Presented at the DLSU Research Congress 2015
De La Salle University, Manila, Philippines
March 2-4, 2015

DESIGNING VALIDATED "LARO NG LAHI"-BASED ACTIVITIES IN MECHANICS

Marc Vener Del Carmen*, Ferdinand Diano, Abel Ole
Philippine Normal University
venerbar@yahoo.com

Abstract: Several educational assessments, national and international levels, reflect poor performance of Filipino students in understanding Physics. One possible factor for this is the lack of instructional materials to assist teachers and accommodate students' diverse learning styles. In addition, unavailability of instructional materials in the country's new K-12 Science Curriculum is evident, thus, this present study aims to develop and to validate a compilation of Mechanics activities for Junior high school students which feature "Laro ng Lahi". The influence of game theory, cultural learning and used of science process skills are the underpinnings in the development of the said learning activities with the belief that it will further stimulate better students' academic performance in physics in general and ease in grasping specific concepts by the end of the activity. The developed activities were evaluated in terms of objectives, contents, procedures, illustration/figures/diagrams, language, usefulness, and featured "Laro ng Lahi", using an adapted validation instrument. For the content and face validation, three experts in physics education and one in physical education validated the said activities. Moreover, an independent group of students, which also served as the intact experimental class, were asked to perform the activities for pilot testing. Insights culled from the responses of the validation process revealed that the developed activities may further help teachers in providing a new perspective of pedagogical approach with Filipino cultural - context, likewise it may serve as a collaborative activity, an assessment tool in diagnosing students' prevalent misconceptions and additional supplementary learning exercises for students. Part of the recommendation is to pilot test the activities to respective grade level of target users.

Key Words: Mechanics; Instructional Material; Development and Validation

1. Introduction

1.1 Background of the study

Physics education is vital in ensuring adequate knowledge and skills for every citizen aspiring to actively participate in a democratic society, as well as to the supply, train and update a wide range of scientists and engineers (European Physical Society, 2012). The importance of teaching physics effectively is not new to education institutions, thus curricula are adjusted to deliver the subject in the best manner. Given several reasons, focus on physics teachers' education is a notion to industrialized countries (Sassi and Michelini, 2014). On the other hand, many students still think and say that "Physics is difficult" (Ornek, et. al. 2008). Angell et al. (2004) found that students find physics difficult because they have to contend with different representations such as experiments, formulas and calculations, graphs, and conceptual explanations at the same time. In fact, Redish (1994) pointed that physics requires the ability to use algebra and geometry and to go from the specific to the general and back; making learning physics particularly difficult for many students.

The current state of science education in the Philippines, particularly in the basic education level, lags behind other countries in the world (Orleans, 2007). The Philippines ranked third and fourth from the bottom according to the result of the Third International Mathematics and Science Study (TIMSS),1999 and 2003 respectively (Orleans, 2007). However, Talisayon, et al. (2006) found that Filipino students have a positive

attitude towards Physics which is based on Relevance of Science Education. The same results were obtained by Alimen (2008) in his study on attitudes towards Physics. These contradicting research findings of Talisayon, et al. (2006) and Alimen (2008) with that of Orleans (2007) suggest that the problems encountered by students may not be focused on their attitudes toward Physics but may be due to other factors such as the environment itself and the instructional materials. Furthermore, teachers' academic deficiencies and poor collaboration with physics experts may not result to innovative instructional methods in the absence of instructional devices in the classroom. Consequently, ineffective teaching and learning processes take place resulting to poor transfer of knowledge and skills to students. Unsurprisingly, Filipino students perform poorly in educational assessments, national and international tests (Orleans, 2007).

To start development in the country's education situation, the government leads a major reform through K-12 Basic Education program which recognizes several learning theories. One of these theories is constructivism which is described as knowledge is constructed in the mind of the learner based on one's experiences or by reflecting on one's experiences (Brooks and Brooks, 1999). In a constructivist class, students are actively engaged and one provide rapid feedback and focus on phenomena rather than abstraction (Knight, 2004).

