Islands Diversity for Science Education

2017-1-PT01-KA201-035919

Activity Template – with guidelines

Created in the framework of Intellectual Output 1

Co-funded by the
Erasmus+ Programme
of the European Union

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1. INTRODUCTION

This document explains the four steps of the **Design Thinking methodology** and the 5 phases of the **Inquiry Cycle** used in IDiverSE activities as well as the rationale behind it including guidelines on how to create an activity. Each activity will be organized in relation to the 4 steps of the Design Thinking methodology, through which the work for and with the community will be guided and registered. All the activities will also include a science research component that follows the 5 steps of the Inquiry Cycle which can be presented in any moment throughout the 4 steps of the Design Thinking (this is left to the criteria of each author).

Note 1: It is important for you to understand that although Design Thinking and Inquiry are here presented as separate things, they are very related as the Design Thinking methodology follows the Inquiry-Based Learning principles. For this reason, when students are following the four steps of the Design Thinking, they are automatically experiencing Inquiry-Based Learning. If you want to understand better how both are related and to have a deeper look into what Collaborative Inquiry, Design Thinking and the 3D Map of Science Ideas are and the logic behind the IDiverSE methodology, please read the document: “IDiverSE in a nutshell”.

Note 2: All the activities created in the framework of IDiverSE should bring the student close to his/her community, involving topics that are relevant for the community, taking the student to the community, involving the community and creating a final result with the help of the community and for the community.

2. NOTE ON COLLABORATIVE INQUIRY

All the IDiverSE activities accommodate a collaborative component, through the Globallab platform, where students from the different islands of the world will follow the same protocol to collect data in order to compare the results and make a global analysis in a collaborative way. When creating your activity, you can choose to use one of the existing protocols in the platform or to create a new one.

In each activity this data collection can be presented in a different phase, either during the Science Research part or in one of the Design Thinking steps. As an author, in case you want to include collaborative Inquiry in your activity, you should reflect for each activity individually, in which moment you want to accommodate this component.

3. GENERAL GUIDELINES

In each step of this document you will see guidelines and tips for the teacher that can be useful during any activity. However, throughout the activity please consider the following:

- When choosing videos, make sure they come from different backgrounds and highlight both men and women in the job world;
- Choose pictures that respect gender balance and show students how both genders have an important role;
- Make sure you pay attention to all students and promote discussions where both girls and boys participate;
- Invite all students to participate in the discussion;
- Help shy and introvert students to express their opinions and views without being interrupted;
- Promote an environment of tolerance and respect where judging other is not allowed;
- Accept students' mistakes as a natural part of learning. Is it from the mistakes that they will learn the most;
- Promote collaboration between students and groups instead of competition;
- Don't avoid groups "copying" from each other. If groups collaborate and exchange ideas, their works will be enriched.

4.SKILLS AND COMPETENCES

During the IDiverSE activities, students will be developing different skills and competences. In each phase of the activity, you should include which skills and competences you consider the students to be developing. Each activity will call upon different skills.

Here is a list that you can consider:

4 C's of the 21 Century Skills

- Communication
- Collaboration
- Creativity
- Critical Thinking and Problem Solving

Other Skills

Below you have a list of skills with some examples to help you understand them. These where adapted from the document "profile of the students when leaving compulsory schooling" by the Portuguese Ministry of education and are in line with the 4 C's of the 21st Century Skills (Communication, Collaboration, Creativity and Critical Thinking and Problem Solving).

- Language and texts
  - To use different languages and symbols related to language, music, art, technology, maths and science;
  - To apply these languages adequately to different communication, digital and analogic environments;
  - To dominate nuclear understanding abilities of expression in oral, visual, writing and multimodal modalities.

- Information and Communication
  - To use and dominate diverse ways of research, describe, evaluate, validate and mobilize information in an autonomous and critical way, verifying different sources and their credibility;
  - To transform information in knowledge;
  - To collaborate in different communication contexts, in a secure and adequate way, using different types of tools (digital and analogic), based on the conduct rules appropriate for each environment.

- Reasoning and Problem Solving
  - To interpret information, plan and lead researches;
  - To manage projects and make decisions to solve problems;
  - To develop projects that lead to the construction of products of knowledge, using diverse resources.

