

Multiple Representations in the Teaching and Learning of Basic Astronomy in Pre-Vocational Schools in the Republic of Mauritius

M Cyparsade & V Adiapen

Mauritius Institute of Education, Mauritius

Email: m.cyparsade@mieonline.org

Abstract

Scientific literacy among students in Mauritius is far from what is happening in most industrialised countries (Mauritius Research Council, 2004). Much is being done by the Ministry of Education in terms of provision of classroom based resources, teacher training, motivation of students through specific strategies such as free education at pre-primary, primary and secondary levels, free transport from home to school and back and social aids to needy parents. Still, we see that scientific literacy is poor among these learners. This trend is worse among low ability pre-vocational students. These students have failed final exams after two attempts, in most of the academic subjects, after 7 years of primary schooling. These learners have poor literacy and numeracy skills, they lack self-confidence and are sometime very turbulent. Their failure is attributed to lack of interest, poor parents who are not able to provide basic amenities, issues related to broken families, poor educational background of parents, busy or separated parents, learners not having enough competencies to climb to next level in the curriculum and assessment schemes not catering for low ability students. In the pre-vocational stream, students learn very basic skills in numeracy and literacy, life skills, communication skills, basic Science and trade oriented subjects like Woodwork, so as to be employed later. Their curriculum is much diluted as compared to mainstream students, so that they can manage to learn what is very essential for them to lead a reasonable life and understand their surroundings (National Curriculum Framework (NCF) Secondary, 2009). Through this study we attempted to enable pre-vocational learners grasp concepts related to Basic Astronomy. The strategies deployed to achieve this goal were role play, computer simulations embedded in PowerPoint Presentation and 3D models. Classroom observations followed by focus group discussions with students and post-test showed that pre-vocational learners are more at ease when scientific concepts are learnt through innovations like role play, ICT and the use of 3D models. It is therefore recommended that low ability learners should be taught science through more engaging and visual activities, involving collaborative learning; whereby language barrier is kept to minimum. Explanation using mother tongue and ample oral interactions must be encouraged in Pre-vocational schools.

Key words: Multiple representations, ICT, role play, science education, basic astronomy

1.0 Introduction

1.1 Students in the pre-vocational stream

Each year about 25000 students sit for the end of primary education examination which is the Certificate of Primary Education (CPE) examination. Out of them about 35% do not pass and cannot move to secondary schools (Mauritius Examinations Syndicate (MES), 2010). These students are given a second chance to write the CPE examination after one additional year of schooling. Still a large number of students do not pass and move to secondary education. Given they are still at a tender age of 12-14 years and not entitled to obtain employment, the Government has taken decision to keep them in schools for another 3 years and provide them with a specific training. These prevocational classes are conducted within a small number of main stream schools.

The students are low achievers in academic matters, some of them have poor cognitive, affective as well as psychomotor skills. They are not interested in any school activities. These children are quite turbulent, they do not adhere strictly to rules and regulations of the school and are also sometimes involved in delinquencies, teen age pregnancy and so on. They are often considered to be inferior to their counterparts in the mainstream schools. This further renders them rebellious and undisciplined. So it is high time that they are kept busy with constructive activities and all their energies are channelled into positive experiences.

1.2 Rationale of this study

Observations in Mauritius show that many social ills are products of illiteracy. If we aspire to live in a better society, everything possible should be done to reverse the escalation of the problems related to poverty. One of the ways to achieve it is through enhancement of literacy and numeracy among low ability learners who would otherwise fall in the vicious circle of illiteracy, delinquency and poverty.

Through this study the researcher is finding out ways to engage low ability learners in meaningful learning experiences through yet another innovation that is role play coupled with ICT. It is believed that role play is one of the methods that can engage learners into meaningful classroom transactions (Cyparsade, Chummun, Carooppunnen and Moheeput, 2011; Cyparsade, Moheeput and Carooppunnen, 2009; McSharry and Jones, 2000). This study will also provide a data base to educators so that they can include elements of research findings in their lessons. It will be an opportunity for educators to learn about new techniques, up to date resources including ICT, interactive pedagogy and interactive computer simulations from the Internet.

1.3 Aim of the study

The aim of this study is to use Role Play and ICT to encourage pre-vocational students in Mauritius to learn Basic Astronomy.

