

## **Establishing Cross-curricular Links between Science and English in Ninth Grade**

Creación de nexos curriculares entre las ciencias naturales y el inglés en grado noveno

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For many years, English has been studied apart from the other subjects in non-bilingual centres, isolating it from other knowledge areas, underestimating its nature as a vehicle for communication. English has thus been considered just as a set of rules to be memorized with no communicative purpose.

As English teachers our objective to design this proposal, was to show this language as a useful tool, not only to be practiced in the classroom, but also in the context of other areas, in this case, science. Throughout the piloting of this project at Gustavo Restrepo school, in the south of Bogotá, English was used to learn science and science was used to practice English during the performance of some tasks with a communicative purpose so that the students of ninth grade had the opportunity to learn by doing.

**Key Words:** English-High School-Teaching, Sciences-High School-Teaching, English-Teaching-Methods

Por muchos años, el inglés ha sido estudiado aparte de las otras materias en instituciones no bilingües, aislándolo de otras áreas del conocimiento y menospreciando su naturaleza como vehículo de comunicación. El inglés ha sido entonces considerado simplemente un conjunto de reglas que se memorizan sin un propósito comunicativo.

Como profesores de inglés nuestro objetivo al diseñar esta propuesta fue mostrar este idioma como una herramienta útil, no sólo para ser usada en el aula, sino también en el contexto de otras áreas; en este caso ciencias naturales. A través del pilotaje de este proyecto en el colegio Gustavo Restrepo en el sur de Bogotá, el inglés fue usado para aprender ciencias naturales y las ciencias naturales fueron usadas para practicar inglés durante el desarrollo de algunas actividades, con un propósito comunicativo

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de manera que los estudiantes de noveno grado tuvieran la oportunidad de aprender haciendo.

**Palabras claves:** Inglés-Enseñanza Secundaria, Ciencias Naturales-Enseñanza Secundaria, Inglés-Enseñanza-Métodos

## INTRODUCTION

Traditionally, English has been studied apart from the other subjects in non-bilingual centres. Given this fact, students are not exposed to the wide range of opportunities that the foreign language can offer as a means to communicate and acquire knowledge through it.

Today, when English has gained an important place in the world in almost all fields, it is necessary for people to use it in any context. At school, teachers must be aware of this need, in order to correlate it to other areas. That way, students can realize the relevance that this language has in our society and that it cannot be isolated from other knowledge as it has been done so far.

Although in the last few years English has become a more important subject of the curriculum, it has not been yet considered a code through which we can learn, but just a set of rules to be memorized with no communicative purpose.

This research was intended to get students to regard the foreign language as a useful tool not only to be practiced in the English class, but also in the context of other areas. This project was focused in the light of a cross-curricular approach where English could become a vehicle to learn contents of science. The main research question posed was:

- What kind of tasks could be suitable for establishing cross-curricular links between science and English and to promote

foreign language learning in ninth grade?

In order to answer this question, we attempted to answer the following related questions:

- What kind of materials contribute to the promotion of learning in the development of tasks?
- What sort of attitudes do students manifest as a result of the implementation of tasks?

## 1. LITERATURE REVIEW

For the design and development of such tasks, it was necessary to resort to a kind of methodology through which it could be possible to promote learning by means of the completion of tasks. This methodology is known as task-based learning and has to do with the processes of understanding language rather than with the products of instruction.

Bearing in mind Widdowson's notion that unlike science, history or mathematics, language is not a subject in its own right, but merely a vehicle for communicating something else, the tasks designed were centred on one specific subject area: science (1983, in Nunan, 1988). In so doing we attempted to apply content-based learning principles. This perspective responds to the notion proposed by the National Ministry of Education regarding *aprendizaje integral* or whole learning, since the establishment of cross-curricular links "reinforces the concepts and knowledge developed and acquired in other subjects" (MEN, 1999, pp. 36).

## 1.1 Task-based Learning

Nunan (1990) explains that the task is a piece of meaning-focused work, involving learners in comprehending, producing and/or interacting in the target language. In this sense, the performance of a task requires that learners take part in a communicative context in which grammar is not as important to the situation as meaning. The main purpose is to get the message across, taking risks and using English as a tool for communicating, not as the subject matter to be studied.