- Critical and Creative Thinking
  - To think in a deep and embracing way, in a logical perspective, observing and analysing information, experiences and ideas and arguing using implicit and explicit criteria to take a reasoned position;
  - To call upon different knowledge of scientific and humanistic nature, using different methodologies and tools to think critically;
  - To predict and evaluate the impact of personal decisions;
  - To develop new ideas and solutions in an imaginative and innovative way, as a result of the interaction with others or of personal reflection, applying them in different contexts and learning areas.

- Interpersonal relations
  - To adequate behaviours in cooperation, sharing, collaboration and competition contexts;
  - To work in team and use different ways to communicate in person or in a network;

- To interact with tolerance, empathy and responsibility, reason, negotiate and accept different points of view, developing new ways of being, looking and participating in society.

- Autonomy and personal development
  - To establish relations between knowledge, emotions and behavior;
  - To identify areas of interest and of need of acquiring knew competences;
  - To consolidate and deepen the competences they already have in a perspective of a life-time learning;
  - To establish goals, make plans and implement projects with a sense of responsibility and autonomy.

- Wellbeing, Health and Environment
  - To adopt behaviours that promote health and wellbeing, namely in daily habits, food, consumption, physical exercise, sexuality and relationship with environment and society;
  - To understand unbalances and weaknesses of the natural world in the adoption of behaviours that respond to the big challenges of the global environment;
  - To manifest social and environmental awareness and responsibility, working collaborative for the common good, aiming for the construction of a sustainable future.

- Aesthetical and artistic sensitivity
  - To recognize the specificities and intentions of the different cultural manifestations;
  - To experience processes of different forms of art;
  - To critically appreciate the artistic realities, in different technological supports, by contacting with the diverse cultural universes;
  - To value the role of the various ways of artistic expression and of the material and immaterial heritage in life and in the culture of the communities.

- Scientific, technical and technological knowledge
  - To understand the processes and scientific phenomena that allow decision-making and the participation in citizenship forums;
  - To manipulate and handle diverse materials and instruments to control, use, transform, imagine and create products and systems;
  - To execute technical operations, following an adequate work methodology to achieve a goal or draw a reasoned decision or conclusion, adapting the material and technical means to the expressed idea or intention;
  - To adequate the action of transformation and creation of products to the different natural, technological and sociocultural contexts in experimental activities, projects and practical applications developed in physical and digital environments.

- Awareness and mastery of the body
  - To preform motor, locomotor, non-locomotor and manipulative activities, integrated in the different circumstances experienced in the relationship with the own body and with space;
  - To dominate the perceptual-motor capacity (body image, directionality, perceptual thinning and spatial and temporal structuring);
  - To be aware of self on an emotional, cognitive, psychosocial, aesthetic and moral level in order to establish with themselves and with others a harmonious and salutary relationship.

5. ACTIVITY

Name:

Main topic(s) that includes:

Local culture reference(s):

Brief description (1 to 2 paragraphs):

Subject domain(s):

Keywords:

Didactical hours:

Links to important resources (ex. Graasp):

Big Ideas of Science:

Choose the Big Ideas of Science to which this activity is related and write a brief explanation explaining the Intermediate and Small ideas that are involved. Erase the figures that don't apply to this activity. For an overview of the Big Ideas of Science and their progress from the Small and Intermediate Ideas, please visit the following mindmap.


5.1. THE FOUR PHASES OF DESIGN THINKING

1. Feel

This is the phase where the activity begins. The first step of a successful activity is to raise your student's curiosity for the topic. If students are curious, they will feel motivated and engaged and will want to learn more.

During the Feel moment of the Design Thinking, students should learn about what they will be working on and have the opportunity to actually "feel" what the topic is. This is, how it is related to their lives and to their community, how important it is for their community, what is the state of their community related to this topic, if there were any important events happening recently or in the past, related to the topic, how does it affect their family, etc. For each different topic, different scenarios will be presented in this phase.

Begin by introducing the topic in a way that awakens student's curiosity and interest, letting them feel the need to learn more. Try making the presentation of the topic in the most interactive way possible. Here you can use simple intriguing questions, show images or a video that introduces the topic, or you can even take your students to visit a museum or any other real-life scenario related to the topic in question. You can request the students to go home and ask something to their parents, grandparents, neighbours, etc, promoting the interaction with the community straight away, which will allow for a more meaningful outcome of the activity.