1.4 Objectives of the study

The objectives of this study are:-

1. To implement the use of role play and ICT to stimulate learning of basic science at pre-vocational level.
2. To enable learners at pre-vocational level to understand ideas related to Earth and Space through role play and ICT.
3. To evaluate how far teaching and learning of basic science at pre-vocational level is enabled by role play and ICT.

1.5 Research questions

The questions that will be answered through appropriate research tools are:-

1. How far can role play and ICT stimulate learning of basic science at pre-vocational level?
2. What are the constraints facing the implementation of role play and ICT in the teaching of basic science to low ability learners?
3. To what extent the teaching and learning of concepts related to Earth and Space can be achieved through role play and ICT?

2.0 Literature review

2.1 What is being offered in pre-vocational education sector

For the first time there has been a National Curriculum Framework (NCF), in 2009, for Pre-vocational Education in Mauritius. It is a small part of the NCF for Secondary Education.

Some of the aims of pre-vocational education (NCF, 2009) are:

- Enable the holistic development and character formation of each individual learner.
- Foster the ability for understanding, judgement, critical thinking, creativity and self-expression in learners.
- Prepare learners for lifelong learning by developing the necessary mind frame, provide technical and entrepreneurial skills and attitudes.
- Develop functional literacy and numeracy that will serve as the basis for vocational training, apprenticeship or further education.

All these objectives are achieved through four domains:

- (i) **Communication Skills** (English, French, the Arts and Creole language (mother tongue of most Mauritians))
- (ii) **Numeracy and Problem-Solving Skills** (Mathematics, Understanding Nature (Science) & Environment and ICT)
- (iii) **Life Skills** (Values and Citizenship Education, Health and Physical Education)
- (iv) **Livelihood and Trade Skills** (Design & Technology, Home Economics and Entrepreneurship)

This document has established a guideline on what needs to be taught in the pre-vocational sector under the domain of Numeracy and Problem Solving Skills. These are:

- (i) Using ICT as a support for learning
- (ii) Developing basic scientific skills and environmental awareness

Some concepts that are learnt in 'Understanding Nature' in the course of years are:

- i. Basic knowledge about air, water and pollution
- ii. Develop an understanding of human interdependence with his environment and the importance of protecting nature and its resources
- iii. Develop and use simple checklists for an audit of resources and develop the 3 Rs principle (Reduce, Reuse and Recycle) to manage these resources
- iv. Characteristics of life; recognise life-threatening hazards and take protective measures
- v. Components of mains, electric circuits; safe and economical use of electricity; renewable and non-renewable sources; adopt measures towards conservation of electrical energy
- vi. ***Model natural phenomena and occurrence of day and night, illustrate the place of the Earth in our solar system; recognise common celestial bodies***

These concepts are supposed to be covered in 4 academic years of exposure to the diluted curriculum proposed in the NCF (2009).

2.2 Background of educators in pre-voc sector

Educators in the pre-voc sector are performing according to what is stated in students' workbooks, with the aid of teachers' guide. Many of these educators do not possess a qualification needed for teaching of low ability students or they have not undergone specific training in the field of special educational needs i.e., remedial education. All of them possess a School Certificate and many of them have a Higher School Certificate. Around 50% of these educators possess a Certificate in pre-voc education and only around 30% of them have a Diploma in pre-voc education. A small number of these educators even have a bachelor degree. These figures show that there are many educators not having an appropriate professional qualification though they all have academic qualification from the university. This lack of teacher qualification is rendering the teaching – learning process more difficult in the prevoc sector.

Another drawback in this sector is the severe lack of resources, which is the cause of poor response from these students. In fact, high quality teaching of science is dependent on the availability of high quality and appropriate resources. Resources are expected to enhance the teaching and learning process. But, more resources are being injected in the mainstream secondary education sector and this is producing two distinct categories of students; one provided with much facilities and the other category left out, though both sectors are being funded by tax payers' money. The NCF (2009) is trying to remedy this chaotic situation in the pre-voc sector.

2.3 New initiatives for pre-voc students

The Ministry of Education is trying to bring prevoc sector and mainstream secondary sector at par in terms of training provided to teachers and resources provided to students. Even the textbooks for the prevoc sector have been revised so that appropriate materials are provided to these learners. Capacity building for inspectors, heads of institutions, educators

(including temporary ones) have been conducted so that they can drive the implementation of the new curriculum and make it a success.

