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Physics Concepts Reflected in Ilocano Folk Dances: It's Implications to Contextualized Physics Teaching

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Abstract

Using the document analysis method, this study analyzed and interpreted the steps, movements, and props used in the Ilocano folk dances to determine the Physics concepts reflected in the dances. Furthermore, the study determined the Ilocano culture demonstrated in the Ilocano folk dances with identified Physics concepts. Implications of the concepts and Ilocano culture identified to Physics teaching were also deduced in the study. This study analyzed eight (8) Ilocano folk dances, namely, Binatbatan, Chotis Dingreña, Dinaklisan, Ilocana a Nasudi, Innalisan, Pandaggo Ilocano, Polka Ilocana and Surtido Banna. It also made use of the results of the study of Cubangbang (2017), which is a list of dance steps and terms of Ilocano folk dances, dance literatures from the books of Francisca Reyes Aquino titled, "Philippine Folk Dances and Philippine Dances and Songs," and dance presentations from Ilocos Norte Tourism Department, for the analysis. Analyses and interpretations were based on the researcher's perspective. Results show that the Ilocano folk dances are rich in Physics concepts. Likewise, the Ilocano folk dances reflect Ilocano values such as spirituality, adaptability, social responsibility, nationalism, modesty, and frugality. Moreover, results show that the dances are performed during social gatherings. Further, they depict Ilocano principles such as class-consciousness and chief industries of the different towns of Ilocos Norte like weaving and fishing. Finally, the implications to Physics drawn from the findings include the fact that dances could be used to demonstrate Physics concepts and to develop contextualized and culture-based Physics lessons to enrich Physics teaching.

Keywords: *Culture, Dance Movements, Ilocano Folk Dance, Physics Concepts.*

INTRODUCTION

In an ever-changing society of the 21st century, there is a need to provide students with meta-competencies that go beyond cognitive knowledge in the constantly evolving society. As a result, education must shift from imparting knowledge to helping students develop the personal qualities they need to survive in the future. Students are encouraged to cultivate their critical thinking abilities beginning in elementary school by engaging in activities like observation, experimentation, discovery, and inquiry. One of the foundational disciplines in the K to 12 curriculum is Science. Science connects societal movements like sustainability, industry, and technology. Despite the country's significant push for scientific education from curriculum designers, difficulties with students' subpar performance in Science remain a problem [2]. Physics is perceived by students as a challenging subject since concepts must be linked to mathematical and visual representations. The inability of students to apply the concepts and computations in practical contexts is what makes Physics challenging and complex. Students can answer mathematical problems but are unable to apply the solutions to real-world scenarios [3].

One key tool proven to enhance the conceptual knowledge and boost retention of concepts in Physics is contextualization. The curriculum must be adaptable enough to allow for localization, indigenization, and curriculum enhancement in accordance with each school's unique educational and social contexts [4]. Furthermore, culturally relevant instruction is another way to develop learning motivation to students because it can serve as an avenue to significantly connect ties between conceptual knowledge and the cultural practices where the learner is living. In accordance with the national cultural heritage act of 2009 (RA 1006), the Department of Education should collaborate with the National Commission for Culture and the Arts to develop the cultural heritage educational programs both for local and overseas Filipinos to be embedded in the formal, alternative, and informal education, with a strong focus on the safeguarding, conservation, and preservation of cultural heritage properties [5].

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Dances contribute to the development of a society's culture. Dance is the art of learning techniques and styles of movement to portray an expression, story, or tradition. folk dance, in particular, cultivates bodily awareness as well as the technical and expressive abilities needed to move with self-assurance, creativity, and intelligence. Through dancing folk dances, one can develop a sense of respect for and understanding of the various goals, customs, histories, and cultures of societies by creating and responding as engaged performers and knowledgeable spectators of the dance [6]. Liz Lerman, a well-known dancer, and choreographer, considers Science to be a rich supply of content for her dance company to present. She views her dancers as aiding in the public dissemination of scientific findings and aiding in the public understanding of scientific concepts. Dance groups are increasingly choreographing works around Deoxyribonucleic Acid and the Genome Project.