You can introduce the data collection using the Globallab platform (if it makes sense) during this phase in order to introduce your students to the topic and get them in touch with their community from the beginning.

Anytime you present a question to your students, don't give them the answers. This phase is meant to create a mystery in turn of the problem or question motivating the students to seek for the answers themselves. Give them a few minutes to discuss every question and let them discover the answers by themselves throughout the activity.

This is also the phase where you and your students will recall previous knowledge. Our knowledge is stored in our minds in an organized way. Allowing students to recall the knowledge they already have will facilitate the accommodation of the new knowledge in a way that makes sense and increases the retainment of new information. You can create a discussion where students talk about what they already know and connecting concepts, or you can ask them to create real concept maps. Ask them to get creative and find connections with topics from other subject domains or topics from their daily lives.

NOTE: You can choose to begin this phase with a scientific research that follows the Inquiry-Based Learning cycle as detailed in pages 18 to 25 of this document. Otherwise, you can include the scientific research in any of the other steps.

Some tips for the teacher:

- Introduction to the topic should be well contextualized in concrete situations that allow to portrait the reality of islands diversity and references that are specific to their island.
- Try using videos, small documentaries and images anytime you can to sparkle students' curiosity towards the topic to be studied.
- You and your students can use the 3D Interdisciplinary map of science ideas to find connections between concepts.

Useful tools and resources:

- Short online videos (YouTube, TED, Teacher Tube)
- Images and Interactive images (Picasa or Flickr)
- Animations and/or simulations - PowToon is a useful tool if you wish to make your own animations.
- A story or an event related to the subject and to students' memories or experience.
- Concept maps
- Virtual classroom walls (Padlet, Popplet)

Main skills being developed: You can choose from the skills listed in page 4 and 5 of this document. Please consider in the first place the 21st century skills and then if necessary complement with the others from the lists.

Connection to Inquiry: This phase follows the same principles of the **Orientation** phase of the Inquiry Cycle.

2. Imagine

After having "felt" the topic on which the students will be working on and realizing how it relates to their community, students will begin to think about how this topic/question/issue can be worked on for the benefit of the community.

If the topic of this activity concerns a problem that the community is facing, students can start thinking about why the problem exists, how did it originate and imagine possible solutions to solve it.

If the topic concerns a good example that the community presents to others, students can star analysing how this example was born, who was the main stakeholders, how it benefits the community and research the level of development of other communities (and islands) regarding this topic. In case other communities are facing an underdevelopment regarding the topic, students can imagine ways to bring good practices to those communities.

Depending on the activity, this can be a good moment to introduce globallab, if it wasn't introduced before, in order for the students to start getting in touch with their community, evaluating how their community is behaving toward the topic that was introduced before. In case your students have already proceeded with the data collection in the "feel" phase, they can now return to the platform to look to the data collected by their colleagues from other island and compare their community to others to reflect on whether they are different and what they can do to improve their community or contribute for the development of others.

Teachers can collaborate to promote conversations between students from the different islands in the exchange of ideas and in a collaborative data analysis. Students and teachers

can be creative in collaborating in the way they want and in collecting the data in the most relevant way for them. Teachers and students know their communities better than stranger authors of activities so here there should be space for freedom and creativity regarding the field work.

Students can do a field trip to their community in this phase, take pictures, make drawings, write notes, make interviews to their community members to retrieve important information to help them imagine good solutions that are practicable and of great value to the own community.

Important: One major strength of the Design Thinking methodology is that the solutions are created with the collaboration of all the involved parties. This means that instead of imagining solutions without knowing the field in depth, students will be challenged to go out of the classroom environment and visit the real people that experience the topic at hands every day, listen to what they have to say, ask them of how they think the problem could be solved and then start creating solutions accordingly.

NOTE: If you haven't included the scientific research in the first step, you can choose to integrate it in this phase in order for the students to learn more in depth about the scientific component of the topic at hands. The scientific research component follows the Inquiry-Based Learning cycle as detailed in page XXXXX. Otherwise, depending on the activity, it can make sense to include the scientific research in the next step.

Some tips for the teacher:

- Encourage your students to register all their ideas and the conversations with their community members. They can use a recorder to record their conversations and use Padlet, or any other tool they can have access to during the whole activity to take their notes.
- Let your students come up with their own ideas but guide them into respecting and valuing the opinions and thoughts of their community members. Make key questions to make them reflect on how their plans are suitable or not for their community. Allow your students to reach conclusions for themselves.