## 1.2 Cross-curricular Links

Taking into account that any foreign language is also a means for communicating, there arises then, a need for establishing an integrated curriculum whereby students have plenty of opportunities for using the new language in other subject areas such as science, math and art so that they are no longer learning a language for its own sake, but rather, extending their learning horizons cross-curricularly. So, it is necessary to overcome the notion of the foreign language class as an isolated situation and integrate it with different school activities. Also, it is important to implement its use as a tool in the learning of other areas (MEN, 1999).

## 1.3 Content-based Learning

In a content-based learning situation the topic becomes both the vehicle for language learning and the means to provide meaningful contents of educational value, so that it facilitates learning not only through language but with language (Nunan, 1988). One important aspect of this type of learning is the fact that topics are not chosen arbitrarily. Rather, by selecting subject areas the learning process is given a logic and coherent nature (ibid).

## 2. Methodology

This investigation was centred in classroom research, trying to understand what went on in the classroom setting addressing the issue of how suitable, regarding methodology and materials, the activities proposed were to establish links between English and science programs.

The project carried out at Gustavo Restrepo school was heuristic or hypothesis-generating, since the objective was to generate hypotheses about the phenomena studied based on the data gathered; not to test hypotheses as in the deductive approach (Seliger and Shohamy, 1990).

This practice of deriving theory from data gathered is known as grounded theory (Nunan, 1993). Keeping in mind that the main concern was to carry out the research in a real situation and setting (that is, in a classroom), this work was approached from an ethnographic perspective. Ethnography, according to Nunan, is contextual, since it takes place in context; it is unobtrusive, because the researcher does not manipulate the phenomena under investigation; longitudinal because it is relatively long-term. Although the piloting of this project was not longitudinal since it took only one month, it was possible to draw important conclusions from the activities that were carried out. The project is also collaborative because it involved the participation of the teacher researchers, and the learners. It was also interpretative, taking into account that the researchers carried out interpretative analyses of the data. Finally, it should be pointed out that our ethnographic study was organic due to the fact that there was interaction between questions/hypotheses and data collection/interpretation.

## 2.1 The Participants

The piloting of the tasks was carried out at Gustavo Restrepo school, a public institution located in Localidad 18 (Rafael Uribe Uribe), in the south of Bogotá. There are two shifts, one in the morning and one in the afternoon, each with twenty-five courses of forty students approximately.

The class we worked with was composed of thirty three middle and lower-middle class students, fifteen girls and eighteen boys between twelve and fourteen years old. They belonged to two different groups (901 and 903) who were put together on Mondays and Thursdays from 7:00 am to 8:15 am to take the English class due to their higher level of proficiency in this language in contrast to their other classmates (who were studying English at the same time in another classroom). The organization of those groups was according to a placement test and the English teacher's observation and monitoring during the classes.

Taking into account the unobtrusive characteristic of ethnographic studies which states that the researcher does not manipulate the phenomena under investigation (Nunan, 1993), none of the school teachers interfered with the normal performance of the students during lessons. We acted as teacher-researchers. The classroom observation, for example, was conducted alternately by the teachers; so, while one of us was doing an activity, the other was doing the observing (examining the behaviours while the tasks were going on).

## 2.2 Data Collection Procedures

Three kinds of techniques were adopted. Through them it was possible to gather an adequate amount of data to support

interpretations from three different perspectives (teacher's, students' and observer's). These were: introspective techniques (teachers' diaries), elicitation (questionnaires), and observation (classroom observation) (McDonough and McDonough, 1997).

### 2.2.1 Diary

The diary provided relevant written records of personal objective and subjective impressions of learning situations given by the observers (the teacher-researchers). In this diary, feelings and reflections regarding the different tasks during the process of piloting were noted down.

The following points were considered to keep the diary:

- Students' participation in the activities.
- Students' use of English
- Students' interest towards the materials
- Students' problems during the development of the activities

### 2.2.2 Questionnaires

They were used in order to obtain concrete data from students. They provided quantitative responses to specific questions about the methodology and the tasks, and consisted of twelve questions that included multiple-choice questions, ranked questions, scales questions and open-ended questions. Students were free to use their mother tongue so that they could express their thoughts more precisely. They were applied at the end of the lessons (see annex 1).

### 2.2.3 Classroom Observation

classroom observation was conducted alternately by the teachers. So, while one teacher was doing an activity, the other was

observing through checklists, numerical scales and rating scales. They were used to gather data at the very moment of the class. Eight parameters were followed regarding students involvement in the activities, their oral participation, interaction with the materials and their attitudes towards the materials and the activities (see annex 2).