2.4 Use of role Play in science lessons

If the teacher steps into his classrooms with the same kind of planning, usual strategies, similar questions, unchanging resources and evaluation techniques, then it may become very boring for learners, especially if they are low ability ones (Cyparsade, Chummun, Carooppunnen & Moheput, 2011). Teachers should actually have a huge repertoire of strategies, resources and assessment techniques, to enable him/her to teach the intended concept. Role play (Bender, 2005) has been chosen as it is a relatively new strategy and has not been implemented so far at the secondary level (including the pre-vocational sector) in the teaching and learning of science in Mauritius. Actually, learners need focussed and engaging exercises during teaching and learning process. It is also intended to help learners internalise certain abstract concepts through the engagement of more than one sense at a time, through role play (Sharma, 2006).

The key to role-play, and the reason why role-play can help to make science relevant to many children, is that it is based upon 'play' (McSharry & Jones, 2000, p.73)

2.5 Use of ICT in science lessons

The use of ICT in Mauritian classrooms has been introduced since late 1990s (Isaacs, 2007). Several ICT related initiatives have been taken by the Ministry of Education & Human Resources, the Mauritius Institute of Education (MIE) and other stakeholders.

Mauritius has attempted to promote ICTs in schools since the late 1990s which is reflected in its national ICT policy, a segment of which is dedicated to education. (Isaacs, 2007, p.2)

The MIE has introduced ICT in all teacher education programmes as a subject and also as an important support for the teaching and learning process. All pre-service and in-service teachers are encouraged to use ICT in their planning, teaching and assessing tasks. Research has shown that ICT has tremendous potential in enabling meaningful learning.

The introduction of ICT in the school curriculum worldwide has brought a drastic change in the way concepts are taught (Ramma, Dindyal, Kah Chye & Cyparsade, 2006, p.717)

In fact the use of ICT in science lessons help teachers in getting the attention of learners which is very important for learning to take place (Sharma, 2006). It helps in creating and maintaining interest of learners. Mental processes of learners are activated. First-hand experience is obtained through manipulation of ICT tools and software. ICT also enhance

learners' understanding of complex or abstract procedures. It brings a change in the monotonous atmosphere of the certain lessons (Ramma et al, 2006). With these ideas in mind, this study was planned such that ICT would be used to bring about the desired conceptual change in the mind of the pre-vocational learners. However, we should also be cautious on how ICT is used in lessons within a sound pedagogical context so as not to produce more harm than benefits.

2.6 Motivation of young learners / low ability learners

Educators should be aware of how to motivate learners as once motivation is established it is easier to teach.

When people are motivated, they intend to accomplish something ... students' motivation plays a crucial role in science learning

(Sevinç, Özmen & Yiğit, 2011, pp.218-232)

Through this study, there is an attempt to create and maintain the motivation level of students, through multiple representations such as Role Play, use of ICT and of 3D models.

3.0 Methodology

3.1 Participants

The number of students participating in this study, their school, family and geographical backgrounds is as follows:

School description	Location	Student's' background	No. of students participating in this study
School A is an all-girl state owned school.	Village in eastern part of island	Working class families, some are broken families, some single parents	19 girls of form III i.e., age of 14 to 15 years
School B is an all-girl state owned school.	Town in the central part of the island	Working class families, some are broken families, some single parents	12 girls of form III i.e., age of 14 to 15 years
School C is an all-boy state owned school.	Village in the northern part of the island	Working class families, some are broken families, some single parents	15 boys of form III, i.e., age of 14 to 15 years
School D is a coeducational state owned pre-voc school.	Village in the central part of the island	Working class families, some are broken families, some single parents	22 boys and girls of form III, i.e., age of 14 to 15 years

	Students are from different parts of the island	Most students are from middle class or working class to poor families, some are well-off but are not able to study due to certain reasons	All 68 students are aged between 14 to 15 years; given Mauritius is a small island and has a small population of prevoc students, findings of this study can be generalised to a certain extent
--	---	---	---

3.2 Modality of the planning and intervention

The workbooks for students were consulted to find out which topics are included; a unit was selected made which might interest the learners and which is directly related to our daily life and more so something that can be taught through Role Play and ICT. Moreover informal discussions with educators show that learners in pre-voc sector have many misconceptions in Basic Astronomy. This is why Basic Astronomy was chosen. The concepts that students learn at form III level are:

- Our Solar system
- Planets and other bodies
- Relative motions of Sun, Earth and Moon
- Occurrence of eclipses
- Occurrence of day and night on Earth

A set of concepts was chosen and a PowerPoint Presentation was prepared to teach these concepts. The PowerPoint presentation included hyperlinks to:

- Encarta Encyclopaedia (activities found in the science zone in Encarta Kids)
- Colourful photographs related to these concepts along with artists' impressions
- Interactive simulations and video files from the internet showing various celestial bodies and their motion

Along with these ICT resources, it was planned to use Role Play to demonstrate the ideas of motion of the moon around the earth, simultaneous motion of the moon around the earth and motion of the earth around the sun; motion of planetary bodies around the sun, and also the occurrence of day and night on the earth.

All these topics were taught to each of the four groups of students in two periods of one and a half hour each. The session started by a pre-test with the following questions: name a planet, what is a planet, what is space, what is the shape of the Earth, what is a Solar System, how many planets are there in our Solar System, name the planets found in our Solar System, what else is there in the Solar System, what is a Star, what is a Moon, what causes day and night on earth, name some items found outside our Solar System, draw a star to scale on the diagram shown (Sun, Earth & Moon).

The pre-test was in simple English language but only textual information was sought through this worksheet. When the scripts were collected, it was found that most students could not answer even the simple questions. They did not understand the questions.

They were then asked the same questions orally and sometimes in their mother tongue (L1) which is Creole. It was found that they were able to communicate more fluently in L1 and answer questions. It was also found that once L1 was used, students were ready to talk freely on the topic, they even asked questions to the resource persons. Gradually they became much enthusiastic and the students interacted to a large extent.

The next step was the PowerPoint Presentation on basic astronomy using laptop, LCD projector, computer simulations, pictures, and also role play, low cost 3D models made by resource persons and flash cards were used. The first session started with the pre-test, continued with the discussion and presentation that lasted about 60 minutes. This presentation continued during the second session for one hour on another day, and ended with the post tests.

3.3 Tools used in this study were:

- Pre-test; written test with 13 structured questions used to test prior knowledge of learners on basic astronomy
- Oral intervention and PowerPoint presentation with discussions/interactions between researchers and learners and among learners
- Use of role play to depict certain concepts, Creole language to ease understanding of ideas put forward, computer simulations to make concepts visual, to make learning meaningful and to engage students
- Post-test on the same topics as above to test how far the interventions have facilitated the understanding of the concepts
- Second post-test on the same topics, using a worksheet with lots of visuals where students just had to label several diagrams and give very short answers; this was used to test the difficulty with English language. It was intended to find out whether the diagrams were enabling students to understand the questions better and to recall their answers
- Focus group discussion with a group of students from each school
- Interviews with educators working in pre-voc sector and of pre-voc pedagogical inspectors

3.4 Role play

These concepts were taught through role play:

- Earth – Moon system
- Sun – Earth – Moon system
- Solar System (only Sun and 8 planets)
- Occurrence of day and night

3.4.1 For the earth – moon system two students of different heights and sizes of body were involved. The small one represented the moon and rotated around the larger body representing the sun. They ensured that the path of the moon was more or less circular. I asked students whether it was right what some students were performing. Very few could suggest that the earth should spin at the same time.

3.4.2 For the sun - earth – moon system three students of different heights and sizes were involved. The small one represented the moon and rotated around the larger body representing the earth, while the earth was moving around the sun and spinning slowly at the same time. They ensured that the path of the earth and the moon were more or less circular. Several groups of students tried the activity and performed well.

3.4.3 For the solar system a group leader was assigned, s/he was asked to work along with other 10 members of the group to perform a role play to show how the planets move around the sun. They had to prepare word cards on which the sun or the name of a planet was written. While doing the role play they were asked to express which celestial body each one represented. E.g., “Hello friends, I am the sun; all the 8 planets rotate around me. I do not move”. In some cases they expressed in English or French but mostly in Creole. Even the motion of the moon was depicted by a student of smaller size. Given the space was limited inside the classroom, learners were asked to move out. Students were hesitant so very few groups were able to perform this part. They were not forced to do so. However, students readily expressed how this activity may be done if a large space available.