Useful tools and resources:

- Concept Maps
- Virtual classroom walls (Padlet, Popplet)
- Calculators
- Observation sheets
- Recorder
- Camera (or smartphone camera)

Main skills being developed: You can choose from the skills listed in page 4 and 5 of this document. Please consider in the first place the 21st century skills and then if necessary complement with the others from the lists.

Connection to Inquiry: This phase follows the same principles of the **Conceptualization** phase of the Inquiry Cycle.

3. Create

After having collected all the information they need from their communities and imagining possible solutions or ways of action, it is time to out hands on action and start creating the final result of their work.

This result should be the creation of something of value for the community. It can be a leaflet that they will distribute, it can be an exhibition with pictures and awareness raising materials. It can be a theatre or a song. It can be a slow motion or any other type of video. It can be the building of a station that will be permanently accessible to all community members, students can decide to create a proposal for the improvement of any given situation and deliver it to the city hall including a real budget and risk analysis, etc.

Students and teachers should be creative in this part and decide what would be the most effective product to offer to their communities or to the other communities with which they have worked.

NOTE: In case it makes sense to include the scientific research in this phase in order to train the students for the creation of their final result, this can be integrated here. The scientific research component follows the Inquiry-Based Learning cycle as detailed in page XXXXX.

Some tips for the teacher:

- During the creation, students should have an active attitude always. The teacher will only be a pillar for support and guidance when needed.
- Allow your students to make mistakes and correct them. Let them be creative.
- Be patient if you note that your students are feeling insecure. They might not be used to such activities. Offer them words of confidence and support and encourage them to keep motivated and put energy into their researches.

Useful tools and resources:

- Research tools (wikipedia, wolfram)
- Manipulating data, making graphs (Spreadsheets)
- Create programs to manipulate data or simulate models (scratch)
- Online collaboration documents for sharing input and ideas (Google docs)
- Shared space (Dropbox)
- Managing group tools (wiggio)
- Polling and survey tools (Doodle, Survey monkey, kahoot)

Main skills being developed: You can choose from the skills listed in page 4 and 5 of this document. Please consider in the first place the 21st century skills and then if necessary complement with the others from the lists.

Connection to Inquiry: This phase follows the same principles of the **Investigation** and **Conclusion** phases of the Inquiry Cycle.

4. Share

This is the last phase of the activity where the student's creations will be shared with the community. The teacher should make sure that the students disseminate their work well and that the community understands that voices were heard and taken into consideration when creating the final results.

This is the moment when the whole work that students have gone through is made worth and can be shared nationally and internationally with their colleagues from other islands of the world.

Some tips for the teacher:

- Let your students know from the beginning of the activity that they will create something to share with the community.
- Allow students to present their work in whatever way they want, but with quality.

Main skills being developed: You can choose from the skills listed in page 4 and 5 of this document. Please consider in the first place the 21st century skills and then if necessary complement with the others from the lists.

Connection to Inquiry: This phase follows the same principles of the **Discussion** phase of the Inquiry Cycle.

5.2. THE 5 PHASES OF THE INQUIRY CYCLE

1. Orientation

NOTE: The principles of this phase are the same as the ones in the FEEL step of the design thinking. In case you have already introduced the topic of the scientific research during that step, you can skip this phase. If the scientific research concerns a topic that is related but not totally the same as in the FEEL phase, then consider the following:

Description:

The first step of an Inquiry activity is to present the topic in a way that awakens student's curiosity and interest, letting them feel the need to learn more. It is a good idea to introduce the topic in connection to other topics students feel familiar with to increase their understanding and to topics from their daily lives to arise curiosity and interest, showing them at the same time the reason why they need to learn more about the topic. Try making the presentation of the topic in the most interactive way possible.

Here you can use simple intriguing questions, show images or a video that introduces the topic, or you can even take your students to visit a museum or any other real-life scenario related to the topic in question.

Anytime you present a question to your students, don't give them the answers. This phase is meant to create a mystery in turn of the problem or question motivating the students to seek for the answers themselves- Give them a few minutes to discuss every question and let them discover the answers by themselves throughout the activity.