### 3. PEDAGOGICAL DESIGN

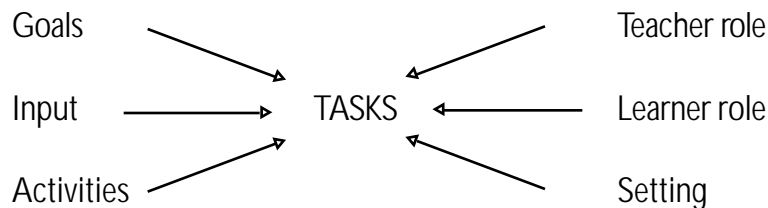
Five tasks were designed to establish cross-curricular links between English and science in ninth grade. They were divided into three main stages: pre-task, while-task and post-task (Willis, 1999). For their elaboration and organization we took into account the model presented by Nunan (1988) about the components of a task. (See Fig. 1)

The part referring to goals was organized under two headings: English and science. This is because of the curricular nature of the project. The input, which Nunan (ibid) presents as verbal

and non-verbal, was organized as verbal (the vocabulary and grammatical structure to be studied during the tasks) and materials or non-verbal input. The following component was a set of activities which was formulated from students' perspectives, that is, what students were supposed to do during the task. Teachers' and students' roles referred to the different roles performed by teachers or students according to the different activities in which they were engaged. The last component of this model we took into consideration was the setting or the way students should be organized for the realization of the activities.

The following are the topics on which the tasks were based:

- Task 1: Paint Colours
- Task 2: Light Colours
- Task 3: The Solar System: Stars
- Task 4: The Solar System: The Planets
- Task 5: Energy from the Sun



**Fig. 1.** A framework for analysing communicative tasks Nunan (1988, pp. 48)

This is a sample of the pre-task designed for task number one.

**TASK N° 1: PAINT COLORS**

Pre-task

**Goals:**

English:

- To share personal likes about colours.
- To describe objects in terms of colour.
- To practice reading comprehension through the answering of questions.

Science:

- To identify different colours that can be seen in the environment.
- To recognize why objects look coloured.

**Input:**

Verbal: Names of different colours; Reading "What colour is it?"

Grammar structures: My favourite colour is (yellow); What colour is it?; Who has (dark blue)?

Vocabulary: Paint colours (Yellow, yellowish orange, reddish orange, red, reddish purple, purple, bluish purple, blue, bluish green, green, yellowish green, pink, black, white, brown, light green, dark green, light blue, dark blue).

**Materials:**

Poster with different colours, cards each one presenting a colour, classroom objects, worksheet number 1.

**Activities:**

1. Observing a poster in which there are circles of different colours and identifying them.
2. Sharing with the class one's preferences in colours.
3. Writing a list of the colours that appear on the poster.
4. Matching colour cards with the corresponding written forms.
5. Describing classroom objects by terms of colour.
6. Looking for objects of a specific colour according to given instructions.
7. Reading a text: "What colour is it?"

### What color is it?

A. Read the following text. Then, choose three objects in the classroom and describe their colour. Say, according to the reading, why they look like that.

Most objects do not produce light of their own. They **reflect** the light that falls on them and our eyes see the reflected light. So the colour of an object depends on the colour of light that it reflects back into our eyes.

Colour objects reflect certain colours and **absorb** the rest. We see the reflected colour. A red shirt looks red because it absorbs most of the colours of light and only reflects red.

White objects reflect **all** the colours of light and black objects reflect **hardly any** of the light that falls on them.

B. Answering questions about the reading. Mark with an (X) the correct option.

1. Objects

- a. don't reflect the light that falls on them
- b. don't absorb the light that falls on them
- c. don't reflect white light that falls on them
- d. don't absorb white light that falls on them

2. We see the colours that objects:

- a. reflect
- b. perceive
- c. absorb
- d. see

3. Your teacher's sweater is black because it:

- a. absorbs all the colours of light
- b. absorbs black light
- c. doesn't absorb any light
- d. reflects black light

4. The sheet of paper that your teacher is holding is white because it:

- a. absorbs all the colours of light
- b. doesn't absorb any light
- c. doesn't absorb blue light
- d. absorbs white light

5. Your teacher's folder is blue because it:

- a. absorbs all colours except blue
- b. absorbs all shades of blue
- c. reflects all colours except blue
- d. doesn't reflect blue

## 4. FINDINGS

After the examination of the information gathered through the three techniques mentioned -diary, survey and observation- which at the same time revealed some important data related to our research, it was possible to establish three main parameters or categories: language use in the activities, cross-curricular links between science and English and social interaction among the students.