Dance can tremendously help teach, assess, and learn various fields of Science [7]. The Ilocano culture has a rich background reminiscent of colonial times. Ilocanos take great pleasure in their numerous dances that showcase their diverse customs, beliefs, and rituals. The Ilocano people, being fond of dancing, is evident in their festive celebrations where dancing is one of the main means of entertainment. Most of the dances depict their personalities, goals, and occupations. The dances have been passed down from generation to generation [8]. Ilocano folk dances are mostly performed during rituals and celebrations. The researchers perceived that Ilocano folk dances can be a great source of ideas for contextualization in Physics that has the potential to improve content knowledge to students, applying their knowledge into action while developing the students' sense of cultural appreciation of the Ilocano Heritage.

In the study conducted by Canovan, Cherry, Pledger et al. [9], results showed that the dance-based classes improved key learning prerequisites like interest, duration of involvement, and concentration. The results also showed shreds of evidence of improved memory of knowledge and maintained a post-session desire for topic 5 material. Also, there is evidence that using dancing in lessons could raise the engagement of students who are not typically interested in Science. Teachers may use the dance movements from folk dances, to offer the students a new perspective on Physics concepts other than textbook-based examples [10]. The researchers strongly believes that students can do more, be more motivated, and enhance their scientific literacy by bringing Physics concepts out of the classroom and into the field, specifically by contextualizing Ilocano folk dances.

Although researches are found involving the integration of dances in teaching Physics subjects, there is still a dearth of research on this field and none yet is centered on Ilocano folk dances. In this study, the Physics concepts and Ilocano reflected in the Ilocano dances were explored as well as the implications of the concepts drawn to Physics Education. Specifically, this research was geared to investigate what Physics concepts are reflected in the selected Ilocano folk dances; Ilocano culture demonstrated in each of the Ilocano folk dances with Physics concepts and deduce the implications of the identified concepts and Ilocano culture reflected in the dances to Physics teaching.

The results of this study could provide Physics teachers with useful and practical ideas and practices in teaching Physics to further improve the performance level in the different Physics competencies and nurture their minds through indigenizing Physics concepts. Contextualizing Ilocano folk dances in Physics could provide teachers with a new taste of the subject area. Students' understanding and application of Physics concepts learned. School administrators can benchmark from the results of the study in developing framework in the educational system that strengthens culture-relevant instruction in Physics education as well as other branches of Science. Dancers, particularly Ilocano folk dancers and multi-talented students could also benefit from the results. They would be able to learn more about Physics while engaging in their passion. Curriculum material developers and implementers of the Schools Divisions could be encouraged to integrate cultural dances as an effective and innovative teaching strategy in Physics. Consequently, they could be challenged to make other dance-based lessons in other branches of Science serving as a baseline to encourage 6 teachers to sustain the improved education efforts already started to conform to the demands of the pupils for higher learning endeavors.

MATERIALS AND METHODS

Materials

The researchers analyzed and interpreted the dance terms, steps, movements, and props used in the Ilocano folk dances to determine the Physics concepts reflected in each dance. This was done via a thorough observation of the available video records on the selected Ilocano folk dances of Ilocos Norte compiled by the Ilocano Norte Tourism Department and dance literature of the selected dances from the books: Volumes of Philippine Folk Dances by Francisca Reyes Aquino[17-22] , one book titled Philippine Dances and Songs by the Bureau of Public Schools headed by Francisca Reyes Aquino, and the study of Cubangbang (2017). The dances were selected on the following criteria: nature of the dance, availability of the dance literature, and availability of the documentation of the dance.

