AST 4: CHEMISTRY SELF-CONCEPTS: GENDER AND CULTURE AND IMPACT OF CHEMISTRY SELF-CONCEPT ON LEARNING BEHAVIOR

ARLYNE C. MARASIGAN, PHD

Chemistry Education Research and Practice

PAPER

View Article Online
View Journal

Cite this: DOI: 10.1039/c9rp00120d

Secondary school students' chemistry self-concepts: gender and culture, and the impact of chemistry self-concept on learning behaviour

Lilith Rüschenpöhler * and Silvija Markic

(i) We could confirm our hypothesis that chemistry self-concept is strongly related to learning goal orientations.

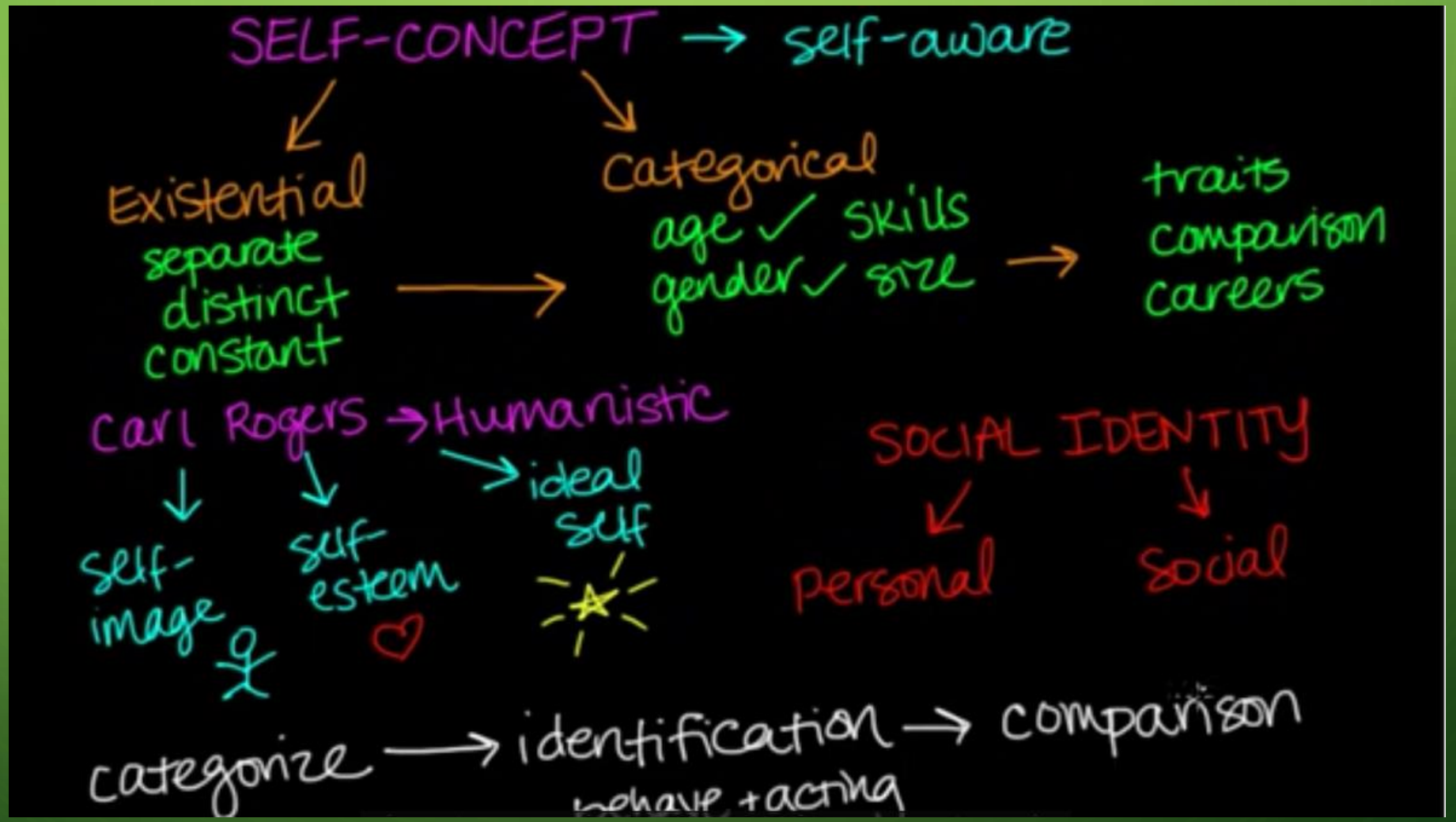
(ii) We investigated the gender relations in chemistry self-concept with a special focus on students' cultural backgrounds. The results show that chemistry self-concept differs from science self-concept: the gender gap traditionally described in the literature could not be found. Instead, the study suggests that an interaction of gender and cultural background might influence chemistry self-concepts.