3.4.4 The modelling of occurrence of day and night was also demonstrated through role play. Students were taught this concept using a model of earth (a globe set on a rotating stand) and light from the LCD projector representing sunlight. The researchers used three basic principles in this explanation. First students discovered that earth is an opaque body, so light cannot travel through to illuminate the side not facing the sun. They then discovered that light travels in a straight line so light from the sun cannot illuminate the whole surface of the globe at one instant. The third idea was to make them understand why the occurrence of day and night is dynamic, i.e., why countries which experience night at one time, experiences daylight after sometime. This was answered by students as the earth rotates on itself and it takes about 24 hours for one turn. So bearing in mind these three explanations, the occurrence of day and night was explained.

After viewing this model, students were asked to reflect in groups about how they can use role play to demonstrate the occurrence of day and night on the earth. It was a difficult task for these learners. In some groups, students were able to manage the role play using a lit torch in front of a student, who would spin slowly. When the light fell on the face of the student, s/he would say “day time!” and when there was no light falling on the face of the student s/he would say “night time!”. This model was chosen for the whole class discussion.

4.0 Findings of the study

4.1 Pre-test

During pre-test learners were not very enthusiastic as they could not decipher the questions. The classroom teacher tried to explain the questions in Creole and asked them to write answers in Creole if they cannot manage with English. Then the enthusiasm increased slightly. This shows that language is still a strong barrier to them in the learning of science. Many students could not imagine of any other planet's name apart from Mars. During the focus group discussion they suggested that they have watched the movie "Mars Attacks" so they know Mars is a planet. It was astonishing to find out that very few considered earth to be a planet, for them a planet should be something far and small.

Many worksheets were returned blank or with answers to only the first few questions out of 13. Among the most important misconceptions demonstrated by students we could find the following:

- A star is a planet
- The sun is a planet
- Only Mars is a planet
- Planets are small and far from the earth
- Earth is not considered to be a planet
- A star is a tiny speck of light in the sky
- The moon is a planet
- There are nine planets around the Sun

These ideas have not been grasped by students when they were at primary school, although they learnt a unit on "Earth and Environment".

4.2 Response to the PowerPoint Presentation

Students were very keen to see the laptop and LCD projector because they are not used to these new technologies in their classroom. They said during the focus group discussion that teaching learning resources used in their class are chart paper, wax crayons, scissors, glue, soap and posters that teachers make or ask students to make. They also have an electric kettle. They are not aware of other resources or any ICT facilities. They do not even get access to Biology, Chemistry or Physics lab, which is found in the same school compound, but used for mainstream students, by mainstream teachers. In only one of the 4 schools students stated that they had been to the labs on few occasions, they liked the activities a lot and performed few demonstrations.

Before the presentation, the objectives and content of the lesson were read and explained so that students know what to expect in the presentation. Students were made at ease and informed that they can ask questions whenever in doubt. Students were very enthusiastic as the lesson unfolded through the slides, pictures, animations, links to Encarta encyclopaedia and so on.

There were also some questions that students asked. These were based on what they have heard in everyday interactions or seen in movies. For example: What is "etoile filante" that is, a shooting star?, What is a galaxy?, What holds the moon in the sky?, Is an eclipse dangerous to watch?, what is a meteorite?, etc. All these were answered to the satisfaction

of the learners through the use of Creole and simple English, along with diagrams drawn on the board. At some points in time, students started discussing among themselves regarding the issues raised in the PowerPoint, so they were encouraged to interact with the whole class so that everyone could benefit from any idea or question raised by students.

4.3 Use of low cost 3D model of our solar system

Along with the PowerPoint presentation, students were shown a low cost 3D model of our solar system, how the planets are arranged around the sun, their relative distances and sizes were exposed, even the rotation of the planets around the sun could be demonstrated with the model and eventually a similar model was shown as a computer simulation. Students could interact with the model and see the planets rotate about a central axis. Students inquired about how they could make a similar model at home, given that easily available materials have been used to make it (Cyparsade, 2006; Waldron, 1998). If time would have permitted, students could have been asked to make a model of our solar system, using easily available materials and then present it to the class.

Another marking point in the explanation was when the Creole version of the mnemonic was given, which is used to recall the positions of planets starting from the Sun. They were initially given the English version but this did not attract much attention as the sentence itself was complicated to understand and recall.