### 4.1 Language Use

One of the ways that raised students' motivation and made them get involved in the development of the activities was the use of visual aids. This, apart from supporting the explanations given by the teachers and making the topics clearer for the students, prompted them to use English. As quoted by Student E, the material *"helped as a guide to understand and do the activity"*. Likewise, teacher B noted that *"the activity in which they had to check the colours reflected on a CD was quite motivating for them to use English. . . Given the fact that they enjoyed these kinds of activities, they participated a lot and used more English than in the other activities"*.

Visual materials attracted students' attention and helped them greatly to understand the topics and practice English. In the same sense, through the games and contests that were carried out, students had the opportunity to use the foreign language. These activities were an interesting and dynamic way to communicate and understand meanings both in written and oral form. Since the students enjoyed these kinds of activities, they could grasp the concepts and structures better.

The readings, on the other hand, lowered students' motivation and willingness to

participate actively. They found the texts complex in terms of structures and vocabulary and so the results were not as positive as expected. It seems also that they were not used to reading, and activities like these would not attract them as the others did. *"Perhaps the main problems that students had were related to English, in understanding the vocabulary of the reading. They kept asking the meaning of words"* (Teacher A).

### 4.2 Cross-curricular Links

The students were motivated and interested in participating in activities which implied a certain level of knowledge about a topic. That could mean that apart from their interest in participating, students wanted to show how well they handled a topic: *"I liked the lesson because I am interested in science and even more in English"* (Student G).

On the other hand, colour mixtures were a real success for they could recall vocabulary about colours and relate it to colour mixtures, as expressed by Student D: *"We learnt through a dynamic activity how we can get primary and secondary colours"*.

In general terms, students could link science and English when describing the rainbow's colours or explaining why an object is red, black or white and not blue or yellow. Student E's remark illustrates this achievement: *"I learnt some things like: new and different colours and why see things with colours"*.

Again, the materials were essential for having students recognize vocabulary and use it within a specific context. They could recognize and name light sources keeping in mind that there are other objects that cannot produce light but that are illuminated by others. They could also



say what activities could be done according to weather conditions. Even simple drawings were enough for having them recognize the process of light reflection and enabling them to explain why things in nature display different colours: *“In these two lessons we have studied colours and from there, how they are reflected on objects, the mixtures, primary and secondary colours. . . And how you say that the mixture between yellow and green makes light yellow”* (Student G, commenting on post-task 2).

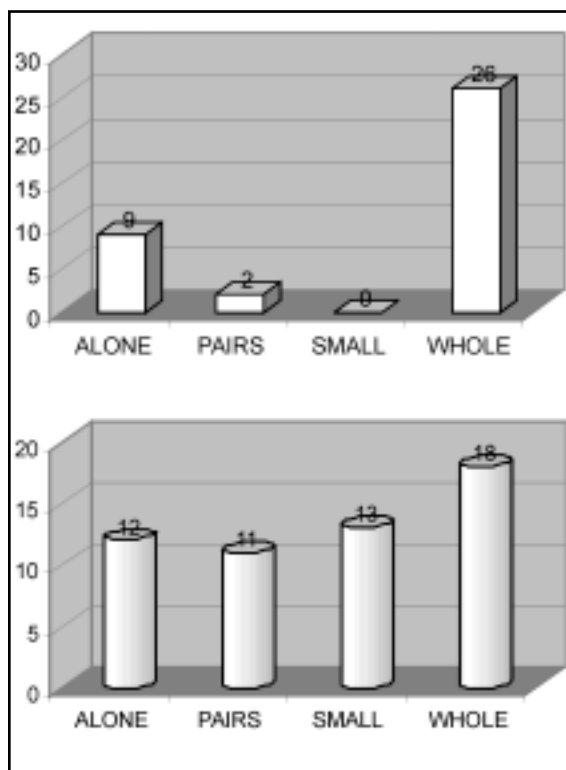
### 4.3 Social Relationships

Although there was a great individual participation in activities like describing, or expressing likes, there was also a special preference for working as a team. Whether in small or big groups, they enjoyed working with their partners in a cooperative way: *“Something that caught my attention was the integration we had”* (Student H).

Given the fact that the group in which the piloting was carried out was made up of students from two different courses who got together only for the English class, they found a good opportunity for integrating the group in the activities that implied fun and competition.

Students also favoured working in small groups since the partnership atmosphere permitted them to overcome shyness at the moment of speaking, reinforcing in their relationship as a group.

In addition, and according to the surveys, most of the students liked whole-class work (see tables 1 and 2) maybe because at the moment of participating they counted on the help and support of the teacher and because it could be the opportunity to show how much they knew or had learned in class.



**Tables 1 and 2.** Students' answers to the question "When did you use more English?", in two different lessons

### 5. CONCLUSIONS

By means of this investigation the learning of the second language served students not only in memorizing and applying a set of grammatical rules (refer to introduction), but rather communicating meanings. According to the Colombian National Curricular Guidelines for Foreign Languages (1999), the fundamental purpose in a foreign language curriculum is to get students to acquire and develop competence in this subject, so that they use the foreign language to relate knowledge, comprehend and interpret the reality around them, and to share ideas, feelings and opinions in communicative situations in which some linguistic and social-behavioural patterns rule.

Students enjoyed game-like activities which implied interaction within the group and introductory activities to the tasks which

supported them in making connections to what they already knew.

Group work helped students to overcome shyness at the moment of speaking, and although sometimes the students made grammatical mistakes, our purpose of promoting second language learning in the students was fostered. As Willis (1999) says, learners need to feel free to experiment with language on their own, and to take risks.

At the same time, we realized the importance of connecting across the curriculum. Students could describe different natural phenomena using English, and so they felt that they were doing something new, having the foreign language not as the subject matter to be studied, but as a vehicle for learning. As Short, et al. (1996) point out, the subject areas are at the centre of the curriculum, but they just need to be integrated more.

In order to solve the main question (What kind of tasks could be suitable to establish cross-curricular links between science and English and to promote the foreign language learning in ninth grade?), two related issues had been proposed. Referring to the materials that contribute to the promotion of learning during the development of the tasks piloted, we found that visual and colourful materials, as well as sources that could be manipulated, were of a great importance to having students speak in English using the language intended to be practiced in the classes. This was also relevant for them, since they could analyse and practice the language closely and with real objects. One of them noted: *"One can taste, feel what one says"*. The students themselves agreed on the fact that the materials had been important in their understanding of the topics dealt with in class: *"The materials helped us to understand what the teachers explained" (Student A); "(The*

*materials) helped as a guide to understand and do the activity" (Student B).*

However, sources like readings did not have as much success as the ones mentioned above. Students' motivation decreased when they were asked to do these kinds of activities. They needed simpler language to understand the texts because their level of English was not very high. The following example illustrates this situation noted by one of us when acting as an observer:

*"Although they showed interest towards understanding the reading their attitude towards the kind of activity itself was not as positive as we expected" (Teacher B).*

In the same line, when they were asked in the surveys which difficulty they had during the development of the activity one student answered: *"The difficulty of understanding the whole text because there were many unknown words"*.

Referring to the second question about the sort of attitudes that students manifested as a result of the implementation of the tasks, we can say that they participated more actively when they were involved in activities that required interaction with their partners. Games and contests became an important tool in the implementation of the tasks, since they encouraged the students to work cooperatively and reinforce their social relationships. Learners' interest and motivation were raised when they had to stand up and move around the classroom exchanging meanings with their classmates, as pointed out by Student C: *"We could participate and there was integration with the whole class. Besides, it was really fun"*.

The main question that we intended to answer through this research had to do with the kinds of tasks that could be suitable to establish cross-curricular links between science

and English and promote foreign language learning in ninth grade. According to the characteristics of the tasks that arose as the most interesting for students and which were helpful to enhancing learning, it is possible to say that the most appropriate tasks were those that implied a challenge, not only in the linguistic realm, referring to the type of the language used, but also those that involved intellectual processes like matching, deducing, experimenting, and classifying. Through them, students had the opportunity to interact in the classroom by expressing and interchanging ideas in English, and also learning or reinforcing some cognitive knowledge about colour mixtures.

This way, English acted as the vehicle for conveying real and contextualised meanings. At the same time, it served as a means to study contents of another subject of the curriculum: science, providing the students with a new view towards the learning of English as a foreign, but useful language. According to the National Curricular Guidelines (1999), this will permit a more integral learning process because the establishment of these kinds of links reinforces concepts and knowledge developed and acquired in other areas, contributes to the consolidation of a pedagogical project and can even serve as a model for other institutions.

It is important to realize then the necessity of correlating contents among the subjects of the school programs rather than keeping knowledge in isolated areas of the curriculum. Through the development of cross-curricular projects, learning is held in a more integrative way and students feel that what they learn at school is helpful in any context. Given the fact that English is essentially a vehicle of communication, it becomes a good tool to integrate other knowledge in class -rather than just the learning of structures- and focus more on contents of different subjects.