One approach to delivery of learning under constructivism is inquiry-based. In physics education this approach is a laboratory-based, step-by-step, in-depth introduction to the physical sciences which offers students direct experiences with the process of science. It is explicitly designed to develop scientific reasoning skills and provide practice in relating scientific concepts, representations, and models to real-world phenomena (Scherr, 2003). Effective implementation of inquiry-based curriculum materials and instruction can enhance students' conceptual understanding, reasoning abilities and interest towards learning science (Wong et al., 2011).

Another approach in education where students are actively engaged in the learning process is Game theory. It is a branch of decision theory concerned with interdependent decisions. The subject of game theory are situations, where the result for a player does not only depend on his own decisions, but also on the behavior of the other players. Game theory deals with any problem in which each player's strategy depends on what the other players do (Hotz, 2006).

Another theory which gives emphasis on active learning and exposing to the environment is Activity Theory. Unlike Game theory, it does not only focus on games but also allow students to investigate on their surroundings (Popov, 2008). Teaching science, especially physics, outdoors allows students to investigate physical phenomena in the natural settings of their daily life. Students can be trained to see the problems of physics in all reality around them and not restrict themselves to technical applications as they most often do. Students can learn the logic of the laws of physics that govern nature while being in nature. (Popov, 2008). And also, although in games in which the principles are simple, the applications are far reaching (Popov, 2008), thus, the learning is also far reaching.

In the Philippines, local games refers to Filipino indigenous games. Such games used in education will fall to the current trend in education which highlights two-way flow of learning and culture. As UNESCO stressed, education should be global in perspective but localized in approach to bring significant effects on sustainability. Learning according to cultural background could promote sustainability and preservation of indigenous knowledge (Morales, 2014). Aikenhead (2001) reported that cross-cultural strategies or cultural integration provides opportunities for students to learn Western science content taught in the context of local community's traditions. Students' cultural perspectives influence how they construct knowledge while cultural background influences cognitive style and motivation (Morales, 2014). Cultural context of education and cultural background provide an understanding of how and why students react in a particular manner to learning material or learning environment (Mankutty, et al. 2007). With the diverse culture of the Philippines, it can be favorable both to students and teachers to integrate culture in physics education.

A possible context where learning takes place and applied, and with a touch of social and physical environment is through traditional games known as "Laro ng Lahi", also described as a

compilation of traditional games practiced in the Philippines. The term "Laro ng Lahi" was coined by the Samahang Makasining Artist Club Inc. "Laro ng Lahi" are Filipino indigenous games, commonly played by children, usually using locally available materials or instruments (Aguado, 2012). Some common "Laro ng Lahi" are "tumbang preso", "piko", "patintero", "syato", "luksong baka", "turumpo", "dampa", and "holen". These games have potential to serve as a cultural context in teaching Filipino students concepts in physics. If "Laro ng Lahi" can be developed into activities, it can then serve as support materials to the country's new curriculum and help improve students' performance in physics.

1.2 Objectives of the Study

The study aims to develop and validate a compilation of Mechanics activities for Junior High School Students featuring "Laro ng Lahi" entitled Laro ng Lahi: Playing with Physics Concepts.

More specifically, this research aimed to:

- Develop physics activities using "Laro ng Lahi" context.
- Validate "Laro ng Lahi"-based activities in Mechanics.
- Determine the inter-reliability and reliability coefficient.

1.3 Scope and Limitation

The researchers aim to produce a compilation of validated mechanics activities that features "Laro ng Lahi". The activities are focused in helping the students create concrete conceptual basis on mechanics and may have limited features on mathematical part. The presented games are the most common games to high school students. These will ensure that the students have schema (rules and regulation, and observed physical concepts of the game) of the game. The "Laro ng Lahi" will be used as the main instrument in the activities. To make it fit to the activities, some of the rules and regulations of the game will be modified. Though, the researchers will try to maintain the heart of the game. The compilation of activities is intended for junior high school students.

This study is limited to design, development, and validation of "Laro ng Lahi"-based activities.

2. Methodology

2.1 Research Design

The main objective of the study was to develop and validate "Laro ng Lahi" based physics activities. Thus, this study can be classified as developmental research type 1. This research emphasizes the study of learning as a result of designing unique instructional interventions (The Design-Based Research Collective, 2003). Type 1 of developmental research study would include phases directed toward first analysis, then prototype development and testing, and finally prototype revision and retesting.