My Very Energetic Mother Just Served Us Noodles
Mercury Venus Earth Mars Jupiter Saturn Uranus Neptune

The Creole version that the researcher has devised is:

Mo Voisine Envie Met Juste So Uniforme Nef

Which means:

My neighbour wishes to wear only her new uniform

This sentence is actually related very much to school life of youngsters and has attracted much attention from teachers as well as students.

When this sentence was given on the PowerPoint slide, most students took out their notebook to write it. I asked them what are they writing and why, to which they answered “this is easier to recall”. In fact, during the following session, most students could recall the names of the planets in the correct order from the sun. The trick was to use aspects of their everyday life to teach the unknown concepts. Another hint is that the last 3 planets’ names start with the letters S - U - N (Saturn, Uranus & Neptune), related to the word sun. This would also help students to recall the planets in the correct order from the sun.

The use of the 3D model as well as the role play activities was very helpful for students to understand basic concepts in astronomy.

4.4 Post-test

The first post-test was conducted through the same worksheet used for pre-test. It was planned to verify how far the researchers’ interventions had made the students grasp the basics of astronomy. It was very surprising to see that these students at the age of 14 to 15

years, could not answer simple questions on what was taught. Through the extent of interaction and effort put in, it was expected to show a reasonable degree of conceptual change.

The first post-test was intentionally structured textually so that it may be established whether learning or reading from a book is a big difficulty for these students. This was indeed found to be correct. Students could barely write answers to these textual questions. To be able to assess the understanding of scientific matters by the pre-voc learners, a second post-test was conducted but this time the demand on the linguistic abilities was reduced considerably.

4.5 Second post-test

Only large diagrams related to the topics studied were provided in the worksheets. Students were expected to discuss in groups and then answer the questions by labelling the diagrams and adding a few words to describe what is observed. They were also required to answer some of the questions orally so that their conceptual understanding could be gauged.

The second post-test gave some clues to the difficulties of the pre-voc learners. One of the main drawbacks is their inability to read, to understand and to write few words or phrases. I was tempted to believe that if the assessments were conducted orally and in creole, most students would pass in their science examinations. In the new NCF (2009), it has been proposed to assess students using innovative strategies such as projects, making of artefacts, giving presentations and also oral tests involving L1. Teachers are being trained to teach creole in schools as a subject and also as a support to the teaching – learning process. It is expected that this input might enhance the interest of these low ability learners and motivate them to like their studies, pass out of the pre-voc stream and join a profession or go for vocational training or even set up a small enterprise of their own. This is in line with the objectives set up in the NCF (2009) for pre-voc students.

4.6 Teachers' and Pedagogical Inspector's views

The class teachers and inspectors' views were also collected through interviews. They had to give their comments regarding the lessons, presentations, and interests and interactions of students, behavioural changes in students after the two working sessions. Teachers and inspectors praised the remarkable enthusiasm of students when these innovations were brought to their classrooms. It is only through the personal initiatives of certain teachers that laptops and other innovative tools have been used in pre-voc classes otherwise only the mainstream students benefit from such teaching learning resources.

Students' views were collected through a focus group discussion after the two working sessions and after they had filled in the two worksheets in the post-test. It was found that students are very much interested with the content of 'basic astronomy' as it is directly related to their everyday life. To make the learning of these concepts lively, strategies have to be devised and carefully chosen and resources provided should be very appealing to the students otherwise they get easily bored or distracted and they resort to misbehaviour. The

teacher has to be very resourceful and should be able to develop resources if these are not available. For example, in this case, the development of the Sun-Earth system, the Earth-Moon system, the Sun-Earth-Moon system and the solar system were modelled to ease understanding. A simple 3D model to explain 'day and night' was developed. The relative positions and motions of these celestial bodies were then depicted using computer simulations as well as through role play with learners' involvement.

In fact the learners got so much involved in the discussions and they asked very pertinent questions which normally they do not ask the classroom teachers. E.g., one student asked 'what is a meteorite?' The question was sent back to the whole class to find out if someone had an explanation. Unfortunately most of the learners thought that it is a 'shooting star' so it is a star that has fallen on the earth. Then I explained that it is just very small fragments of asteroids or comets which fall on the earth. However, when I explained how a meteorite can be captured at home in a bucket of water, they were very excited and were ready to try it at home.

5.0 Conclusion

Through the methodology employed, resources prepared and the strategies deployed by the researchers it has been established in this context that role play coupled with ICT usage can indeed stimulate the learning of basic science/astronomy by pre-vocational learners. The constraints may be the language issues and lack of resources, but these issues can be counteracted by creating an appealing learning environment through innovations that suit low ability learners. So we can say that multiple representations are appropriate for the teaching and learning of basic astronomy to low ability learners in the pre-vocational sector.

5.1 Limitations of the study

Only 4 schools with a total of 68 students were studied whereas in Mauritius there are about 3000 pre-voc students. Output of boys and girls were not analysed separately but in future studies this might be taken up. Two sessions of one and a half hour was conducted per group. This appears to be short for a comprehensive lesson designed to teach basic astronomy. Additionally, in this feasibility study, only qualitative analysis has been performed, so further studies are needed to establish a particular theory.

5.2 Recommendations

L1 must be used in explanations as there is a learning barrier which is the content and on top of this hurdle there is another hurdle which is the English language. At least one barrier (language) can be removed or alleviated for appropriate learning to take place. Resources used should be appealing to be able to attract and maintain the attention of these low ability students. Lots of interactions should be envisaged, ample questions should be asked and learners should be encouraged to ask questions to clarify any doubt they have in mind.

Other aspects to bear in mind with pre-vocational learners is the pacing and sequencing of the lessons. Simple activities should be followed by oral linguistic inputs and then followed by active learning techniques to consolidate the concepts learnt.

In order to assess the learning of science concepts among prevoc learners, care should be taken that their poor language skills do not affect their performance. Therefore, when conducting an assessment, language demand should be kept to a minimum. It is recommended to use level-specific tools such as oral tests, demonstration of learning by drawing, labeling diagrams, oral explanations of phenomena and even problem solving by drawings, labeling diagrams, sketches, annotated diagrams, project works and oral presentations. These tools can effectively assess the learning of science without much emphasis on their linguistic skills.

5.3 Acknowledgement:

We wish to heartily thank all the students who have participated in this study, the rectors and educators, for their support, the MIE for providing basic resources for this study.

6.0 References

1. Bender, T. (2005) Role playing in online education: a teaching tool to enhance student engagement and sustained learning, *Innovate* 1 (4), available at <http://www.innovateonline.info/index.php?view=article&id=57&action=article>
2. Cyparsade, M. (2006) "A Critical Appraisal of the Teaching and Learning Materials Prepared and Used in Science Lessons by Primary School Trainee Teachers". MA Ed thesis. Published in the Proceedings of University of Brighton-MIE Annual Research Conference, 2006.
3. Cyparsade, M., Moheput, K. and Carooppunnen, S. (2009) Role play as an innovative strategy to actively engage students in learning physics, Proceedings of the International Science Education Conference 2009, Singapore
4. Cyparsade, M., Chummun, U., Carooppunnen, S. & Moheput, K. (2011) Using role play in the teaching and learning of kinematics at School certificate level, Proceedings of the epiSTEME4 International Science Education Conference 2011, India
5. Isaacs, S. (2007) Survey of ICT and Education in Africa: Mauritius Country Report
6. Mauritius Examinations Syndicate (MES) 2010, Statistics on Examinations
7. Mauritius Research Council (2004) *Report on teaching of science in schools*
8. McSharry, G. and Jones, S. (2000) Role Play in Science Learning, *School Science Review*, September 2000, Vol. 82, No. 298
9. MicroSoft Encarta (2009), Encarta Kids

10. Sevinç, B., Özmen, H. and Yiğit, N. (2011) Investigation of primary students' motivation levels towards science learning, *Science Education International*, Vol.22, No.3, September 2011, 218-232 (accessed at <http://www.icasonline.net/sei/september2011/p5.pdf> on 31 May 2012)
11. National Curriculum Framework for Secondary Education (2009), Ministry of education and Human Resources, Republic of Mauritius
12. Ramma, Y., Dindyal, J., Tan, K.C. and Cyparsade, M. (2006) "*Engaging students to develop conceptual understanding in Physics using ICT*" Proceedings of the International Science Education Conference 2006, Singapore
13. Sharma, R.C. (2006) *Modern Science Teaching*, DhanpatRai, New Delhi
14. Waldron, N. (1998) "Back to Basics for Science Teachers in Rural India", *School Science Review*, Vol. 80, No. 291, pp.77-82.