Methods

The study is mainly anchored on the Integrative Learning (IL) Theory and Contextual Teaching and Learning (CTL) Theory. The idea behind integrative learning is that students take charge of their own education, developing into critical thinkers who can draw connections between many fields of study and apply critical thinking to real-world issues [11]. Integrative learning is the process of connecting ideas and experiences so that knowledge and skills can be applied to new and complicated problems or situations. On the other hand, the CTL Theory is based on the idea that students make up their own meanings of things as they gain experience, so enhancing their intrinsic drive and desire to learn. According to Giallermo [12], when students reach a point where they apply their contextualized knowledge to the environment in the same proportion that the environment provides it to them, this can result in transformative experiences.

The descriptive research design was used in this study, employing documentary analysis to identify the Physics concepts reflected in the selected Ilocano folk dances. The study involves the analyzation of the steps, movements, and props used in the Ilocano folk dances to determine the Physics concepts reflected in the dances. Furthermore, the study determined the Ilocano culture demonstrated in the Ilocano folk dance with identified Physics concepts. Then, analysis and interpretation of the dance terms, steps, movements, and props used in the Ilocano folk dances to determine the Physics concepts reflected in each dance followed. This was done via a thorough observation of the available video records on the selected Ilocano folk dances of the province of Ilocos Norte. An informal interview with Ilocano folk-dance experts was also done to triangulate the data gathered. The data gathered were collated and tabulated using a researcher-made matrix. The matrix was shown to two (2) Ilocano Folk dance experts for their inputs. After this, the data gathered were shown to the researchers' advisory committee.

RESULTS AND DISCUSSION

Physics Concepts Reflected in the Ilocano Folk Dances

Table 1 presents the selected Ilocano folk dances of Ilocos Norte gathered, analyzed, and interpreted by the researcher. A closer look at the dances specified shows that there are a variety of dance steps and terms present in these dances. The dance steps and terms common to all of these dances are arms in reverse "T" position, do-si-do, four-step turn, chasing step, close step, contra-gansa step, cross-habanera, galop, jump, korriti step, mudansa step , salok, sagamantica step, saludo, slide step, stamp, step, step-hop, three-step turn waltz step, waltz turn, pivot, and kumintang, a unique hand movement found in Ilocano folk dances. Other dance movements were also identified such as clapping, girl sits on the thigh of the boy, arms in lateral position moving sideward, partner hold hands together, forearm turn, and beating of sticks on the floors which are particular to a certain dance.

It can be deduced from Table 1 that the Physics concepts common to the eight (8) dances are Friction, Periodic Motion, Distance, Displacement, Angular Momentum and Angular Displacement, Inertia, Kinetic and Potential Energy, Newton's Laws of Motion, Moment of Inertia, Torque and Center of Gravity and Mass. Other Physics concepts reflected 11 in the dances are Projectile Motion, Work, Velocity, and Sound Propagation. The results of the study are consistent with the results of the study of Van der Veen [6] which

claimed that dance and music of any culture can be utilized to introduce Physics concepts. The results of the study also conform to the study of Capocchiani, Lorenzeni, Michelini, et al. [13], which asserted that dances provide interesting hints to approach Physics concepts, particularly the movements of the dance. Furthermore, the results corroborate with the study of Wulansari and Admoko [14] wherein they identified the Physics concepts in a local dance. They have invigorated that local dances could be a potential source of learning Physics

Table 1. Physics concepts reflected in the different Ilocano folk dances

Ilocano Folk Dances	Basic movements particular to the dance identified by the researcher with Physics concepts	Physics Concepts Reflected in the dance
Binatbatan	Striking sticks on the floor	a. Frequency b. Periodic motion c. Newton's third law of motion
	Raise the sticks 1 foot high from the floor	d. Work e. Gravitational potential energy
	Striking own sticks together	f. Sound and vibration g. Collision
	Kumintang	h. Torque i. Periodic motion
	Stamp	j. Newton's third law of Motion
	Chasing step and *Korriti* step	k. Distance l. Displacement m. Friction n. Newton's Third law of motion o. Velocity
	Jump	p. Newton's Third law of motion
	Saludo	q. Center of gravity r. Center of mass
	The dancer picks up sticks and then executes a three-step turn	s. Moment of inertia t. Angular momentum u. Friction v. Angular displacement
Chotis Dingreña	Partners bow to each other	a. Center of gravity b. Center of mass
	Change step	c. Displacement
	Chotis	d. Newton's Third law of motion e. Work
	Kumintang	f. Torque g. Periodic motion
	Do-si-do	h. Distance vs Displacement
	Galop step	i. Projectile motion j. Distance
Dinaklisan	Girl carries *Bilao* on her waist and executes a waltz step	a. Work
	Waltz Step	b. Displacement c. Inertia d. Newton's third law of motion e. Velocity
	Salok	f. Conservation of mechanical energy g. Torque h. Center of mass
	Kumintang	i. Torque j. Rotational motion
	Cross turn & Waltz turn	k. Angular displacement
	Girl raise *bilao* in front upward and downward	l. Work
Ilocana a Nasudi	Three-step turn	a. Moment of inertia b. Angular displacement