On the other hand, according to Gay as cited by Eslabra (2005), descriptive method is the research method that includes the collection of data in order to test hypotheses concerning the status of the subject of the study. This was use in showing the development of activities based on "Laro ng Lahi" and in presenting the results of the study.

2.2 Participants

Three experts in physics education and one expert in physical education from the Philippine Normal University were requested as validators. One intact class of second year Bachelor of Science in Physics for Teachers composed of 23 students were asked to perform the developed activities for pilot testing.

2.3 Research Instrument

The instrument used in the validation of the developed activities was adopted from a study of Pantig (2013) and modified to be appropriate for the developed material. It assessed the activities in terms of objectives, contents, procedures, illustrations/figures/diagrams, language, usefulness, and featured "Laro ng Lahi".

2.4 Development of "Laro ng Lahi" based Mechanics Activities

The researchers developed eight "Laro ng Lahi"-based mechanics activities for junior high school, two for each grade level, under the guidance of related learning and activity theories, as well as conforming the activities to the new K-12 curriculum. The activities were packaged in an activity book entitled "Laro ng Lahi": Playing with

Physics Concept. It has accessory parts namely: Implementation Guide, Description of Activities, Rubrics, and Over-all Assessment Instrument.

Preliminary validation was done by submitting the initial drafts of "Laro ng Lahi"-based mechanics activities to the adviser for suggestions. Then, initial validation focused on the evaluation done by several professors as experts. Their initial rating were considered, especially their noted corrections, suggestions, and comments, for another revision of the activities.

Pilot test was done to one intact class, where the eight activities developed by the researchers were tried on the same day due to time constraint. Class discussion were not simulated, though the volunteer participants were given time to read the activities beforehand the activity performance. The pilot testing proper includes the execution of the actual activity and answering the activity sheets. After every activity, the students were instructed to record their experiences while performing each activity by answering a given journal. After performing all the activities, the student participants rated the developed activities as well.

The researchers presented the improved activities to the previous expert validators for a final rating. The result of this final expert validation, together with the student participants' rating was used in describing the developed "Laro ng Lahi"-based Mechanics Activities.

2.4 Statistical Treatment

In processing the data gathered, the following statistical treatments were employed: Weighted Arithmetic Mean, Cronbach's Alpha, and Interrater reliability (Kappa).

3. Results and Discussion

Table 1. Overall Mean Rating of the Activity Book

Area	Scores	Verbal Interpretation
1. Objectives	4.75	Highly Acceptable
2. Contents	4.68	Highly Acceptable
3. Procedures	4.81	Highly Acceptable
4.Illustrations, Diagrams and Figures	4.65	Highly Acceptable
5. Language	4.67	Highly Acceptable
6. Usefulness	4.79	Highly Acceptable
7. Featured "Laro ng Lahi"	4.80	Highly Acceptable
Overall Mean Rating	4.74	Highly Acceptable

The table shows the overall validity of the developed activities. The 4.74 overall mean rating shows that there are still rooms for the improvement of the activity but it is already in good shape to be used as Mechanics activities for Junior High School.

Table 2. Measure of Reliability of Students' Ratings- Cronbach's Alpha

Area	Alpha Value (α)	Verbal Interpretation
Overall Alpha	0.90	Excellent

The table shows the reliability of the constructed material based from the ratings of the student participants. The high value of the reliability coefficient α, rated as "Excellent" ascertains that the instrument has a high index of reliability. This further substantiates the data gathered from the validation process. Difference from the alpha values may be due to uneven number of criteria per area.

Table 3. Measure of Interrater Reliability of Experts' Validation

Area	Kappa Value (κ)
1. Objectives	0.58*
2. Contents	0.52*

3. Procedures	0.63^
4.Illustrations, Diagrams and Figures	0.50*
5. Language	0.44*
6. Usefulness	0.67^
7. Featured "Laro ng Lahi"	0.60*
Overall Kappa Value	0.58*

* - moderate agreement; ^ - substantial agreement

The table shows the interrater reliability of the ratings of the four expert validators. The presence of agreement within validators, though moderate, shows that there is a good possibility but by no means a guarantee, that the ratings do in fact reflect the facets they are purported to reflect. On the other hand, the value of kappa which is still several points distanced from an "Almost Perfect Agreement" implies that the ratings have its limitations.

4. CONCLUSIONS

4.1 Summary

The researchers developed eight "Laro ng Lahi"-based activities in mechanics for junior high school. These activities can be performed by junior high school students within the given period of time in a particular high school setting. The expected contents for the competencies of Grade 7 to Grade 10 are covered where the degree of success of students is measurable. Easy to visualize illustrations, diagrams and figures are present to aid and allow students to view concepts from different perspectives and different forms. The language of the activity is easy for students to comprehend and follow because of limited technical terms used and within the context of Filipino students.

"Laro ng Lahi" used in the activities are valid and properly integrated to the concepts, where chosen "Laro ng Lahi" used in the activities are among those most common within Filipino student's cultural or social context. "Laro ng Lahi" as class activity promotes collaboration among students. It also serves as a good source learning experience. The activities can be easily reproduced because the materials used in the activities are indigenous materials.

The developed activities can improve and develop students' critical thinking skills and conceptual understanding in physics which can further arrive with application of concepts to real life situations. It has the capability to elicit and address common misconceptions of students for they are free to explain the line of reasoning of their answers. The activity can also serve as assessment tool for the teacher.

4.2 Findings

The data gathered and analyzed revealed the following:

1. Eight "Laro ng Lahi"-based activities were developed for junior high school, two activities per year level (from Grade 7 to 10). The activities were packaged in an activity book entitled "Laro ng Lahi": Playing with Physics Concept. It has accessory parts namely: Implementation Guide, Description of Activities, Rubrics, and Over-all Assessment Instrument.

2. The developed activities were validated and rated as "Highly Acceptable" by the expert validators.

3. The values of the reliability coefficient α of different areas of the instrument used are all acceptable. The interrater reliability coefficient κ of the ratings of the validators is interpreted as "moderate agreement".

4.3 Conclusions

From the high scores on Objectives, Contents, Procedures, Illustrations, Diagrams and Figures, and Language facets of the activities developed, it can be said that it is fit to be used in science classes for the junior high school of the new K-12 Curriculum. Teachers can use these activities as supplementary activity for instructions on Mechanics. Popov (2008) found that outdoor physics can trigger students' thinking and give them deeper understanding of concepts and methods in physics. With the activity, students will be aided in deal with the pace of the class and even developed certain cognitive skills. The developed material most probably guarantees a time efficient class, where students are expected to grasp specific concepts by the end of the allotted time for science.

The activities developed are validated to have various usefulness. Using the developed activities will not cause any hassle to facilitators since the materials needed on the activities can be provided by the students, and it can be reproduced easily and inexpensively. The activities are as well designed for ease of administering to students; teachers will only guide the students in performing the task. It can also be used as an assessment tool which can be helpful in detecting students' misconceptions. It is also align to the K-12 curriculum assessment scheme where performance based evaluation is given priority.

"Laro ng Lahi" based activities in mechanics can be used as a collaborative in-class activity where students can help one another allowing them to learn easier and can develop their communication skills. On study of Morales (2014) about Culturally-Sensitive Curriculum Materials in Physics (CS-CMIP), she found that students preferred contextualized activities due to presence of collaboration and use of mother tongue language.

The use of "Laro ng Lahi" as an instrument in classroom activities can help to sustain Philippine indigenous games. This is aligned to the Department of Education being a major instrument in implementing and realizing the content of the Section 14, Article XIV of the 1987 Philippine Constitution which states that the state shall foster the preservation, enrichment, and dynamic evolution of a Filipino national culture. Students will be playing indigenous games frequently or even be exposed to such which they are unfamiliar with. "Laro ng Lahi" are indigenous materials thus conforming to RA 10533 which encourages the use of locally produced learning materials; students are more familiar with such materials. Regular use of the developed activities will involve the education sector in the preservation of the country's cultural treasure.