This is also the phase where you and your students will recall previous knowledge. Our knowledge is stored in our minds in an organized way. Allowing students to recall the knowledge they already have will facilitate the accommodation of the new knowledge in a way that makes sense and increases the retainment of new information. You can create a discussion where students talk about what they already know and connecting concepts, or you can ask them to create real concept maps. Ask them to get creative and find connections with topics from other subject domains or topics from their daily lives.

Some tips for the teacher:

- Orientations should be well contextualized in concrete situations that allow to portrait the reality of islands diversity and references that are specific to their island.
- Try using videos, small documentaries and images anytime you can to spark students' curiosity towards the topic to be studied.
- You and your students can use the 3D Interdisciplinary map of science ideas to find connections between concepts.

Useful tools and resources:

- Short online videos (YouTube, TED, Teacher Tube)
- Images and Interactive images (Picasa or Flickr)
- Animations and/or simulations
- A story or an event related to the subject and to students' memories or experience.
- PowToon is a useful tool if you wish to make your own animations.
- Concept maps
- Virtual classroom walls (Padlet, Popplet)

2. Conceptualization

Description:

This is the phase where your students will really start putting their minds into action to make hypotheses and questions about the topic in hands. Here, the previous knowledge students recalled is going to help them address the problem.

Encourage your students to set the questions they want to address to solve the problem and to make preliminary predictions regarding those questions.

After making their predictions promote a discussion, either in group or with the whole class, about what they could do to test their hypotheses. Promote discussions where students debate on the strong and weak points of each strategy that comes up.

In case you want to include the collaborative data collection in this research activity, this phase is very important to make your students think about what is important in an investigation that includes collaboration and the collection of data by different people in

different places. Instead of telling them that they have to follow a protocol, lead the conversation to allow them to reach this conclusion for themselves.

After this discussion, you can give your students the protocol for collecting data (add the globallab platform project link).

Let them read the protocol and get acquainted with the globallab platform, discuss it in groups and make a simple research to clear any doubts they might have regarding the protocol.

Make sure that students understand all steps of the protocol and are fully aware of the reason for each step, being able to connect it with the problem at hands and with their questions.

If students feel that the protocol doesn't fully accommodate the collection of data to answer their questions, allow them to create an additional investigation design that can be relevant for their specific questions and for their islands.

Finally, encourage your students to think about how they will work with the existing data from other locations to answer their initial questions.

Some tips for the teacher:

- Encourage your students to register all their questions and predictions. They can use a Padlet, or any other tool they can have access to during the whole activity.
- Don't correct any wrong predictions or mistakes. Students should have the opportunity to discover their own mistakes throughout the activity and correct them themselves.
- Let your students come up with their own protocols and investigation plans. Make key questions to make them reflect on how these plans are suitable or not in a collaborative investigation framework. Allow your students to reach conclusions for themselves.
- Make sure that your students follow the protocol correctly as this will be of great importance for students from other locations, however, allow them to create a plan to collect more data and use other research strategies, if they find it meaningful to their work.

Useful tools and resources:

- Concept Maps
- Virtual classroom walls (Padlet, Popplet)
- Study Cards (Studyblue)
- Online virtual and remote labs (for example www.golabz.eu)
- Calculators
- Tools for collecting data and making graphs (like excel)
- Error calculator tools (http://www.golabz.eu/apps/experimental-error-calculator)
- Observation sheets

3. Investigation

Description:

This is the phase where students' plans are put into action. Guide your students into following the protocol step by step and introducing the data correctly in the globallab platform. After this, give them time to make any extra research they find relevant to their work.

If during this phase new questions appear, allow your students to explore them, making new predictions and new research plans for them.

Some tips for the teacher:

- During the investigation, students should have an active attitude always. The teacher will only be a pillar for support and guidance when needed.
- Allow your students to make mistakes and correct them. Let them be creative.
- Be patient if you note that your students are feeling insecure. They might not be used to such activities. Offer them words of confidence and support and encourage them to keep motivated and put energy into their researches.

Useful tools and resources:

- Research tools (wikipedia, wolfram)
- Educational games, online labs
- Manipulating data, making graphs (Spreadsheets)
- Create programs to manipulate data or simulate models (scratch)

- Online collaboration documents for sharing input and ideas (Google docs)
- Shared space (Dropbox)
- Managing group tools (wiggio)
- Polling and survey tools (Doodle, Survey monkey, kahoot)

4. Conclusion

Description:

This is the phase where students will organize the data they have collected and will analyse it to draw conclusions. This data should be the result of their research and any other extra data collected by them like recordings of interviews, handwritten data, pictures of site observations, data from online sources, etc.