(iii) We were interested in the influence of the context of the chemistry classroom and language on self-concept.

In line with the literature, we found that a good relationship with the chemistry teacher seems to have a positive impact on chemistry self-concept. Also, the perception of chemistry language and chemistry self-concepts were strongly correlated.

Source: Ruschenpohler, L. & Markic, S. (2019). Secondary school students' chemistry self-concepts: gender and culture, and the impact of chemistry self-concept on learning behaviour. Chemistry Education and Practice. Royal Society of Chemistry

UNDERSTANDING SELF-CONCEPT



- **Self-concept** was measured using an adapted version of the PISA 2006 science self-concept scale (Q37) (OECD, 2009b) with six items in which we replaced the word “science” with “chemistry”.
- We measured the students’ learning goal orientations with three indicators. The first indicator was (i) the students’ need for cognition in chemistry.
- We measured (ii) the students’ perceptions of their task persistence in chemistry with the five-item scale of the PISA 2012 questionnaire (Q36) (OECD, 2014a) in which we inserted “in chemistry” in each sentence

ON SELF-CONCEPT

- In educational psychology, it is assumed that self-concept is closely related to the **social context** in class (Lin et al., 2009; Jacques et al., 2012).
- The **socio-cultural context** has been found to be crucial in the formation of students' self-concepts.
- the self-concepts of minority students have been investigated. Minority students tend to have lower self-concepts than students who belong to a **country's dominant ethnic group** (Leslie et al., 1998; Riegle-Crumb et al., 2011; Woods-McConney et al., 2013; Simpkins et al., 2015).
- The language of chemistry seemed to be perceived as difficult, especially by those students with weak chemistry self-concepts (Ru¨schenp¨ohler and Markic, 2019).

ON GENDER

- In contrast, in biology, **girls** tend to have stronger self-concepts (Nagy et al., 2006).
- The analysis of the data revealed that the main effects of **gender and culture** were **not significant.** This indicated that gender and cultural background alone might not have an impact on chemistry self-concept.

CULTURAL BACKGROUND

72 (12.3%)	Turkish or Kurdish
19 (3.2%)	Italian
17 (2.9%)	Each a Greek, Kosovan, or Polish
10 (1.7%)	Russian
11 (1.7%)	Croatian
9 (1.7%)	Each a Bosnian or Romanian
85 (14.5%)	other migration backgrounds
18 (3.0%)	not specified migration background
50 (8.5%)	multiple migration background
248 (42.4%)	stated not to have a migration background

Appendix

The English version of the survey instrument. Please refer to the authors for the German version that has been used in this study.

Perceived student support

*HBSC 2013/2014 (MQ61) (*Inchley *et al.*, 2016*), "my class" replaced with "my chemistry class"*

1. The students in my chemistry class enjoy being together.
2. Most of the students in my chemistry class are kind and helpful.
3. In chemistry class, other students accept me as I am.

Sense of belonging

*PISA 2003 (Q27) (*OECD, 2005*), "My school is a place where" replaced with "In my chemistry class"*

1. In my chemistry class, I feel like an outsider (or left out of things). (reverse coded)
2. In my chemistry class, I make friends easily.
3. In my chemistry class, I feel like I belong.
4. In my chemistry class, I feel awkward and out of place. (reverse coded)
5. In my chemistry class, other students seem to like me.

Perceived teacher support

*HBSC 2013/2014 (MQ62) (*Inchley *et al.*, 2016*), "teacher" replaced with "chemistry teacher"*

1. I feel that my chemistry teacher accepts me as I am.
2. I feel that my chemistry teacher cares about me as a person.
3. I feel a lot of trust in my chemistry teacher.

Self-concept

*PISA 2006 (Q37) (*OECD, 2009b*), "science" replaced with "chemistry"*

1. Learning advanced chemistry topics would be easy for me.
2. I can usually give good answers to test questions on chemistry topics.
3. I learn chemistry topics quickly.
4. Chemistry topics are easy for me.
5. When I am being taught chemistry, I can understand the concepts very well.
6. I can easily understand new ideas in chemistry.