Games in the developed activities allow students to immediately apply skills they acquire that will make them competent and knowledgeable. Thus, with the use of the developed activities, students' motivation and learning will increase.

4.3 Recommendations

The developed activities are intended for the use of junior high school students, therefore it is better to be pilot tested to junior high school students to verify the activities' effectiveness. With that, time restriction can be factored in the evaluation where one activity will be tested using the time allotted to science. Each activities are also designed for different levels, so it is better to administer each activity to appropriate target students/levels.

The researchers advised that the validity of the developed activities be further verified using a standardized instrument, though it should be apt enough.

5. ACKNOWLEDGEMENT

Thank you for the big assistance from Dr. Marie Paz E. Morales and Prof. Brando C. Palomar.

6. REFERENCES

Aguado, D. (2012). The traditional Filipino street games are alive in the Philippines, Retrieved: November 22, 2013, from < http://dickieaguado.wordpress.com/2013/10/03/the-traditional-filipino-street-games-are-alive-in-in-the-philippines/>

Aikenhead, G.S. (2001). Integrating Western Aboriginal sciences: cross-cultural science teaching. *Research in Science Education, 31* (2).

Alimen, R. (2008). Attitude towards physics and physics performance, theories of learning and prospects in teaching. *Liceo Journal of Higher Education Research, 6 (1).*

Angell, C., Ø. Guttersrud, E. Henriksen, and A. Isnes (2004). Physics: frightful, but fun. pupils' and teachers' views of physics and physics teaching. Science Education, 88(5).

Brooks, J. and M. Brooks (1999). The constructivist classroom: the courage to be constructivist. *Educational Leadership*, 57 (3), 18 –25.

Hotz, H. (2006). Introduction to game theory. Retrieved: November 23, 2014, from <http://www.theorie.physik.unimuenchen.de/lsfrey/teaching/archiv/sose_06/softmatter/talks/Heiko_Hotz-Spieltheorie-Handout.pdf>

Knight, R. D. (2004). *Five easy lessons: strategies for successful physics teaching*. New York: Addison Wesley.

Mankutty, S., Anuradha, N.S. & Hansen, K. (2007). Does culture influence learning styles in higher education?. *International Journal of Learning and Change,* 2(1), 70-87.

Morales, M. (2014). Cultural and epistemological profile of Filipino learners. *Electronic Journal of Science Education*, 18 (6).

Morales, M. (2014). Culture and language sensitive physics on student concept attainment. International *Journal of Learning and Teaching*, 6 (1), 1-12.

Morales, M. (2014). The impact of culture and language sensitive physics on concept attainment. *International Journal of Learning, Teaching and Educational Research* 2 (1), 1-29.

Orleans, A. (2007). The condition of secondary school physics education in the Philippines: Recent developments and remaining challenges for substantive improvements. *The Australian Educational Researcher, 34*(1), 33-54.

Ornek, F., W. Robinson, & M. Haugan. (2008). What makes physics difficult?. *International Journal of Environmental & Science Education,* 3 (1), 30 – 34.

Popov, O. (2008). *Developing outdoor physics project using the activity theory framework*. In: GIREP 2008 International Conference. University of Cyprus 18-22 August 2008: Physics curriculum design development and validation, 2008.

Talisayon, V., F. De Guzman, and C. Balbin (2006). *Science Related Attitudes and Interests of Students*. Diliman, Quezon City, Philippines: University of the Philippines.

The Design-Based Research Collective (2003). Design-based research: an emerging paradigm for educational inquiry. *Educational Research*.

Redish, E. F. (1994). The implications of cognitive studies for teaching physics. *American Journal of Physics*, 62.

Sassi, E. and M. Michelini (2014). Physics teachers' education (PTE): problems and challenges. Retrieved November 26, 2014, from <link.springer.com/content/pdf/10.1007%2F978-3-319-00297-2_4.pdf>

Scherr, R. (2003). Implementation of physics by inquiry in large-enrolment class. *The Physics Teacher*, 41.

Wong, D., L. Yam, and P. Lee (2011). A large-scale study on the effect of "physics by inquiry" pedagogy on secondary 1 students' attitude and aptitude in science. Singapore. *NIE Research Brief No. 12-006*