After organizing and processing the data, students should be able to find the answers to their questions, compare them with their predictions and make their final conclusions about the problem at hands.

Students should reflect on the whole process, reflecting on their predictions, research designs, the process of collecting and the drawing of conclusions. If their predictions were incorrect, students should reflect on what led to the mistake and how they discovered the right answer.

During this phase students might discover that something went wrong with their research and should be given time to redesign and repeat it.

Furthermore, new questions can arise from this phase, which can lead to a new inquiry.

Some tips for the teacher:

- Students might feel lost with all the data. You can provide them tools to analyse them like an Excel sheet where they can make graphics and tables, or other tools you may know.
- Guide your students with simple questions that make them reflect on the process, without having to give them straightaway answers.

Useful tools and resources:

- Research tools (Wikipedia, wolfram)
- Online collaboration documents for sharing input and ideas (Google docs)
- Shared space (Dropbox)
- Virtual classroom walls (Padlet, Popplet) (reflecting on the conceptualization phase)
- Study Cards (Studyblue) (reflecting on the conceptualization phase)

5. Discussion

Description:

This is one of the most important phases of any Inquiry, or, truth being said, of any scientific research. Every time students learn a new topic they should be able to share their work, discuss it and connect it with everyday life.

During this phase students will present their work to their colleagues, from their initial questions and predictions, to the drawing of conclusions. Make sure students include references that are relevant for their own island and explain how their work can be directly applicable to their community.

Promote a reflection on the added value of working in collaboration with students from other locations on earth.

Invite students to reflect on how their work was important for themselves, their families and their communities and to reflect on how they felt during the activity. Being able to associate school work to real life and to personal emotions can be beneficial and promote the development of several skills like tolerance and respect for others.

Some tips for the teacher:

- Let your students know from the beginning of the activity that they will present their work by the end
- Allow students to present their work in whatever way they want, like a PowerPoint presentation, a Powtoon video, a blog, a picture show, a theatre, etc.

- Establish a time frame for the presentations, encouraging students to filter the most important information and be effective speakers.

Useful tools and resources:

- Presentation tools (MS PowerPoint, Open Office Impress, Prezi)
- Story making tools (Storybird)
- Timeline tools (Dipity)
- Word clouds (Wordle)
- Movie and animation making tools (windows movie maker, animoto)
- Blogging tools (Blogger, Wordpress, Tumblr)
- Photo sharing and editing tools (Picasa, Instagram, Snapchat, Flickr, Photobucket)

Annex A

Activity template - Blank

Name:

Main topic(s) that includes:

Local culture reference(s):

Brief description (1 to 2 paragraphs):

Subject domain(s):

Keywords:

Didactical hours:

Links to important resources (ex. Graasp):

Big Ideas of Science:

Choose the Big Ideas of Science to which this activity is related and write a brief explanation explaining the Intermediate and Small ideas that are involved. Erase the figures that don't apply to this activity. For an overview of the Big Ideas of Science and their progress from the Small and Intermediate Ideas, please visit the following mindmap.


1. Feel

Description:

Tips for the teacher:

Useful tools and resources:

Main skills being developed:

2. Imagine

Description:

Tips for the teacher:

Useful tools and resources:

Main skills being developed:

3. Create

Description:

Tips for the teacher:

Useful tools and resources:

Main skills being developed:

4. Share

Description:

Tips for the teacher:

Useful tools and resources:

Main skills being developed:

Inquiry Cycle

1. Orientation

Description:

Tips for the teacher:

Useful tools and resources:

Main skills being developed:

Accompanying files:

2. Conceptualization

Description:

Tips for the teacher:

Useful tools and resources:

Main skills being developed:

Accompanying files:

3. Investigation

Description:

Tips for the teacher:

Useful tools and resources:

Main skills being developed:

Accompanying files:

4. Conclusion

Description:

Tips for the teacher:

Useful tools and resources:

Main skills being developed:

Accompanying files:

5. Discussion

Description:

Tips for the teacher:

Useful tools and resources:

Main skills being developed:

Accompanying files: