how such theoretical tools can stand in the complex and multifaceted human reality. The aims of this pilot, therefore, can be articulated as:

1- To examine the practical procedures of the research, specifically to:

* test the procedures of the video and audio recording of the science lessons in the Omani classes; where the electronic devices are to be located and how to be used in a way that can capture more details of the whole class interaction and some of the groups' talk.
* observe the arrangements of the implementation of the different written tests; the questionnaire, the Bubble dialogue sheets and the normal test questions.
* check the schedule of the training intervention; time, space and display details of the pre-workshop tasks and workshop activities.
* practise the role of researcher in the critical settings of the interview and focus group.

2- To investigate the reliability of the research tools and techniques that are planned to be implemented in the study, specifically to;

* examine the appropriateness of the drawings in the bubble dialogue scenes and the stimulus cards.
* compare the capacity of the normal test questions and the bubble dialogue tools in revealing the pupils' learning outcomes.
* check the validity of the content and activities of the training intervention.

3- To obtain preliminary findings that might help in highlighting the importance of the different aspects of the research inquiries.

## Participants of the pilot study

The Piloting took place in one school in the interior region of Oman. A teacher who teaches grade nine with the pupils in her class constituted the case of this study. Four other teachers in the same school, however, participated in the training intervention. Three groups, each of five pupils, were chosen randomly to be video and audio recorded. Two of these groups constituted the sample for investigating the learning outcomes where two kinds of tests were used. The pupils in the group that had been tested with Bubble dialogue questions comprised the participants of the two focus groups for searching the learning outcomes and pupils' perception of the CT.

|  |  |  |
| --- | --- | --- |
| Activity | Sample | |
| Teachers | Pupils |
| Videotaping lessons | One | 30 in the observed case |
| Audio recording groups' talk |  | 3 groups: 5 each |
| Answering normal test questions |  | Group 2: 5 pupils |
| Filling Bubble dialogue sheets, Focus group |  | Group 1: 5 pupils |
| Training intervention | 5 teachers |  |
| Focus group 'Perception of CT' | 5 teachers | Group 1: 5 pupils |

Table : Participants per activity

## Procedures

Before the start of the new academic year in Oman, I took the research proposal to the Ministry of Education in the Sultanate to get permission for conducting the study in the schools of the Interior region. I then arranged for the pilot study to be done in a local second cycle school (grades5-10) where two experienced teachers were supposed to teach grade nine. Unfortunately, the plan of the science teachers in the school had changed in the last day before the school because of the transferring of teachers from one town to another at the beginning of the year. The plan ended up with two new teachers to teach grade nine where one of them was waiting also to be transferred. This, therefore, had left me with one choice; a teacher with one year’s experience who had recently moved to the region. The teacher kindly agreed to participate and to be videotaped.

An overview of all the procedures taken throughout the stages of the piloting is summarized in the following tables:

**1. First Stage:**

|  |  |  |
| --- | --- | --- |
| Aspect1: Characteristics of teaching in terms of CT | Aspect2: Teaching/learning perceptions | Aspect 3: Learning outcomes |
| - Videotaping 4 lessons of chemical/physical changes  - Audio recording three groups' talk  - Informal interviews with the teacher after each lesson | --- | - Filling the bubble dialogue sheets (Group 1: 5 pupils)    - Answering the test questions (Group2: 5 pupils)  - Conducting a focus group with group 1 about their answers to the bubble sheets. |

Table : Procedures of the first stage

**2. Training intervention**

|  |  |
| --- | --- |
| Pre-workshop tasks | - Distributing the questionnaire for grades 7, 8, 9,10 (66 pupils)  - Handing the teachers the first part of the handout including a task related to the questionnaire (5 teachers) |
| First workshop | - Discussing the findings from the questionnaire and relating them to the topics presented in the handout.  - Presentation which moves from the pupils' pre-ideas to the classroom interaction  - Displaying some examples from the talk exchanged in group 1 that shows their ideas about the chemical and physical changes  -Handing the teachers the second part of the handout to be discussed in the second workshop |
| Second workshop | - Discussing the topics presented in the handout  - Demonstrating the two teaching activities of ''Big circuit'' and ''Rope loop''  - Displaying other examples for the four kinds of communicative approach in addition to the ones presented in the handout  - Having a focus group discussion about the different approaches to teaching using the stimulus cards. |

Table : Procedures of the training intervention

**3. Second stage**

|  |  |  |
| --- | --- | --- |
| Aspect1: Characteristics of teaching in terms of CT | Aspect2: Teaching/learning perceptions | Aspect 3: Learning outcomes |
| --- | - Interview with the obseved teacher  - Focus group with group 1 using the stimulus cards. | --- |

Table : Procedures of the second stage

## Preliminary findings and observations

### First Stage

#### Characteristics of the CT in the observed case

**The overall teaching approach:**

The topic of chemical and physical changes was taught in four lessons. In the first lesson, the teacher focused on giving theoretical information on the definitions of the two kinds of change with some examples. The whole second lesson, however, was spent in doing an experimental activity about the changes happening in nature which led to the formation of rocks. Discussion of the different steps and the results of this activity constituted the third lesson (the researcher was not able to attend it). The teacher moved in the final lesson to talk about the signs (or the evidences) of chemical changes and demonstrate some of these signs practically (see table 18)

|  |  |
| --- | --- |
| Lesson | Details |
| 1- Matter Changes | *Matter and how it change - Kinds of changes – Definitions and characters of chemical / physical changes – Demonstration of simple examples of changes (cutting off a paper – burning a paper) – Pupils giving examples* |
| 2-Changes that cause the construction of rocks. | *Practical activity of nine steps (putting Sodium Carbonate in a test tube and Calcium Chloride in another one – adding water to each one – mixing the two tubes together – pouring the mixture through a filter paper to get a liquid and a remaining precipitate – adding Hydrochloric Acid to the precipitate– evaporating the remaining liquid )* |
| 3- Discussing the activity of lesson 2 | *Discussing the remaining substances in the last two steps- Identifying the kind of the change in 5 steps – Explaining the existence of Calcium Carbonate in rocks – Explaining the existence of the salty rocks in the middle region of Oman)* |
| 4- Possible evidences of chemical change | *Displaying the evidences ( change in temperature - change in colour – gas rising or formation of bubbles – formation of precipitate ) – Practical activity (adding some water to red Phenol and Calcium Chloride and observing the temperature – adding Sodium Bicarbonate to the mixture and observing the temperature again) – Discussing the activity – Giving examples of chemical changes and the evidences that prove their kind.* |

Table : Details of lessons in the first stage

Generally, transcriptions of the teacher-pupils talk in the first, second and fourth lessons did not show dialogic talk according to the authoritative/dialogic dimension of the communicative approach. Very little talk had been exchanged during the practical activity in the second lesson, and was related mostly to the instructions and the group work of the activity. So, there are no episodes of talk from this lesson to be characterized. On the other hand, the teacher-pupil talk uttered in the first and the fourth lessons did not need to be analyzed in a scale of small-intervals of time as it is very obvious from the transcriptions the absence of the interactive and non-interactive dialogic talk and the dominance of the interactive and non-interactive authoritative one. In fact, the observed lessons showed a persistent attitude toward a non-interactive talk.

One of the aims of this study is to look at the pupil-centred approach which represents one of the bases in the philosophy of BE in Oman. Applying this approach in teaching assumes the dominance of interactive talk in which pupils have a greater chance to talk and to participate. This research is planned actually to examine this interactive talk more deeply to investigate if there are dialogic signs that can disclose the reality of this approach whether it is pupil-centred intellectually or just verbally. The observed case, unfortunately, did not even adopt the interactive approach in teaching that is recommended by the new system. In an informal interview, the teacher did talk, actually, about the insufficient qualification she got from her college of Education about the system of 'Basic Education'.

To illustrate the authoritative dimension in her teaching, I will display some of the teaching episodes from the first and the forth lessons. These episodes are just examples from the overall talk uttered in the class, but they reflect the pattern of talk that was repeated over and over during the lessons.

**Some teaching and learning episodes:**

The first episode is from the first lesson where the teacher began to introduce the scientific story of chemical and physical changes.

**Episode 1:**

1. T: ….now we are going to know about some changes that happen to the matter, we will know the kinds of these changes. Now I will give some examples and see the kind of change that happen (she take a sheet of paper and rise it up)

2. T: We have here?

3. Group of Pupils (GP): Paper

4. T: If I did what? Tear this paper. Ok, tearing this paper to pieces (she tears the paper). Now we have the paper into pieces. So we think now, do we have a new substance now because of the tearing?

5. GP: No

6. T: So, there is no new substance. Ok, did the paper' outward appearance change?

7. S2: Yes

8. T: Good, so the appearance of the paper changed. So, what do we have here? There is no new substance but what? Its outward appearance changed. Now we have this new appearance, its features changed from the original one? I mean for this appearance, did the original features of the paper changed?

9. S3: It doesn't change

10. T: So the features of this paper after tearing do not differ from the features before the tearing. Ok, this kind of change, what do we call this kind of change?

11. S4: Chemical change

12. T: Who gives us another kind of change? Yes?

13. S5: Physical change

14. T: Physical change and not chemical change. Ok, define the physical change? (looking at S4)

15. S4: It changes from a state to a state

16. T: It is the change from a state to another, but for this example (holds the paper) it is a physical change. From your knowledge what is physical change? For this substance (the paper) a physical change happened…

17. S4: We can bring back the primary substance

18. T: Yes, we can bring back the substance. And?

19. S5: Its outward shape changes

20. T: Yes. Its outward appearance changes without losing its primary features and it can be reversed. Ok? So this change is what? Physical change. So physical change is what? It is a change of the outward appearance only. Change in the outward appearance only and the matter doesn't lose its primary features and it can be reversed. I mean girls that reversing the change is not a necessary condition for the physical change. Ok? It means that some changes are considered as physical ones but they can't be reversed. For example, tearing the paper, we cannot get it back without anything. Right? It means that although of this, this change is still what? Physical (some girls say chemical but the teacher doesn't listen to them)

21. T: So it is not necessary for the physical change that we can get the substance back to its primary state. Ok? Now we knew about one kind. The second kind that we are going to know about is what? Through this demonstration we are going to show what? The second kind of change. Look girls to this paper. Ok? (she burns part of the paper) now girls, we have this paper. It was white, right? When I burned it, it becomes like this (holds the burned paper in her hand) do you see this black shape, you see? It didn't burn completely, but we have this black substance. Does it differ from the white substance?

22. S6: Yes. It differs

23. T: So it differs. This means that I have a new substance. So we have in this change, what? A new substance? Can we reverse the change or get back the primary substance?

24. S7: No

25. T: So we can't reverse the change, what is this change? A new substance produced. Of course the new substance, its features differ from the primary substance. It means that the features of this (points to the burned paper) differ from the paper before burning. Right? So this kind of change is called.. ?

26. S8: Chemical

The whole first lesson had maintained this pattern of interaction; the teacher talks and pupils listen, the teacher asks questions and answers them herself. Although in few episodes the exchanged talk seems like the; teacher asks, pupils answer, teacher evaluates (e.g. turns 10-19), the teacher was, in fact, putting the answers in the girls' mouths who were trying to say what she wants them to say. It was all about what she thinks of and what she considers the right information that must be filled in the pupils' heads. Most of the pupils' answers, therefore, were short and restricted to very few words. Some answers were just a repetition of the information presented in the textbook. The lesson was devoid of any kind of intellectual interaction and the teaching followed, in fact, teacher- and curriculum-centred approaches. The pupils were far from taking any responsibility of their learning as their role was ignored by the teacher.

In the interview after the lesson, the teacher noted that the teaching objectives of the lesson are for the girls to define the two kinds of change, understand their characteristics and give correct examples of both of them. What she did, however, that she was, herself, the one who makes the definitions, presents the characteristics and gives the examples. She built a very weak scientific story by repeating the information displayed in the text book, refusing any different idea without discussing it, and evaluating the answers by 'Yes/No' or 'Right/Wrong' without explaining why.

The analysis of the whole CT exchanged in this lesson following the Mortimer and Scott (2003) framework demonstrates the same characteristics (table 19) with the difference in the scientific piece of information presented in each episode.

|  |  |
| --- | --- |
| Teaching objective | Presenting the scientific information |
| Content | Scientific |
| Communicative approach | Interactive/Authoritative and  Non-interactive/Authoritative |
| Pattern of talk | I – R – I – R-… and I – R – F – I – R – F - …. |
| Teaching Intervention | Lecturing the scientific story |

Table : Analysis of Lesson 1

At the end of this lesson, the teacher asked the pupils' groups to write some examples of the two kinds of change. Each group presented the examples in front of the class, and the teacher gave a 'right/wrong' evaluation only. It happened, though, that the videotaped group (Group1) did have different opinions about the example of dissolving salt in water. The researcher interjected and asked them to talk about their points of views. An interactive/dialogic talk had been exchanged between the five girls in the group (will be discussed in the part of learning outcomes). Although this episode did occur in the lesson, it was the researcher who initiated and insisted on keeping it for the purpose of investigating the pupil-pupil talk, where the other two recorded groups did not have such kind of argument.

The fourth lesson had the same scenario followed in the first lesson in presenting the scientific story. This scenario, however, emerged in this lesson not just through the whole class discussion as in the first lesson, but also during the teacher-group interaction. After doing the practical activity of this lesson (see table 18, p. 73) the teacher was talking to each group about their observations. Here is an example of the talk exchanged between the teacher and group 1:

**Episode 2:**

1. T: …Do you know the kind of change? How was I at the beginning?

2. Azari: It was white

3. T: Was white? (looking at Fatma and Asma)

4. Fatme: It was white

5. Asma: It was darker

6. T: Yes it was darker. it means there is a change in ?

7. Farah: Colour (the teacher nods her head showing her approval)

8. T: The temperature, was affected here?

9. Azary: Yes

10. T: How?

11. Farah & Asma: It changed

12. T: How? How was it at the beginning?

13. Farah: It was hotter and then it changed

14. T: Yes, it was hotter and now it is less

15. T: Is there a precipitate? Do you see something here? (She points to the precipitate in the test tube). May be you can see it from a distance (raise the tube up)

16. Asma: Yes

17. T: So, what do you have here? A precipitate….

The teacher did have this kind of talk with each group before having a similar conversation with the whole class. The analysis of the different episodes of this lesson (table 20) confirms the teacher's attitude towards the authoritative approach in her teaching.

|  |  |
| --- | --- |
| Teaching objective | Presenting the scientific information |
| Content | Scientific |
| Communicative approach | Interactive-Authoritative |
| Pattern of talk | I – R – F – I – R – R - F - …., |
| Teaching Intervention | Demonstrating the scientific information practically |

Table : Analysis of lesson 4

In a similar way to what had happen in the first lesson, the teacher asked the groups to write some examples of chemical changes and the evidence that proves the kind of change. The researcher again interjected and asked the girls in group 1 to talk in details about their thoughts and handed them the camera, so they wouldn't feel embarrassed. An interactive/dialogic talk had been also exchanged and it could also show some of the learning difficulties that these girls face with this scientific topic.

#### Indicators on the pupils' learning

One of the aims of this pilot study is to test the potential of two kinds of tools to examine the pupils' learning outcomes; the normal test questions and the Bubble dialogue sheets. The pupils' response to the Bubble sheets seems to reflect their thoughts more than the normal questions do. For the scientific topic of this stage, the pupils' answers to the normal questions were very general and just a repetition of the scientific facts displayed in the text book (e.g. It is a chemical change because there is a new substance and it cannot be reversed...etc). The scenes and the speech bubbles in the bubble sheets, though, could motivate the pupils to express some of their ideas. These ideas, however, could be more elaborated through the focus group discussion. Although the topic of chemical and physical changes does not seem difficult as the topic of electric circuits, the two research tools of bubble dialogue and focus group together could reveal different mis/alternative conceptions held by pupils. Some of these ideas appeared, actually, during the group' discussion in the class as mentioned in the section before.

Let's begin with the talk uttered between the girls in group1 at the end of lesson1 when the teacher asked the pupils to write some examples of chemical and physical changes;

**Episode 3:**

1. Asma: The dissolving of salt in water is physical

2. Samar: What?

3. Asma: The dissolving of salt in water is physical

4. Samar: Can you have it back?

5. Fatma: Yeah, right (Fatma is supporting Asma' opinion but Samar thinks that she is supporting her, and she writes it as a chemical change)

6. Asma: Not chemical, physical

7. Samar: How can you get it back

8. Asma: You put it in the Sun and the water evaporates (Asma laughs and Samar is not convinced)

9. Fatma: Yeah, right. The dissolving of salt is physical

10. Samar: Wait a sec (she is thinking silently) salt dissolves in water, dissolves, dissolves, dissolves. If we put it in the sun, don't we have a precipitate? And there is…

11. Azari: The water remains

12. Samar: No the salt remains. It means that we have a precipitate, and the formation of a precipitate, doesn't mean that it is a chemical change?

13. Asma: It means that it gets back

14. Samar: How it gets back?

15. Asma and Farah: Physical change

16. Samar: Chemical

17. Azari: Physical

The argument in this episode is very interesting and striking at the same time. Different remarks can be noticed and different points can be discussed:

* The episode can be classified as an interactive/dialogic kind of talk as different points of views had been presented, and yet we can sense the authority in every pupil's words. Four of them believe it is physical and they didn't accept the different point of view of Samar. At the same time, they could neither defend their idea of the possibility of the reverse nor could they argue her about the precipitate. Similarly, Samar insisted on writing it as a chemical change (she was taking the role of the writer) and she was not, actually, listening to her group mates' opinions as her thinking was dominated by the idea of the precipitate.
* Samar has the right story of this change, and yet her answer is wrong. She knows that the salt will dissolve and by heating the mixture, the water will evaporate and the salt remains in the beaker. Though, Samar was confused by the idea of the precipitate as the episode shows. The attempt to analyse her thinking, however, opens the discussion to different direction. On one hand, it can reveal different mis/alternative conceptions that pupils might have in thinking about the chemical and physical changes. On the other hand, it makes us think about how simple the pupils' thinking is and how complicated it can be at the same time.

In analysing her thinking, we can see that Samar was not able to differentiate the change process from the reversed one. In other words, the dissolving of salt in water is the process that is discussed here, and in which there is no sign of a precipitate. Getting the substances of water and salt back is a different process. The reversed process is used usually to prove that in a particular change there are no new substances as long as we can get them back. The signs of chemical change have to be examined in the process itself and not in the reversed one.

Even in the reversed process itself, can we consider the salt a precipitate as Samar did? A possible argument can be opened here about the word of 'precipitate' as a verb and as a noun; the salt precipitates (verb), so is it a precipitate in itself (noun)? The argument can also be moved to the precipitate as a new or a non-new substance, where the precipitate as a new substance is the possible sign of the chemical change. Samar, as she had explained in the focus group after that, believes that a precipitate is any remaining substance in any process, and the formation of a precipitate in any change (the remaining substance) is definite evidence that this change is chemical.

Moreover, thinking about Samar's strong argument of her mistaken answer put into sight a very important point. Samar's thinking about the dissolving salt, the evaporating water and the remaining salt after that can be seen as more spontaneous than her thinking that holds to the scientific fact that the formation of a precipitate is a sign of chemical change. Without this scientific fact in her mind, it was possible that Samar would decide that the change is physical. This actually is what had happened with her mates. In the fourth lesson, the teacher did talk about the signs of chemical changes, and from there did the confusion with the formation of precipitate and the other signs appear with the whole group. Samar, though, knew about the precipitate from the text book since the beginning, and this explains why her misunderstanding did appear before her mates who do have, actually, the same difficulty.

Although Samar, in the focus group situation, had held very strongly to the non-formation of a new substance as a feature of a physical change, she, unconsciously, had neglected it in her thinking about the process of dissolving salt in water. This confirms again the dominance of the formation of the precipitate on her thinking (or as DiSessa (1988; 1993) would describe it as having a stronger cuing priority in this situation). This opens, in turn, our sight to the critical situation in which the scientific information, when not explained correctly and deeply, can, themselves create the mistaken conceptions that might even spoil the right spontaneous thinking about things.

It can be argued here that Samar got that piece of information from the text book before being explained by the teacher; and this is right. However, the teacher did, in fact, contributed to circulate this confusion to the whole class by her way of repeating the text book information without any other explanation. In some cases, the book information was even more precise than the ones repeated by her. For example, the teacher talked about the evidence of chemical changes where the curriculum talks about the 'possible' evidence. Here we can see how one word can create a big difference in science and put into view the need for precision in teaching and learning science. The absence of the word 'possible' and the absence of a detailed explanation of the evidence had, actually, caused a huge misunderstanding and the pupils got lost between the evidence and the features of chemical change. To see the jumble in the thinking of group1, let's examine the following episode when the teacher asks the pupils to give examples of chemical changes and the signs that prove it:

**Episode 4:**

1. Fatma: Oil, the oil, it is clean at the beginning and when we use it, it changes

2. Asma: Oil with what? (she is the writer)

3. Fatma: Oil and fish

4. Azari: Oil and water (she is joking and the girls laugh, but Fatma holds to the idea)

5. Fatma: Yeah, oil and water. When we put water in oil, it makes bubbles

6. Asma: Ok..What happens? Change in temperature? Change what?

7. Fatma: The temperature changes. It becomes colder

8. Farah: No no, first change in temperature and the formation of gases

9. Fatma: And change in colour and formation of precipitate…

10. Farah: Formation of bubbles and change in colour (Fatma erases the formation of gas to put formation of bubbles)

11. Asma: The colour doesn't change. What change it?

12. Azari: It doesn't change

13. Fatma: Formation of precipitate and bubbles and change in temperature (reads what is written)

Through the whole discussion which this episode is part of, the girls were trying to find a place for all the evidence to any chemical change they think of. They were, indeed, following the teacher’s manner shown in the second episode. The teacher did not spend any time in explaining when the signs of temperature, colour, bubbles and precipitate can be considered as evidences for a chemical change and when it can not. When asked about the precipitate again during the focus group discussion, Asma was confused and replied: ''In science, everything changes…physical…chemical''. And when asked about the bubbles of the evaporated water and the bubbles resulted from the mixing of vinegar and Soda Bicarbonate (presented in the bubble dialogue sheets), Asma laughed and said: ''here are bubbles and we said physical, and there are bubbles and we said chemical''.

Sometimes, the girls could not defend their answers precisely because the whole scientific story was not seen. Let's see these two episodes as examples;

**Episode 5:**

1. Fatma: Chemical because the salt changes (talks about the dissolving salt in water)

2. Asma: How does it change? Becomes sugar?

3. Fatma: Means, it is bigger round particles and then they become smaller.

4. Asma: Ok, it is still salt. It didn't change

Here, Fatma got confused with the size of the particles and Asma could not see it and could not explain simply that the change in the size without producing a new substance is a physical change.

In another part of the discussion, Fatma refused to agree with them that the evaporation of the water when frying the egg in the first bubble dialogue sheet is a physical change;

**Episode 6:**

1. Samar: why are you insisting that it is chemical? (means the evaporation of water)

2. Fatma: because it is not possible to get it back (the girls suggested before that this can be done by condensing the vapour, but couldn't explain how to do it practically)

3. Samar: It is not necessary for physical changes that we can get everything. Miss said that we might get things back and we might not. For example, when tearing the paper, can we get it as it was?.....

The problem of Fatma here is that she couldn't imagine how the vapour in this particular situation can be reversed to water again, how they can do this practically. Samar and the others couldn't explain it simply that 'we' might not be able to get the water back, but this does not mean that it is not possible.

In taking a general and a positive picture, though, it can be noticed that the formation of a new substance or not as a distinction between the two kinds of change was very helpful for them to classify the changes correctly and to hold, at the end, to their answers in spite of their suspicions because of the evidence. On the other hand, it can be argued that the progression of the girls' group discussion starting with the group's talk in the lessons, through the written chat in the bubble sheets and continuing within the focus group discussion could develop the quality of the exchanged talk. This can be noticed when comparing the nature of the talk exchanged between the girls in episodes 3 and 4 for example, and the following episodes from the focus group discussion:

**Episode 7:**

This episode follows episode 6 in which I was trying to explore more deeply Fatma's thinking, and the girls were trying to convince her that the evaporation in the scene of the bubble dialogue sheet is physical:

1. Researcher: How do you understand physical and chemical changes?

2. Fatma: If it is chemical we can't get it back, but if it is physical we might get it back

3. Samar: Might, might. You didn't say we get it back…you said might

4. Fatma: Yeah, it means we might get it back (means can get it)

5. Samar: Might but not 100%

6. Researcher: Samar is saying we might but not necessary. Ha Fatma?

7. Fatma: Chemical also we might get it back (confused)

8. Samar: It is not possible to get the chemical back

9. Azari: The chemical doesn't come back

10. Samar: We have new substance

11. Fatma: If it is physical how can you get it back? Tell me

12. Samar: I'll tell you. For example, I have a hot water and I put it inside the fridge, doesn't become ice? If I put it outside, it will become a liquid as it was

13. Asma: Right, you will get it back, but not in the chemical

14. Fatma: Ok, it is a decision, physical

**Episode 8:**

This episode happened at the end of the focus group setting. I was reading what Afrah had written in the dialogue bubbles of the scene of mixing the vinegar and the Soda Bicarbonate, and wondered about the bubbles resulted from this process;

1. Asma (laughing): These bubbles (refers also to the bubbles of the evaporating water) that we don't know where they come from

2. Fatma: They are mixing together and produce the bubbles

3. Afrah: May be because the vinegar is an acid and the Bicarbonate is an alkaline. I mean the substances reacted together, so we got the gas

4. Researcher: So, is this a physical or chemical change? (After this turn I was trying to test their understanding for the difference between the bubbles in the two scenes. This happened after a discussion of the bubbles in the heated water and after the argument about the signs of the precipitate and the temperature). This is how they defended their opinion:

5. Samar: Here we mixed together two substances which gives us a new substance, and we can't reverse this new substance. As to the water, we didn't mix anything. The bubbles are because of the rise in temperature

6. Researcher: But there are bubbles

7. Fatma: Because of the high temperature

8. Samar: When it evaporates, the bubbles arise

9. Asma: It means because of the temperature

10. Samar: Here we didn't mix substances (points to the scene of the heated water)

11. Fatma: The bubbles in the water came from the increase of the temperature while the bubbles there came when we mixed the vinegar with the Bicarbonate and they reacted together

12. Samar: Yeah, it is like this

We saw how the pupils' talk in episodes 3 and 4 could reveal some of the learning difficulties and misconceptions, and we see here in episodes 7 and 8 how the talk developed to ease these difficulties and refine the misconceptions. We saw in episodes 3 and 4 how the intellectual communication was lost between the pupils, and we see here how smooth this communication is going. Was it because of the teaching? It might be, but thinking that the talk in episode 4 had been uttered at the end of the fourth lesson make us think of another factor. I believe that the talk has developed in such a way because simply we gave this group the chance to express their thoughts. These girls had been asked to think and to communicate their thoughts orally or on paper. This in turn, has made them more aware of their thinking and helped them to refine their ideas. They were confused about the signs of the chemical change and by thinking, loudly; they conclude that these signs are not always definite evidences. Samar did not pay her attention to the non-formation of a new substance and the possibility of the reverse in episode 3 about the dissolving salt, but she was the one who defended strongly these features in episodes 6 and 7 when trying to convince Fatma about the evaporating water. The harmony of the communication between the girls of this group on one hand, and their courage to talk in the existence of the researcher and being recorded on the other hand, have also developed positively.

This in turn;

* Makes us think how the authoritative talk of the teacher has contributed to causing some learning difficulties, and how the dialogic talk of the girls could relieve some of these difficulties.
* Shows us how the pupils talk, inside or outside the classroom, can reveal their misconceptions and how it can contribute to refining these misconceptions at the same time.
* Makes us wonder; whose fault is when the pupils do not dare or even bother to utter their understanding?, why did the videotaped and randomly chosen group have the discussion in episode 3 and 4 while the two audio recorded groups did not ?

### Second Stage

The first and the third aspects of this study could not be investigated during the second stage because of the time circumstances. Lessons of the topic of electric circuit were planned to be videotaped and analysed for the purpose of investigating the influence of the training intervention. In an informal interview long after the intervention, the teacher referred to a change in her teaching practice regarding the CT. She talked about giving more opportunities for the pupils to talk and express their ideas. This, however, could not be tested practically through the analysis of the CT characteristics and the pupils' learning outcomes.

Though, the researcher did look for the teachers’ and pupils’ perceptions of CT as a part of the second stage.

#### Teachers' and pupils' perception of CT

Three related drawings had been used to stimulate the discussion in the focus group settings (see Appendix 4). The handcrafts man in these drawings represents the teacher while the embroidered palms refer to the scientific story. The first drawing is meant to reflect the practice when the teacher alone is narrating the scientific story and the pupils are just listening without participating in such narration. The second one, however, shows the teacher and the pupils together building the scientific story while the third one refers to the pupils’ whole responsibility in achieving the right scientific understanding.

Generally, both teachers and pupils did refer to the second drawing as to represent what they think is the best practice in teaching. They believe in the superiority of this one because it means the participation of both the teacher and the pupils that hands each one of them part of the learning responsibility. It also allows the pupils’ thoughts and ideas to be taken into account through the teaching. For the pupils, the lessons are boring without taking part of the effort. They talked about the whole class being together in discussing the scientific topics.

Commenting on the first drawing, one of the teachers said: “the first one makes you feel pleased with yourself because you presented all that you have, but your pupils did not take anything from you except that piece of information … that you think they got it. They didn’t make any effort that makes this information subsist in their minds”. As all of the teachers and the pupils did not appraise the first drawing to reflect the best teaching, they agree that it is the one that is practiced in most of the classes because of different reasons. Meanwhile, most of the teachers and the pupils in the focus group settings do not see a ‘big’ problem with the first view to teaching as long as it includes a verbal interaction. However, they kept talking about the need for the two views to teaching represented by the second and the third drawings.

The pupils pointed, frequently, to the time they should be given to think about the presented knowledge. When asked about the reasons for their hesitation in asking the teacher about the things that they don’t understand, the pupils turned to the time factor among other reasons. They said that they are not given, usually, enough time to think about the questions raised during the lessons. The competitive way that the teachers follow to encourage the pupils to answer as fast as they can makes them care only about what is considered to be the right answer without paying much attention to their thoughts about; “we want to finish, to be the first”. One of the consequences of such practice as one of the pupils had expressed, is: “I care only about the marks. I mean the right answer is important to me; chemical, physical and that’s it”.

Another reason appeared when I had asked them if they are happy with the kind of the CT practiced by the teachers. One pupil had referred to an interesting thing, saying that: “there is a shortcoming in CT, but we got used to…that we don’t know what we are missing”. Proceeding with this point, the pupils talked about their satisfaction with the chances they have under the new system of the basic education to participate through the whole class and the group discussion and by doing lots of practical activities. They mentioned, however, their need to be convinced with the right answer and that the teacher should help them to achieve the right understanding gradually without being told the right answer immediately; “even if the answer is right, why don’t the teacher ask us how and why instead of saying right or wrong”, “why don’t the teacher give us papers and open a discussion about them as you did (referring to the focus group setting)”.

They also talked about the way of teaching when the teacher just “comes, explains things and goes” as a reason that make them avoid asking and expressing their ideas in the class. One of the pupils commented on this saying that: “In chemistry, this way of teaching is not excellent, but it can work, but in physics we need to see things and we need to talk about it”. They expressed their happiness with a math teacher who can know even from their face expressions if they do understand or not, describing how much she cares about each one in the class even if they get delayed in the lesson. They explained that with such a teacher, they do not feel shy to ask or embarrassed to say that they don’t understand.

On the opposite side, one of the teachers commented on the problem with the pupils as a difficulty in trying to follow the way of teaching represented by the second drawing; “there is a problem with the pupils, they don’t talk. It is difficult to make them give an opinion. They are afraid that someone will laugh of what they are saying”. After talking about the teacher’s role in encouraging them to talk, the pupils also commented that it is not all the teacher’s fault, saying that “sometimes it is us who do not ask, we feel shy or we don’t care”, “we spend more time and think more deeply about the details of our lives than we do about the things we study about”, “we talked to you (the researcher) because there are no marks”.

As the pupils did, the teachers also referred to ‘habit’ as one of the reasons that constrains them, in practice, to the kind of teaching in the first drawing; “we have been taught and we are teaching now in this way (the first one), and maybe the generation we are teaching now is going also to follow us”. Among other reasons, they talked about the constraints of time and the scientific knowledge they have; how difficult it is to open a dialogue about a certain scientific topic when they do not have, themselves, the right understanding or enough information about it. They stated that it is more secure for them to follow the first way of teaching.

In a similar way to the pupils, they also referred to the nature of the subject, physics, chemistry or biology, as a factor that might affect the possibility of opening a dialogue. They got confused between two situations in biology; as it is more related to the real life and so it is easier to make the pupils talk about or as it is more about memorizing theoretical scientific facts and so there is nothing much to open a discussion about.

Regarding the third view of teaching that reflects the group work without a real participation from the teacher, both teachers and pupils talked about its importance. One of the teachers did, actually, considered it as the best practice of teaching when supported by the teacher. She talked about its importance in teaching pupils how to talk and how to listen to each other; how it can give them the skills of thinking and opening a dialogue and how it can qualify them for the future. Similarly, one of the girls noted that through the groups’ discussion, the pupils can express their ideas without feeling shy or embarrassed and stressed that by having the chance to think loudly in such a situation, they are more able to refine their thoughts. Others, however, refused strongly this way of teaching as it neglects the role of teacher, arguing that the pupils do not know the right scientific knowledge and the objectives of each lesson. The teachers have to be there with the pupils to direct the whole process of teaching and learning. One of the pupils expressed this view saying that: “alone, we might have mistakes. It means we need help. Whatever the situation is, we need help, we need a teacher. We need to be together, all together…means she helps, we say opinions, we might get new things, new ideas and it will be better and faster”.

So although the three drawings have been bounded directly to three different ways of looking at teaching, I tried to direct the discussion to be about the participants’ views of CT more specifically; how do they prefer it and what they think is there in practice. Generally, both groups of participants believe that pupils’ intellectual participation does not exist satisfactorily because of several difficulties concerning time, habits, the lack of rich information and strong understanding about the scientific topics, the nature of subject and the personalities of both teachers and pupils. They do believe, though, that the pupils’ interaction with the teacher, verbally and intellectually, is most likely to achieve a right and a strong scientific understanding.

As the pupils were asking for the teacher to “care about the pupil, don’t get nervous, treat us like our elder sister so we don’t feel shy of her and we can give and take with her”, they do think that they have the chance to talk and participate. Likewise, although the teachers had expressed their worry about the pupils’ willingness and ability to participate effectively in building the scientific story, they do agree that the pupils should be involved intellectually. Some of them had noted, in fact, that the pupils can sometimes think more deeply about things than the teachers do and so they can be more able to give new ideas.

## Implications

1- Throughout the practical arrangements of the pilot study, It had become more and more clear that the main study is more appropriate to be conducted during the second semester of the schools’ academic year because of the teachers’ and the schools’ circumstances at the beginning of the year (see section 4.3). It has been planned, therefore, to do the study during the second semester of the academic year 2007/2008. Four cases in one of the largest and well-known female second cycle schools in the interior region of Oman had agreed to participate and did, kindly, postpone the chemistry and the physics units to be taught in the second semester. The decision to select all the cases from one school had been taken because of some considerations. Schools from the same type in Oman are usually far from each other. It is difficult, therefore, to control the time of the lessons that are planned to be videotaped, the thing that might cause the loss of some data. The practical procedures of searching the three aspects and conducting the workshops through the pilot study have also demonstrated the risk of losing some participants’ involvement in producing data or losing the data itself when conducting the study in different schools.

2- Interviews with teachers that were planned to be held after videotaping the lessons have been eliminated. The teacher’ talk about the purposes, the content, the teaching intervention and her reflection on the kind of the interacted talk in the observed lessons appeared to be quick, general, and do not contribute to the CT analysis.

3- The activities of the first workshop proved to be interesting, suitable and effective in highlighting the different issues concerning everyday/scientific languages and spontaneous/scientific concepts. The examples of pupil discussions from the observed lessons had reinforced, in fact, the significance of exploring such issues to look into their influence on teaching and learning science. The planning of the second workshop, however, was not as suitable as the first one. From the researcher evaluation and the teachers’ reflections, this workshop can be improved by:

* Displaying the teaching activities, exemplified by the second part of the handout, on screen and discussing them before and during the practical demonstration. The details of these activities had been presented in the handout which was handed to them long before the workshop. Assuming that all the teachers had read it understandably was not a sensible estimation from the researcher and did affect the progress of the workshop.
* Including some teaching episodes that show how the teacher can build the scientific story based on the pupils’ ideas. The episodes that I have exhibited in this workshop as examples of dialogic talk could not show up the role of dialogic talk in anything rather than disclosing the pupils’ preconceptions. The teachers had noted that dialogic talk in this sense is intended to be used through some practices. They are guided, for example, to evaluate the pupils’ knowledge before and after each unit and to adopt also the problem solving approach, which in both identifying pupils’ thoughts is required.

The examples of the Omani pupils’ talk in the first workshop had contributed in directing the teachers’ attention seriously to the pupils’ thinking. Likewise, the issue of the kinds of CT needs to be supported by some examples from Omani lessons. Demonstrating the dominance of the authoritative dimension in some of the Omani science lessons can emphasize more apparently what we mean by dialogic talk.

* Carrying out some activities where the participated teachers have to classify the different episodes of CT according to the categories of the communicative approach. One of the defects of the second workshop was the authority of the researcher over the whole talk, which stands against the main goal of this workshop of calling attention to the meaning and the role of the dialogic talk.

4- The investigation of the teachers’ and the pupils’ perceptions needs to be given more thought for how and when to be searched. The cards used to initiate the talk in the focus group settings have been based on the idea of “who is building the scientific story in the class”. The drawings in these cards, however, have been sometimes misinterpreted by the participants, which has affected, in turn, the progress of the discussion. On the other hand, doing the teachers’ focus group after the intervention proved to be a mistaken decision. After the intervention, the teachers got to know about the kinds of CT categorized by the communicative approach. Naturally, the teachers were trying to interpret the drawings in terms of these kinds of talk. They noted, for example, that one of the drawings reflects dialogic talk while this drawing, in fact, can entail the whole four classes of talk.

As a result of such inconvenience, the planning for investigating the second aspect has changed to be as follows:

* As to the time, it is decided to carry out the focus group for the pupils during the second stage as has been done in the piloting stage. For the teachers, however, it is suggested to do it twice, before and after the intervention. This is to open the chance to get into the teachers’ perceptions before presenting the dialogic teaching, as adopted by this study, and after their attempt to practice it through the second stage. Such a procedure might provide more realistic picture of how these teachers perceive their teaching in terms of the CT and how they do consider the good teaching to be.
* In the first stage, the teachers’ perceptions are to be investigated through individual interviews. This might allow the researcher to relate each teacher’s beliefs to her practice in class. The questions of these interviews are proposed to be built around two views to teaching as represented by two cards; the teacher is filling the pupils’ minds with information without them taking any role in the process of their learning; the teacher and the pupils are working together in achieving the intended scientific understanding (see Appendix 2) Through the interviews, the teachers will be asked about how they consider CT to look like in such ways of teaching.
* Through the second stage, though, the teachers will be asked to write their diaries regarding their attempts to practice more dialogic talk in their teaching. These diaries constitute a secondary technique in getting to know about the teachers’ perceptions. The themes that might be raised in these diaries are proposed to guide the discussion in a focus group setting which will be conducted with the teachers in the four cases together after teaching the electric circuits topic. At the same period of time, the pupil focus group is planned to be performed. The discussion here will be stimulated using the two cards used in the individual interviews with the teachers. Some episodes of different types of CT will also be used to build up the discussion around the practiced and the desired talk from the pupils’ point of views.

5- The Bubble dialogue sheets proved to be more effective in searching the pupils’ learning outcomes than the normal test questions. On one hand, the written dialogue through the speech bubbles seemed to reflect the pupils’ thoughts more than the general answers for the normal questions do. On the other hand, the scenes of the bubble sheets did play a good role in stimulating the focus group discussion. The pilot study had showed, in fact, the effectiveness of the bubble sheets and the focus group ‘together’ in revealing the pupils’ thinking. It showed also that the recorded group discussion during the observed lessons is a potential technique for investigating the learning outcomes, the thing that was not taken into consideration when planning for this study before the pilot stage. Consequently, the three techniques of group talk, Bubble sheets and focus group will be implemented to investigate the third aspect of this study concerning the pupils’ learning outcomes.

## Appendixes of research tolls used in the pilot study

### Appendix 1: Bubble Dialogue Sheets

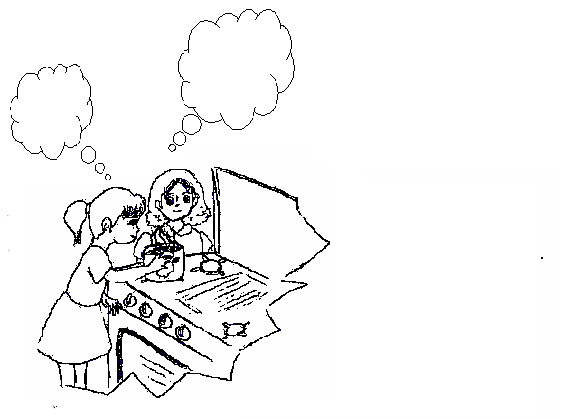
Sheet 1: Chemical and Physical changes

Sara and Madeline are frying some eggs for breakfast. They are

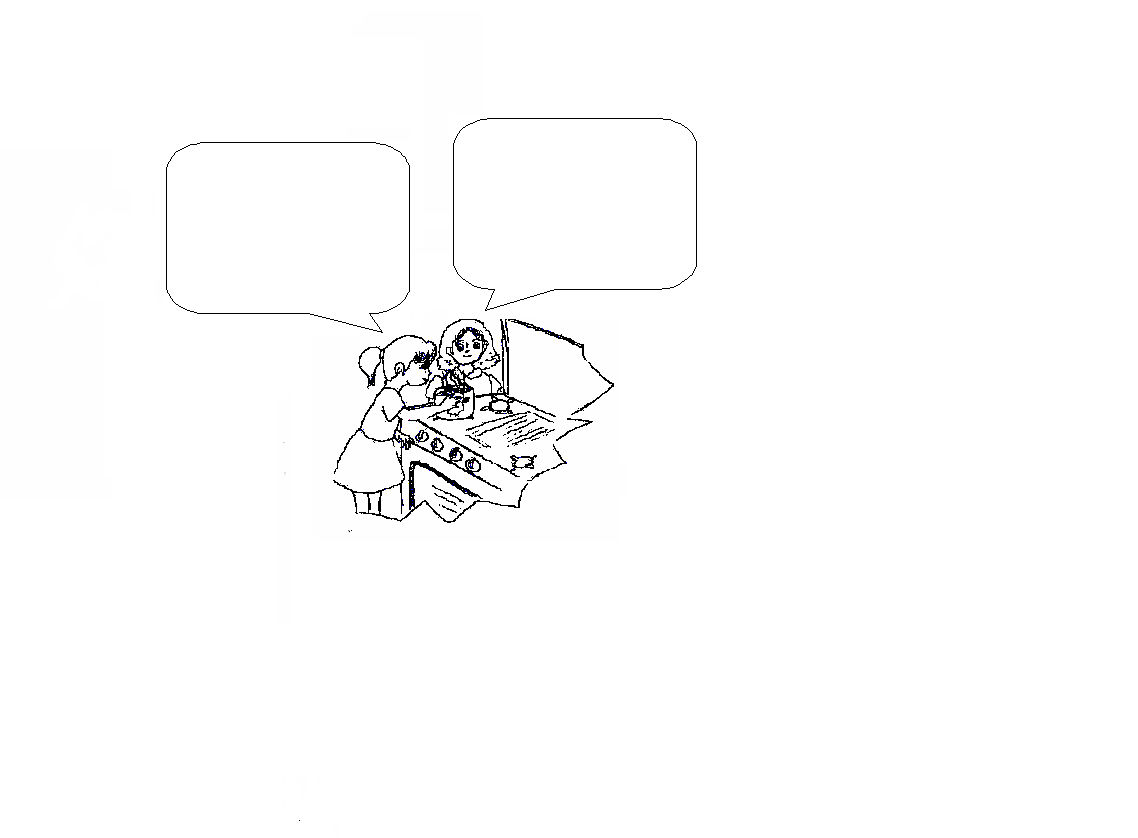
looking at the bubbles in the boiling water and wondering where

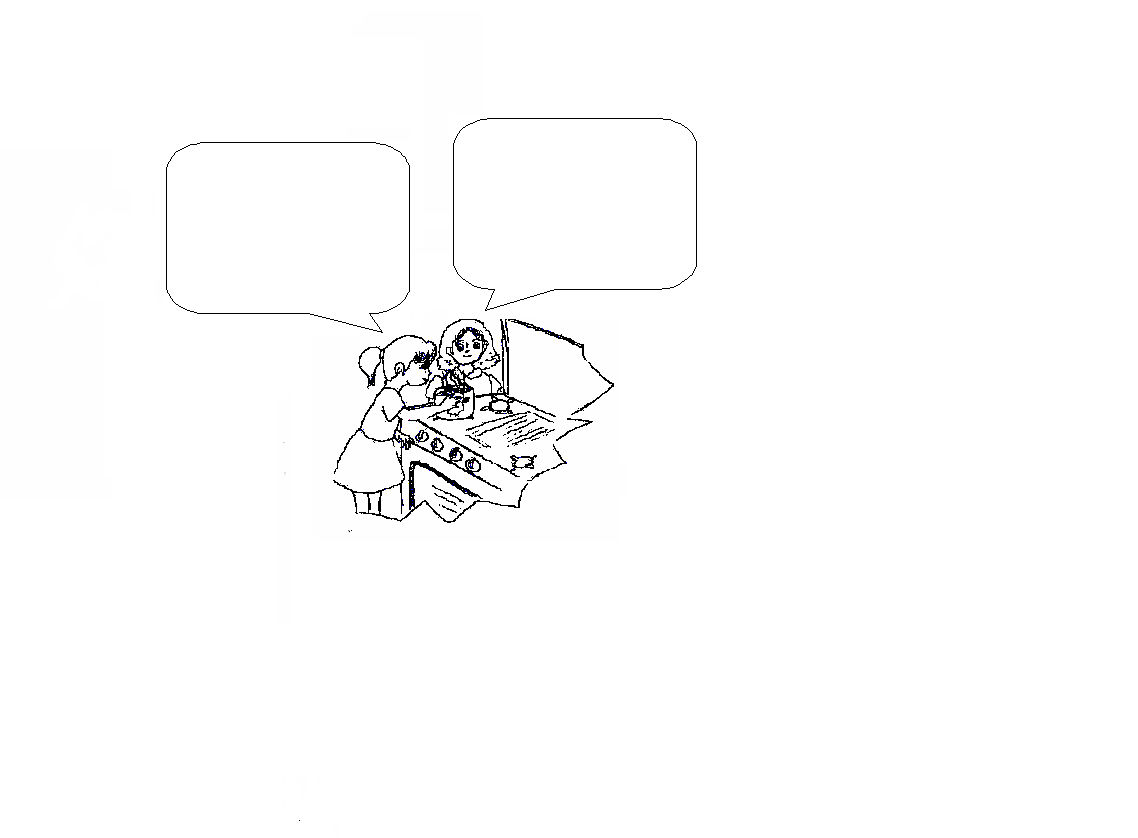
do these bubbles come from and what is actually happening to the

water and eggs?!



Notes:





Sheet 2: Chemical and Physical changes

Amal and Jasmin put some vinegar in a glass and added some

bicarbonate of soda to it. They are looking at the rising bubbles

and thinking about what has happened when mixing the

bicarbonate with the vinegar?!



Notes:

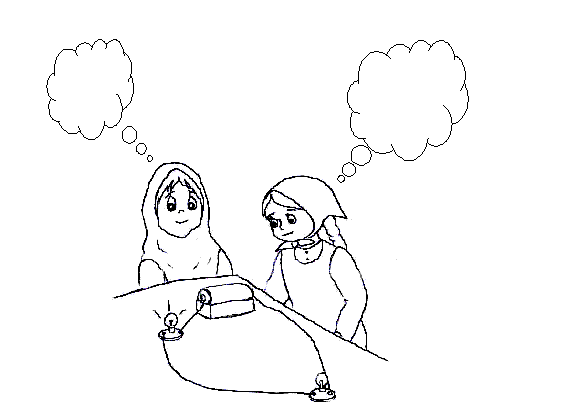
Sheet 3: Electric Circuit

Muna and Salma connected the electric circuit as shown below. The

red bulb lit brightly but the green bulb was dim. Muna suggested

swapping the two bulbs over to make the green bulb lit brightly, but

Salma did not agree!!



Notes:

Sheet 4: Electric Circuit

Widad and Farah connected an electric circuit using two batteries and

two bulbs. Widad is thinking what will happen to the brightness of

the two bulbs when one battery is removed. Farah is wondering

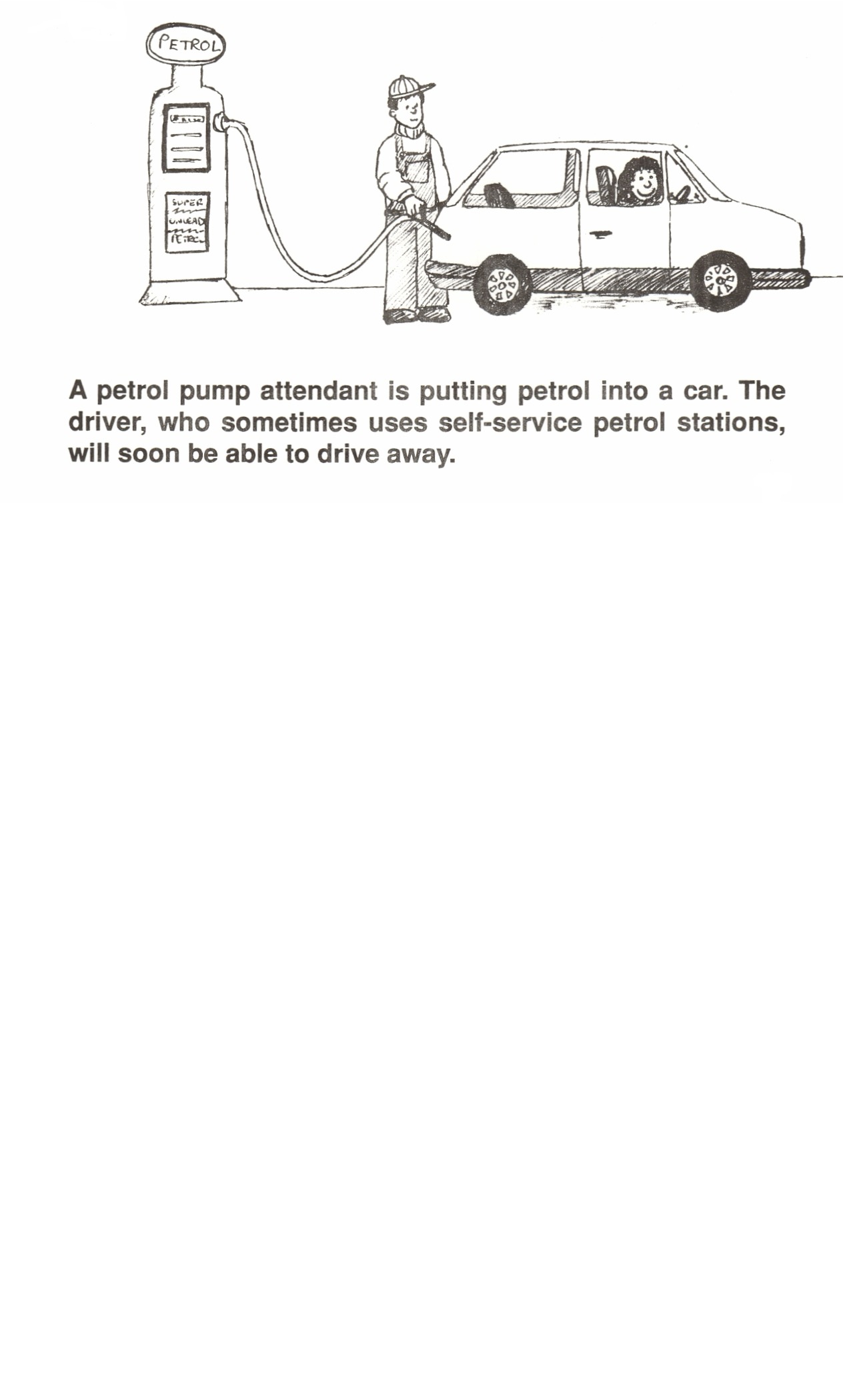
what will happen to the brightness of one bulb if the other bulb

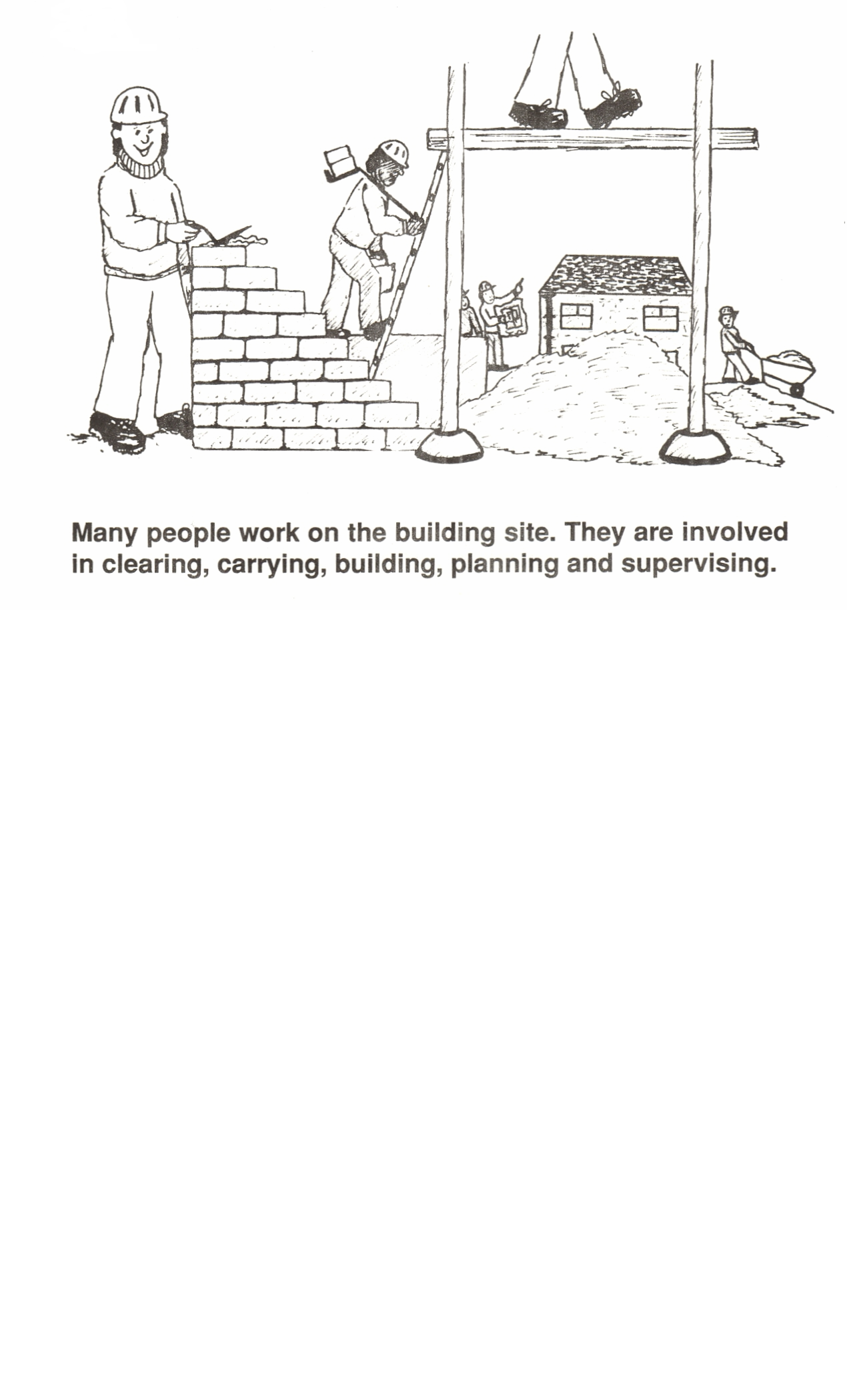
is removed and the two batteries are kept.



Notes:

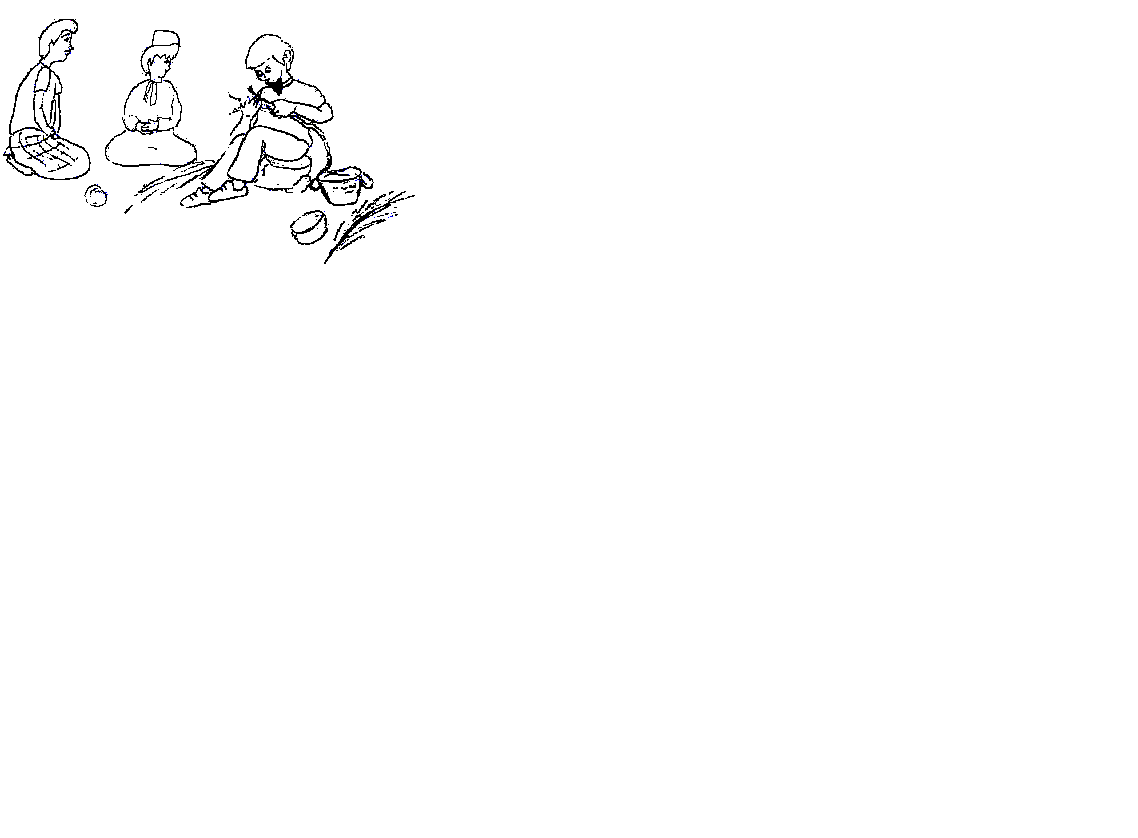
### Appendix 2: Stimulus Cards

Card 1:

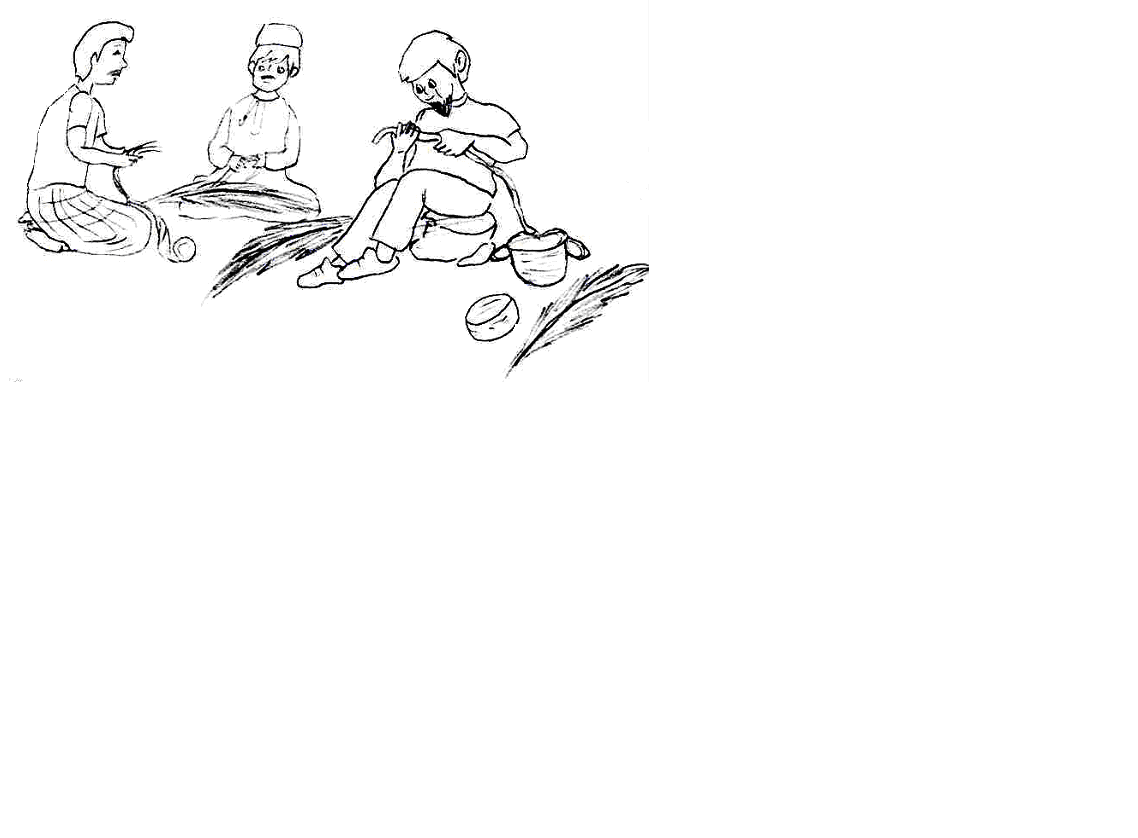
Card 2:

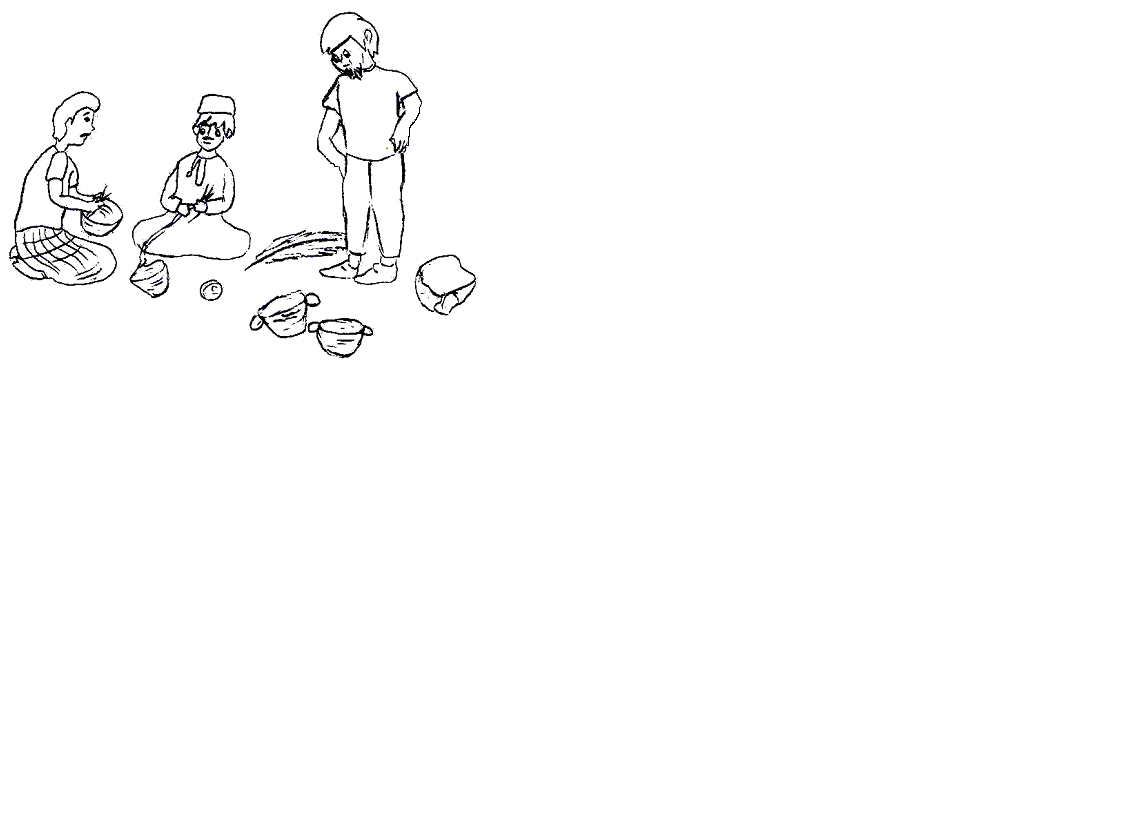
### Appendix 3: Replaced Stimulus Cards

The handicrafts man is sewing the palms in a brilliant way…He is doing this alone… The people around him are observing what he is doing…



The handicrafts man is sewing the palms… He is not doing this alone…The people around him are participating with him …



The handicrafts man is not, himself, sewing the palms…The people around him are doing this…He is supervising them only…