	Girl executes *Kumintang* sideward R and L with torso twist	c. Periodic motion d. Angular displacement e. Rotational motion
	Korriti step	f. Distance g. Displacement h. Velocity
	Pivot	i. Moment of inertia j. Angular displacement k. Friction
	Girl sits on the thigh of the boy	w. Force x. Newton's laws of Motion
Innalisan	*Saludo*	a. Center of gravity and Center of mass
	Change step	b. Distance c. Displacement
	Three-step turn and Four-step Turn	d. Friction e. Angular displacement f. Angular momentum
	Mincing step	g. Friction
	Pivot	h. Moment of inertia i. Angular momentum j. Angular displacement
	Dancer steps R sideward and kicks L foot sideward (for Boys)	k. Kinetic Energy l. Velocity
	Clapping	m. Sound propagation
	Partners hold hands together	n. Heat Transfer
	Chasing step	o. Velocity p. Distance and Displacement
	Galop step	q. Projectile motion
Pandanggo Ilocano	Walt Step	a. Distance b. Displacement c. Inertia
	Forearm turn	d. Angular displacement
	Mudansa Step	e. Moment of inertia
	Three-step turn in place	f. Friction g. Angular displacement
	Do-si-do	h. Distance i. Displacement
Polka Ilocana	Galop steps to the right	a. Projectile motion b. Acceleration
	Three-step turn	c. Angular momentum d. Friction e. Angular displacement
	Kumintang L, R alternately	f. Periodic motion g. Rotational motion h. Torque
	Contra-ganza step	i. Newton's Third law of motion
	Boy claps his hands when pointing the foot	j. Sound Propagation

	Slide step	k. Friction
Surtido Banna	Step R across L in front and raise L foot in rear	a. Balance and Center of Gravity
	Arms in lateral position moving sideward R and L alternately	b. Angular displacement
	Stamp	c. Newton's third law of Motion
	Waltz	d. Inertia e. Newton's third law of motion
	Four-step turn	f. Angular displacement
	Salok	g. Conservation of mechanical energy h. Torque i. Center of mass
	Close step	j. Simple machines- Second Class lever k. Distance l. Displacement

Results of the study on Table 2, proves that Ilocos Norte province has a strong cultural legacy. The people's values reflect their long-standing customs and way of life. The common values of the Ilocanos closely relate to the DepEd core values of human dignity and its related values of love, spirituality, social responsibility, nationalism, and economic efficiency that are really evident in the dance movements and dance steps. In support to the above findings, Malaluan and Masangcay [15] stated that one of the key objectives of Science education is the preservation of Philippine culture, which has been eroding in students' ideals as a result of technological improvements. Culture-based pedagogy can help achieve this goal. Culture can be incorporated into Science lessons by employing a universally understood native language, cultural practices and traditions that have significant scientific connections, and methods and techniques that are consistent with local traditions and values.

Ilocano Culture Reflected in Ilocano Folk Dances

Table 2. Ilocano Culture reflected in the Ilocano folk dances.