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**ANNEX 1: QUESTIONNAIRE APPLIED AT THE END OF THE LESSONS**

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 Research Project Developed at Gustavo Restrepo School

Please answer the following questions about the class in the most objective way. Follow your teacher's instructions:

1. How much of the lesson did you enjoy?  
 All of it / Some of it / None of it
  
2. How much do you think you learnt?  
 In English: Nothing / Something / A lot  
 In science: Nothing / Something / A lot
  
3. How much did you understand?  
 In English: Nothing / Something / A lot  
 In science: Nothing / Something / A lot
  
4. How was the lesson? Boring / Interesting  
 Why?  
 \_\_\_\_\_  
 \_\_\_\_\_
  
5. How did you find the activities?  
 Very Easy / Easy / A bit difficult / Very difficult  
 Why?  
 \_\_\_\_\_  
 \_\_\_\_\_
  
6. Write down any difficulty you had during the activity regarding:  
 Language required:  
 \_\_\_\_\_  
 \_\_\_\_\_  
 The development of the activity:  
 \_\_\_\_\_  
 \_\_\_\_\_
  
7. Write down anything you particularly enjoyed about the class:  
 \_\_\_\_\_  
 \_\_\_\_\_
  
8. How much English did you use? 0 1 2 3 4 5

9. When did you use more English?

\_\_\_\_\_ Working alone

\_\_\_\_\_ Working in small groups

\_\_\_\_\_ Working in pairs

\_\_\_\_\_ Working as a whole class

10. Did you like the materials? Yes / No Why?

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11. How much did the materials help you understand? 0 1 2 3 4 5

12. What other sources would have helped illustrate the topic? Why?

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**ANNEX 2: OBSERVATION REPORT**

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Date: \_\_\_\_\_ Topic: \_\_\_\_\_

Activities:

- 1 \_\_\_\_\_
- 2 \_\_\_\_\_
- 3 \_\_\_\_\_
- 4 \_\_\_\_\_
- 5 \_\_\_\_\_
- 6 \_\_\_\_\_

1. Students' involvement in the realization of the activities:

Activity	Not very involved			very involved	
1	1	2	3	4	5
2	1	2	3	4	5
3	1	2	3	4	5
4	1	2	3	4	5
5	1	2	3	4	5
6	1	2	3	4	5

2. Students' oral participation in the activities:

Activity	low			high		Not Applicable
1	1	2	3	4	5	_____
2	1	2	3	4	5	_____
3	1	2	3	4	5	_____
4	1	2	3	4	5	_____
5	1	2	3	4	5	_____
6	1	2	3	4	5	_____

3. Students speak English:

Activity				Not Applicable
1	Frequently	Sometimes	Never	_____
2	Frequently	Sometimes	Never	_____
3	Frequently	Sometimes	Never	_____
4	Frequently	Sometimes	Never	_____
5	Frequently	Sometimes	Never	_____
6	Frequently	Sometimes	Never	_____

4. Students use the language required for the activity

Activity

1 \_\_\_\_\_  
 \_\_\_\_\_

2 \_\_\_\_\_  
 \_\_\_\_\_

3 \_\_\_\_\_  
 \_\_\_\_\_

4 \_\_\_\_\_  
 \_\_\_\_\_

5 \_\_\_\_\_  
 \_\_\_\_\_

6 \_\_\_\_\_  
 \_\_\_\_\_

5. Students' interaction with the material

Activity	none					a lot/much	Not Applicable
1	1	2	3	4	5		_____
2	1	2	3	4	5		_____
3	1	2	3	4	5		_____
4	1	2	3	4	5		_____
5	1	2	3	4	5		_____
6	1	2	3	4	5		_____

6. Materials attract students' attention

Activity	not much					a lot	Not Applicable
1	1	2	3	4	5		_____
2	1	2	3	4	5		_____
3	1	2	3	4	5		_____
4	1	2	3	4	5		_____
5	1	2	3	4	5		_____
6	1	2	3	4	5		_____

7. Do the materials encourage students to speak English?

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8. Attitude of students towards the realization of the activities:

Activity

1 \_\_\_\_\_

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2 \_\_\_\_\_

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3 \_\_\_\_\_

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4 \_\_\_\_\_

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5 \_\_\_\_\_

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6 \_\_\_\_\_

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