Incremental theory of intelligence, excluded from analyses Dweck's (2000), *entity and incrementalist beliefs subscales, "for chemistry" added to the sentences*

1. You have a certain amount of intelligence in chemistry, and you can't really do much to change it. (reverse coded)
2. You can learn new things in chemistry, but you can't really change your intelligence in chemistry. (reverse coded)
3. No matter who you are, you can significantly change your chemistry intelligence level.
4. No matter how much intelligence for chemistry you have, you can always change it quite a bit.

Perceived task persistence

*PISA 2012 (Q36) (*OECD, 2014a*), "in chemistry" or "chemistry" added to the sentences*

1. When confronted with a problem in chemistry, I give up easily. (reverse coded)
2. In chemistry, I put off difficult problems. (reverse coded)
3. In chemistry, I remain interested in the tasks that I start.
4. In chemistry, I continue working on tasks until everything is perfect.
5. When confronted with a chemistry problem, I do more than what is expected of me.

Need for cognition

Cacioppo and Petty (1982), *items 1, 4, 18, 23, 40, and 41, "in chemistry" added to the sentences*

1. I really enjoy a task in chemistry that involves coming up with new solutions to problems.
2. I would prefer a task in chemistry that is intellectual, difficult, and important to one that is somewhat important but does not require much thought.
3. In chemistry, I find it especially satisfying to complete an important task that requires a lot of thinking and mental effort.
4. In chemistry, I would rather do something that requires little thought than something that is sure to challenge my thinking abilities. (reverse coded)
5. In chemistry, I would prefer complex to simple problems.
6. In chemistry, simply knowing the answer rather than understanding the reasons for the answer to a problem is fine with me. (reverse coded)

Feeling of understanding chemistry language

Constructed by the authors

1. I understand the texts we read in chemistry.
2. After having read a text in chemistry I sometimes don't really know what it was about. (reverse coded)
3. When my chemistry teacher is talking in class, I can follow easily.
4. In chemistry class, it sometimes seems to me as if they all spoke a language I don't understand. (reverse coded)
5. Chemical equations confuse me. (reverse coded)
6. I find it exciting to work on chemical equations.

Table 1 Mean values, standard deviations, and values for Cronbach's α for all the scales. SRMR and CFI values from the confirmatory factor analyses for all the scales. The incremental theory scale was excluded from further analyses

	Item	*M*	SD	α	SRMR	CFI
Student support	3	4.55	1.14	0.72	0.036	0.978
Belonging	5	4.85	1.14	0.78	0.041	0.939
Teacher support	3	4.38	1.32	0.72	0.059	0.948
Self-concept	6	3.91	1.23	0.91	0.026	0.971
Incremental theory	4	4.24	1.22	0.65	0.122	0.761
Persistence	5	3.81	1.22	0.77	0.057	0.890
Need for cognition	6	3.63	1.43	0.76	0.039	0.951
Language	4	4.30	1.31	0.80	0.018	0.987

RESULTS AND DISCUSSION

- Persistence, need for cognition, and understanding of scientific language in chemistry seemed to be good predictors of students' chemistry **self-concept.**
- Reflection on task choice behavior in small groups of students could be an interesting approach for supporting students' development of a **positive chemistry self-concept.**
- The **social context** in chemistry class seemed to explain only little variance in **chemistry self-concept.**
- Peer relationships in chemistry did not have a significant impact on chemistry self-concept.

- The perception of language **seems** to be closely related to chemistry self-concept.
- Language-sensitive chemistry teaching tends to focus on helping students to address practical challenges in chemistry teaching. The emotional and social aspects of the perception of **chemistry language** tend not to be discussed in class.
- It becomes clear that students' **cultural backgrounds** need to be considered in research using chemistry self-concept as a variable and, in particular, when investigating gender relations and the construction of chemistry identities.

DRAW-A-SCIENTIST TEST (DAST)

- **an open-ended projective test designed to investigate children's perceptions of the scientist.**
- For several decades, researchers have used the “draw a scientist” test to make inferences about the **beliefs and stereotypes that children** hold about scientists (Chambers 1983).
- These **drawings often depict white, middle-aged male scientists with lab coats, glasses, and facial hair working indoors under sometimes dangerous or secretive conditions** (Finson, Beaver, and Cramond 1995). Despite the recent emphasis on equity in science education and particularly women in STEM, **children’s work still resembled that of earlier generations.**

FIGURE 4

Student sketch showing the social nature of science.

FIGURE 5

Student sketch showing a “mad” scientist.

FIGURE 6

Student sketch showing scientist with wild hair.

FIGURE 7

Sketch of a female scientist.

FIGURE 8

Student sketch depicting a female scientist in a dangerous working environment.

FIGURE 9

A student drawing of an African American female scientist.

THE ROLE OF GENDER IN SCIENCE

- In describing drawing someone like themselves, a female student said, "I kind of imagined myself." When asked to elaborate why they drew a male or female scientist, students explained:
- "Usually men are scientists, not women, so I drew a man for my scientist." (male student)
- "Because I just see more men than women. It's just that I've never seen a girl one. And the boys find more things than the girl ones, I think. Like, they figure out more things to fix up." (female student)
- "Because most [scientists] are [men]." (female student)
- "When I usually think scientist, I think man." (male student)
- "I don't really see girl scientists a lot, like on TV. I know they are there. That's just the first thing that came to my mind." (female student)
- "I never saw a scientist on the movies that was a girl." (male student)

THE ROLE OF GENDER IN SCIENCE

- When asked to explain their choice to draw a male or female, a few students emphasized that they knew women can be scientists despite drawing men.
- "'Cause most scientists are male, but the rest are … some can be girls. It's not rare or anything. It's just that I don't think many girls want to be scientists." (male student)
- "A lot of scientists … well, I don't know. I was going to say, a lot of scientists are boys, but that's not true." (male student)
- "[I drew a male] 'cause I was a boy, but I know there are lots of women scientists." (male student)

- SCIENTIST/CHEMIST ANG TATAY/NANAY KO
- SCIENTIST/CHEMIST SI MA'AM/SIR

- When children break through stereotypes in science, they become informed citizens who understand the role of science in society. Breaking through stereotypes also allows children from all gender and racial backgrounds to see themselves (and people different from themselves) as contributors to science.

- The **socio-cultural context** has been found to be crucial in the formation of **students' self-concepts.**

DISPLAYING FILIPINOS PHOTOGRAPHY AND COLONIALISM IN EARLY 20TH CENTURY PHILIPPINES

- Dr. Benito M. Vergara, Jr.
- OBJECTIVE/S OF THE AUTHOR IN WRITING THE BOOK
- To provide a deeper insights into the nature of American colonialism and representation of the Philippines through the medium of photography.
- Combines the approaches of the historian and of the cultural and social anthropologist.

- Two genres, according to sources:
  - 1. travel literature and
  - 2. official colonial documents.

- In both genres, colonial officials, anthropologists, and travelers of different kinds utilized the camera as an instrument of surveillance and display, and imaged the Filipinos as racially and technologically inferior.

2. PHOTOGRAPHY AND TRUTH

- Basic notion of the photograph as the bearer of truth is based on several factors:
  - The camera vision and human vision
  - The attribution of objectivity and authority
  - The authentication of presence/existence
  - The distancing of the producer at the moment of production.


White
Red
Orange


Black
Blue
Green


Pink
Yellow
Black

- The author's analysis of photographs revolved around these issues:
  - Framing
  - Representativity (Decontextualization / (Re)contextualization)
  - Authentication of presence (Possibilities of distortion)
  - The genre
  - The caption

THE TASTE OF EMPIRE

- The relations between colonizers and colonized.
- Allan Sekula: “A photograph communicates by means of its association with some hidden or implicit text.”
- Uncover the underlying master narrative beneath the debris of events and ideas – specifically, within the photographs
- “civilizing process” / “social engineering”
  - Political education
  - Schooling
  - Economic recovery

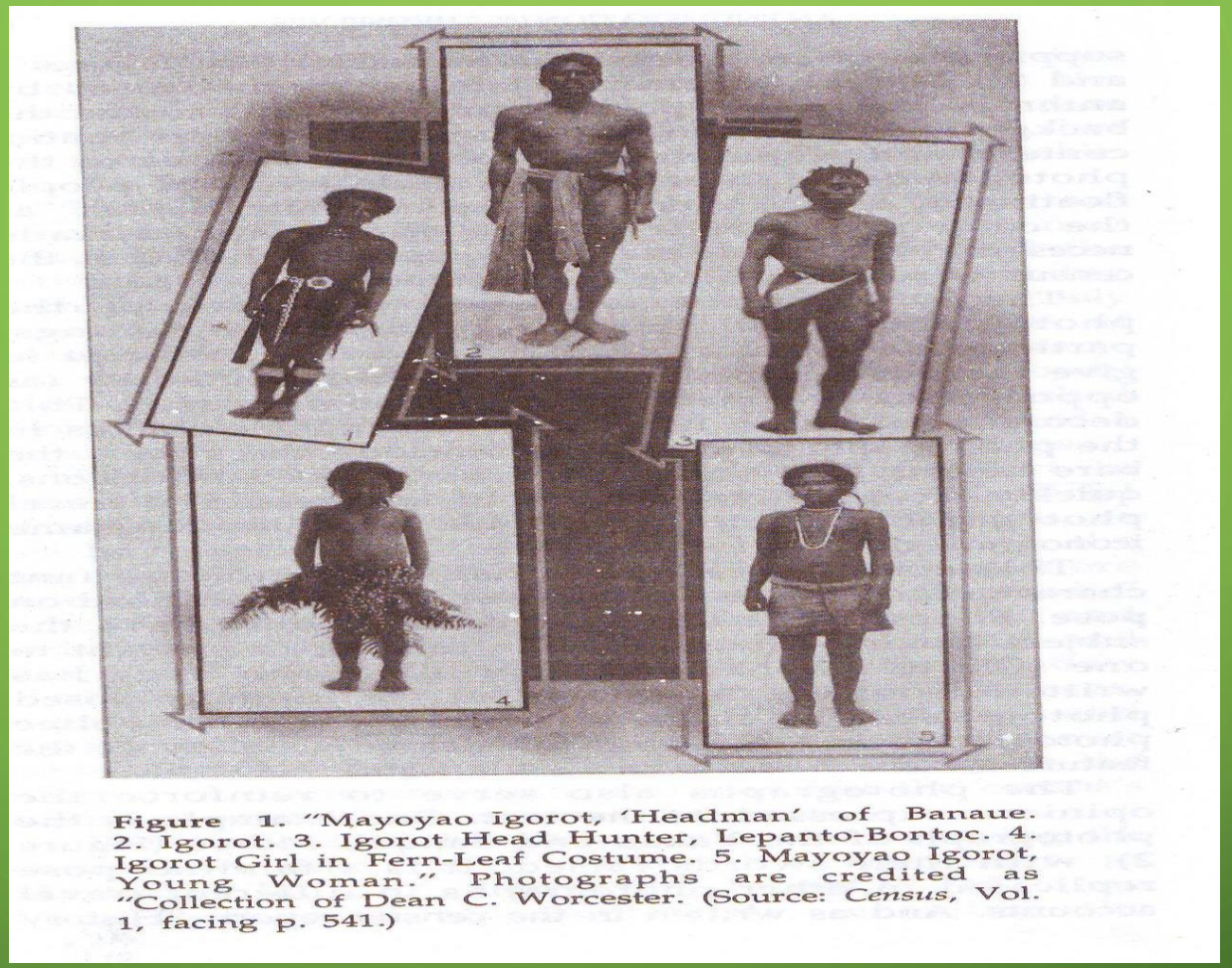


Figure 1. "Mayoyao Igorot, 'Headman' of Banaue. 2. Igorot. 3. Igorot Head Hunter, Lepanto-Bontoc. 4. Igorot Girl in Fern-Leaf Costume. 5. Mayoyao Igorot, Young Woman." Photographs are credited as "Collection of Dean C. Worcester. (Source: *Census*, Vol. 1, facing p. 541.)

- White sheet- depriving the photographs of its spatial context and emphasizes the physical features of the photographed
- The eerie effect of people floating in space
- Decontextualization – loincloth, the sword, the bare breasts – recognizable as a signs of wildness.

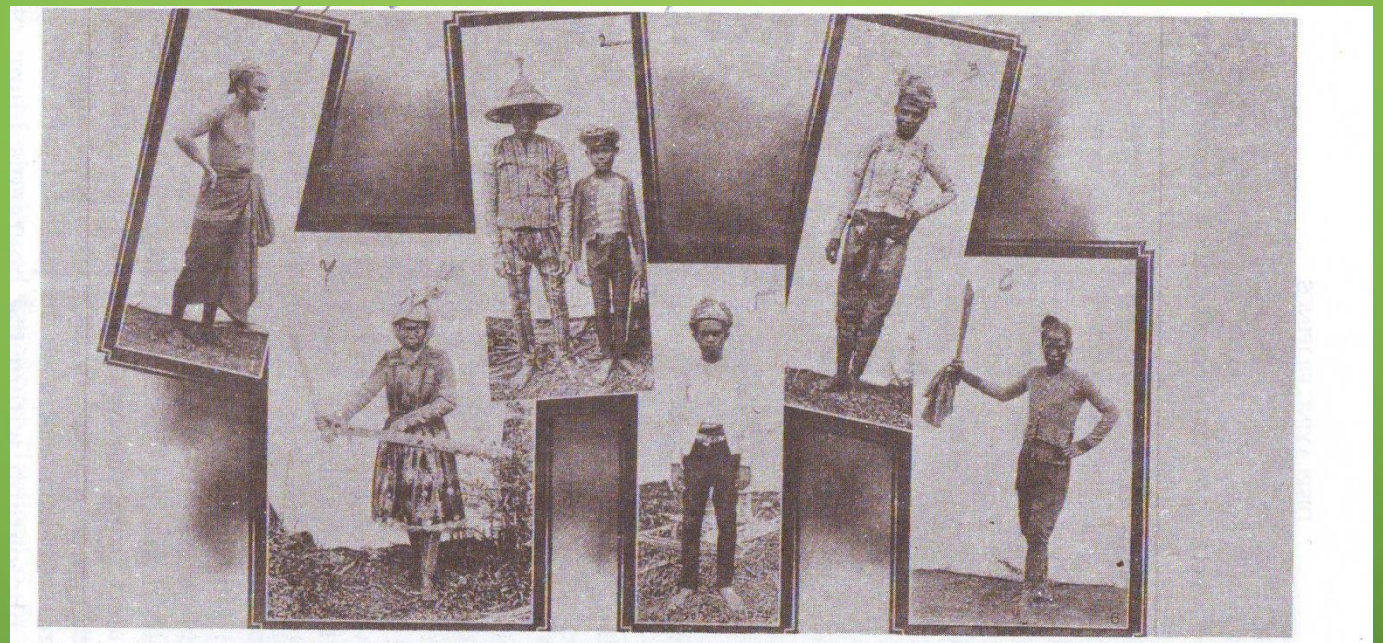


Figure 2. "1. Moro Showing One Way of Wearing the Sarong. 2. Sanguil Moro Warrior in Brass Helmet and Cuirass. 3. Samal Moros, Characteristic Dress. 4. Samal Moro of Zamboanga. 5. Malanao Moro. 6. Yakan Moro." (Source: *Census*, Vol. 1, facing p. 563.)

- White sheet is a reminder of the anthropological beginnings… air of scientific authority…
- Most of the pictures shows individually…
- Consistent doubt on the capacity of the Filipinos to govern themselves…

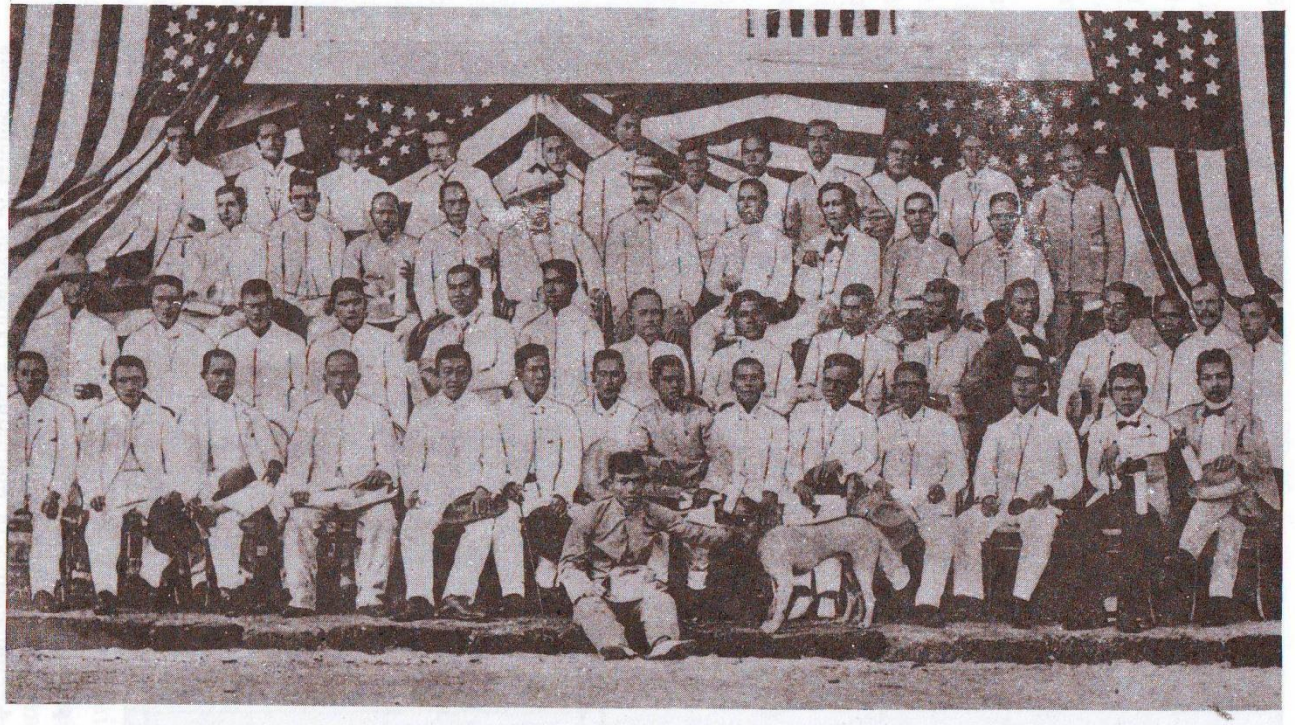


Figure 4. "Enumerators, Province of Sorsogón (Bícols)." (Source: *Census*, Vol. 1, facing p. 450.)

- The symbols of "civilization" conspicuously displayed (hats, canes, the pocket watch chain, the bow ties)
- Ironically, the subjects deprive from individuality… sight of men lost in a flood of white suits

SIGNIFICANT VOICES GATHERED AND USED BY THE AUTHOR IN HIS BOOK

- Patricia Albers and William James call “photography’s basic epistemological premise.” --What one saw in the pictures seemed to look exactly as it would in “real life”
- According to Fred W. Atkinson the Philippines was seen as a vast ethnological laboratory: “an ethnic museum, in which we can study the human race in its manifold forms”
- De Olivares’s book the photographs were the book’s main selling point; in a sense, the written text was only there to elaborate on the photographs. In comparison, the text seemed inefficient, and impoverished, in visualizing “reality”; the photograph was the inevitable substitute.

- Roy Barton expresses regret in his conclusion of The Half-Way Sun: (Most striking passage to me as a reader…
- We have made them raw material out of which to work a national stunt; with government, schools. And a brand of education to them of doubtful value, we are fast destroying a culture incalculably old. Whether they profit more than they lose by we, ourselves attain a higher civilization, we may long – and very keenly – for just such beauty spots of primitive culture as now, in our passion for making folk like ourselves, we are destroying.

DRAW-A-SCIENTIST-PLACE (DASP): A PROPOSAL

- **Culture-Gender-Place ⇔ Self-concepts and Learning Chemistry**
- **Language-Contextualization-Localization-Indigenization**
- Assessing and Understanding Learner's Place (Learning Environment)

- FOUR SEASONS
- Summer
- Winter
- Spring
- Autumn
- TWO SEASONS
- Wet
- Dry

DRAW-A-SCIENTIST-PLACE (DASP)

- THE CHEMISTRY BEHIND (MAKING/PRODUCTION)
- CHEESE
- BEER AND WINE
- DYING OF FABRICS
- TRADITIONAL MEDICINE
- FOOD PRESERVATION (USEFULNESS DURING DISASTER)

- SCIENTIST/CHEMIST ANG TATAY/NANAY KO
- SCIENTIST/CHEMIST SI MA'AM/SIR

INCLUSIVITY…INCLUSIVE EDUCATION

READINESS OF SCIENCE LABORATORY FACILITIES OF THE PUBLIC JUNIOR HIGH SCHOOL IN LANAO DEL SUR, PHILIPPINES

HANIFA T. HADJI ABAS[1], ARLYNE C. MARASIGAN, PhD[2]
http://orcid.org/0000-0003-0708-2988[1], http://orcid.org/0000-0003-2362-7634[2]
hadjiabas.ht@pnu.edu.ph[1], marasigan.ac@pnu.edu.ph[2]
Philippine Normal University, Philippines

ABSTRACT

The Philippine K to 12 science curriculum is a learner-centered and inquiry-based discipline that requires learners to utilize learning materials and learning spaces needed for a meaningful understanding of the scientific concepts and for developing their scientific literacy. This is anchored to the constructivism theory that supports 'learning by doing.' A laboratory is an essential place for active learning and science teaching that would provide students with opportunities to think creatively and critically to solve real-world problems. This study assessed the current status of the science laboratory facilities in two public junior high schools in the province of Lanao del Sur. This is to assess the current condition and availability of laboratory facilities and to identify the challenges faced by science teachers. This study employed descriptive case study method, in which the participants were from two selected schools in Lanao del Sur. A researcher-made checklist of laboratory facilities and semi-structured interviews were used to gather the data. Frequency was used as a statistical tool for quantifying the number of available laboratory facilities and equipment. Based on the findings, both schools have inadequate laboratory facilities that hinder the performance of the activities in the science module designed by the Department of Education. The lack of a laboratory room, the inadequacy of laboratory facilities and science equipment, defective laboratory equipment, the inadequacy of learning materials, lack of water supply, lack of electricity are common issues in both schools. Teacher-respondents of this study have difficulty in teaching some science concepts and are not fully equipped on how to use some science equipment. Addressing the identified challenges is recommended to achieve quality education for all.

Keywords: *constructivism, K to 12 Science, laboratory, Lanao*

INCLUSIVITY…INCLUSIVE EDUCATION

International Journal of Research Publications (IJRP.ORG)

Status of Science Laboratory in a Public Junior High School

Joanna Marie A. de Borja
https://orcid.org/0000-0002-7684-160
deborja.jma@pnu.edu.ph
PhD Science Education Student, Philippine Normal University - Manila, Philippines

Arlyne C. Marasigan, Ph.D.
https://orcid.org/0000-0003-2362-7634
marasigan.ac@pnu.edu.ph
CGSTER Faculty, Philippine Normal University - Manila, Philippines

Abstract

The laboratory is the heart of science in which the individual could put theory into practice. School laboratory is essential to the holistic development of a learner as it involves multiple tasks to understand complex concepts. However, students were not able to perform laboratory experiments and activities as there are issues regarding the adequacy of laboratory materials and apparatuses, class size, time duration of an experiment, available laboratory room, and safety. To address the issues, teachers provide the materials for the students to perform the experiment and/or download YouTube videos of experiments or activities that show the science concepts being discussed. The Department of Education is fully aware of this current condition thus, laboratory activities need not utilize expensive apparatuses and materials. Nevertheless, science and technology in the high school level will not advance unless appropriate materials and laboratory facilities will be provided. Based on this study, teachers suggested that the government should support the funding of Science laboratories and at the same time decrease class size for the students to reach optimum development of learning as they believe that Science experiments will help students to have better retention and appreciation of the science concepts.

Keywords: education, Science laboratory, K to 12 Science curriculum, case study, Philippines

INCLUSIVITY…INCLUSIVE EDUCATION

PEDAGOGICAL PRACTICES OF MULTIGRADE TEACHERS IN CONDUCTING SCIENCE LEARNING ACTIVITIES

JOANNA MARIE A. DE BORJA[1], EIVAN MARK S. SIGUA[2] , ARLYNE C. MARASIGAN, Ph.D.[3]
https://orcid.org/0000-0002-7684-1602[1], https://orcid.org/0000-0003-0041-5110[2],
https://orcid.org/0000-0003-2362-7634[3]
Philippine Normal University - Manila, Philippines[1,3]
Pampanga State Agricultural University, Philippines[2]

ABSTRACT

The world is on the verge of recognizing the right of every learner to quality education and learning. It has been part of the United Nations Sustainable Development Goal (UN-SDG) to open the door of equity education for all children, especially in rural areas. Hence, this research discusses how pedagogical practices of multigrade teachers in teaching Science learning activities are facilitated. The qualitative research design was used in collecting data through document analysis and semi-structured interviews. Five teachers from two multigrade schools in Bataan and Quezon provinces were the key informants. Two major themes emerged in the study, namely: following protocol as prescribed by DepEd and challenges in the pedagogical practices of Science teachers. The challenge of complying with the requirements and protocol posted by DepEd, multigrade Science teachers need to adjust to every aspect of the education process. Thus, the perennial situation of multigrade schools made them lag in terms of pedagogical practices as compared to monograde given the limited budget allocated for multigrade schools. However, multigrade teachers are observed to be creative and resilient.Finding revealed that majority of the multigrade teachers need to provide learning materials out of their own pockets to make Science learning activities possible. This study recommended revisiting the policy on School Maintenance and Other Operating Expenses (MOOE) of multigrade schools. In addition, training to multigrade teachers should be conducted so that these teachers will be better equipped with the necessary tools in teaching multigrade Science learning activities.

Keywords: multigrade teachers, multigrade learners, Science learning activities, teachers' training

- Reflect on…
  - Physical Environment (Place –Rural & Urban)
  - Technology Available
  - Race/Ethnicity
  - Gender
  - Inclusivity

HOW ABOUT OUR TEACHERS SCIENCE/CHEMISTRY SELF-CONCEPT? ☺

REFERENCES

- Kelly, L.B. (2018). Draw a Scientist: Uncovering students' thinking about science and scientists. Available at: https://www.nsta.org/draw-scientist
- Ruschenpohler, L. & Markic, S. (2019). Secondary school students' chemistry self-concepts: gender and culture, and the impact of chemistry self-concept on learning behaviour. Chemistry Education and Practice. Royal Society of Chemistry
- Vergara, B. M. (1995). DISPLAYING FILIPINOS: Photography and Colonialism in Early 20th Century Philippines. University of the Philippines Press