Ilocano Folk Dance	Ilocano Culture Reflected *(Principles, Beliefs, Practices, Values, Attitudes, and Occupation)*	Physics concepts reflected in the dance
Binatbatan	Depicts the primary industry in Paoay, Ilocos Norte which is weaving or also called *pinagabel.* ▪ The dance illustrates Ilocanos' love for hard work and perseverance. ▪ The dance steps intricate the merrymaking of the weavers in Paoay, Ilocos Norte. ▪ *Saludo* a dance step used in the dance portrays that Ilocanos are courteous and respectful. ▪ *Kumintang* displays the frugality and thriftiness of the people from Ilocandia ▪ *Korriti* step portrays how fast Ilocanos can adapt to any challenges they may encounter. ▪ The chasing step depicts that Ilocanos are Jolly in nature.	▪ Frequency ▪ Periodic motion ▪ Newton's third law of motion ▪ Work ▪ Gravitational potential energy ▪ Sound and vibration ▪ Collision ▪ Torque ▪ Distance ▪ Displacement ▪ Friction ▪ Velocity ▪ Center of gravity ▪ Center of mass ▪ Moment of inertia ▪ Angular displacement
Chotis Dingreña	▪ The dance is only performed by elite families and people during big social gatherings. ▪ The dance illustrates the class-conscious attitude of Ilocanos. ▪ Saludo, a dance step used, portrays that Ilocanos are courteous and respectful	▪ Center of gravity ▪ Center of mass ▪ Displacement Torque ▪ Periodic motion ▪ Distance
	▪ The basic movement Arms in reverse "T" position, interpret the Ilocano women's reserved and modest nature.	
Dinaklisan	▪ The dance portrays the chief industry of the people from	▪ Work

	Currimao, Ilocos Norte which is *pinagdaklis* or fishing. ▪ The dance also depicts the sense of togetherness of the people from Currimao. The dance displays how appreciative the people are for the blessings they receive from the seas.	▪ Displacement ▪ Inertia ▪ Newton's third law of motion ▪ Velocity ▪ Conservation of mechanical energy ▪ Torque ▪ Center of mass ▪ Torque ▪ Rotational motion ▪ Angular displacement
Ilocana a Nasudi	▪ *Ilocana a Nasudi* translates to "the lovely Ilocana". The dance reflects the traits of a modern Ilocana. ▪ The basic movement Arms in reverse "T" position used in the dance, interpret the Ilocano women's reserved and modest nature. ▪ *Korriti* step portrays how fast Ilocanos can adapt to any challenge they may encounter. ▪ The frugality and thriftiness of Ilocanos are portrayed in the execution of *kumintang.*	▪ Angular displacement ▪ Periodic motion ▪ Rotational motion ▪ Distance ▪ Displacement ▪ Velocity ▪ Moment of inertia ▪ Friction ▪ Force ▪ Newton's laws of Motion
Innalisan	▪ The dance portrays an Ilocano characteristic which is *"Innalis"* which means to transfer from one location to another.	▪ Center of gravity and Center of mass ▪ Distance ▪ Displacement Friction
	▪ Ilocanos frequently relocate in search of a better quality of life, as depicted in *Innalisan.* ▪ The chasing step portrays how lively and merry Ilocanos are. ▪ Values of togetherness, tenacity and working towards a common goal are shown in the dance.	▪ Angular displacement ▪ Angular momentum ▪ Moment of inertia ▪ Kinetic Energy ▪ Velocity ▪ Sound propagation ▪ Heat Transfer ▪ Velocity ▪ Projectile motion
Pandanggo Ilocano	▪ *Pandanggo Ilocano* has fluid and soft dance movements portraying the elegance and graciousness of an Ilocano. ▪ *Kumintang* is used in the dance that portrays the frugality of Ilocanos. ▪ The dance is based on two (2) famous Ilocano songs *Pamulinawen* and *Neneng Biagko*	▪ Distance ▪ Displacement ▪ Inertia ▪ Simple machines- Third Class Lever ▪ Angular displacement ▪ Moment of inertia ▪ Friction

Polka Ilocana	▪ The dance is based on two (2) famous Ilocano songs *Pamulinawen* and *Neneng Biagko* ▪ This dance is performed during social gatherings such as birthdays, baptisms, and weddings. ▪ The dance involves a lot of movements such as hoping and turning that depict an active and tireless Ilocano	▪ Projectile motion ▪ Acceleration ▪ Angular momentum ▪ Friction ▪ Angular displacement ▪ Periodic motion ▪ Rotational motion ▪ Torque ▪ Newton's Third Law of Motion ▪ Sound Propagation
Surtido Banna	▪ *Surtido Banna* is performed during social gatherings such as fiestas. ▪ *Sagamantica* is a dance movement wherein dancers move forward and then backwards which portrays value of going back where you came from. ▪ The goal of the dance is to promote peace and development in the province through sharing abilities and resources	▪ Newton's third law of Motion ▪ Inertia ▪ Angular displacement ▪ Conservation of mechanical energy ▪ Torque ▪ Center of mass ▪ Simple machines ▪ Distance ▪ Displacement

Implications of the Physics Concepts and Ilocano Culture Reflected in the Dances to Physics Education

This part of the research discusses the implications of the Physics concepts and Ilocano values reflected in the Ilocano folk dances in Physics education. The implications are organized into three themes, namely, 1) Integration of Ilocano Folk Dances in Physics, 2) Adoption of Ethnoscience approach in Physics and 3) Development of Dance-based Lessons in Physics.

Integration of Ilocano Folk Dances in Physics. This study supports the idea that dances could be used to demonstrate Physics concepts. Dance, which would seem to be a context totally unrelated to Physics, provides highly fascinating insights for approaching various areas of Physics in motivating but not superficial ways. It entails extremely complex and seemingly unexpected movements that Physics can account for by building ever-more-complex models. Hence, dance provides Physics teachers with several opportunities to motivate students while demonstrating how Physics concepts can be applied and visualized. The result of this study confirms that Ilocano 25 folk dances can be a potential source for contextualization and integration of Physics into the curriculum.

Adoption of Ethnoscience Approach in Physics. Physics instructors should socio-culturally contextualize Physics concepts. Furthermore, the outcomes are consistent with the research by Astuti, Sumarni, and Suhaya [16] who discovered that regional dances may be incorporated into Physics classes to help students grasp the fundamental ideas of Physics. By incorporating cultural knowledge such as Ilocano folk dances into Physics education, Ethnophysics seeks to make Physics more relevant, engaging, and accessible to students from diverse cultural backgrounds. This can help students develop a more holistic view of the world and their place in it. Further, this study encourages students to think creatively about how to apply Physics concepts to real-world problems. This fosters creativity and innovation, which are essential skills in today's rapidly changing world.

Development of Dance-based Lessons in Physics. The ability to give students a more engaging and active learning experience is one of the main benefits of incorporating dance into Physics lessons. Dance-based lessons that can be developed from the identified Physics concepts can help to increase student engagement and motivation because they allow them to experience Physics topics in a more concrete and collaborative way. Dance-based lessons can support diversity and cultural awareness initiatives in addition to encouraging involvement and teamwork. The incorporation of dance from various cultural traditions can aid in broadening students' horizons and fostering greater cultural understanding. As a result, students from various backgrounds may find Physics to be more relevant and accessible, contributing to the development of a more inclusive and diverse learning environment.

CONCLUSIONS

Based on the results and discussion presented, it can be concluded that Ilocano folk dances are rich with Physics concepts such as Motion, Torque, Center of Mass and Gravity, Friction, Sound, Inertia, and Energy. Hence, the dances could be used to contextualize lessons in Physics. It is also concluded that the province of Ilocos Norte is rich in folk dances which are part of Ilocanos cultural heritage that illustrate the cultural stories, values, principles, and occupations of the people from llocos Norte. This study further concludes that dances could be used to demonstrate Physics concepts. Students can simultaneously obtain local knowledge about their own culture while learning Physics.

Conflict of Interest Statment

The authors declare no conflict of interest.

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