Development of differentiated activities in teaching science: educators’ evaluation and self-reflection on differentiation and flexible learning

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Abstract. This study determines the evaluation of educators to the developed differentiated activities in the learning module. Developed differentiated activities for grade-seven science class were assessed and evaluated by educators. Three academic administrators, two of which are science teachers, six junior high school science teachers of La Salle Academy and four in-service Department of Education teachers participated in this research study. Through mixed-method research design, where quantitative designs, weighted-mean, independent-sample t-test and standard deviation analysis, the comparison of evaluators’ ratings in a DI and Non-DI Learning Module were determined. Findings showed that, the developed Learning Module with Differentiated activities received very good to excellent ratings from the evaluators. Based from their ratings, teachers significantly gave higher ratings to the Developed Differentiated Learning Module compared to Non-DI Learning Module. Furthermore, results in their self-reflection indicated that educators see the Developed DI-Learning Module as opportunity and avenue of students to develop the values of patience, teamwork and safety. Thus, these results were discussed in relation to making teachers equipped in using differentiated and flexible learning teaching strategies and practices that may contribute to closing the achievement gap among Filipino students.

1. Introduction
Contextualization and flexibility anchored to students’ learning styles, needs and interests play an important role in enriching learning experience for each and every student. Today’s classroom consists of variance of learners with different personalities, needs and backgrounds. And over the years, educators and curriculum makers continue to assess and reassess the learning processes where students learn best. If you are a seasoned teacher, you learn based from your experience that there is no best strategy and method to reach all students in your class. This struggle among educators, pointed to the direction of the topic of differentiation in education. Differentiated instruction is recognized to be a compilation of many theories and practices related to effective teaching and its link to student achievement. It requires a departure from traditional methods of teaching and the belief that learners
vary according to readiness, ability, motivation, and interest. It is teacher’s approach as to how he/she ensures learning in his/her classroom. “It means teachers proactively plan varied approaches to what students need to learn, how they will learn it, and/or how they will show what they have learned in order to increase the likelihood that each and every student will learn as much as he or she can, as efficiently as possible” [1] [16]. At its most basic level, differentiating instruction means “shaking up” what goes on in the classroom so that students have multiple options for taking in information, making sense of ideas, and expressing what they learn [2].

With this, Filipino teachers are challenged to address the diversity of Filipino students, and to accommodate these differences as they motivate their students to learn [3]. Concepts and skills in science can be differentiated based on several different factors [4]. Such as, utilizing a variety of instructional delivery methods, use of flexible grouping and small-group instruction on a regular basis, have a variety of materials, resources, and texts available for student use and by varying the degree of complexity of laboratory investigations, have students create agendas by choosing from suggested activities, tasks, and projects, utilize complex instruction, engage students in role play or simulation activities, develop learning stations, engage students in orbital studies and differentiate assessment tools.

In his study entitled: “Studying the Effects of Differentiated Instruction in the Science Classroom, Rojo [5] found out that the use of differentiated activities does have a very important place in the classroom to, at the very least, improve the level of student confidence and assurance. There is not much empirical data on its use and implementation in Philippine classroom setting. Most of the Filipino teachers are still engaged in traditional instruction, in which one lesson is designed to meet the needs of all learners, and these teachers think they are using differentiation but are actually not [3]. This motivated the researcher to conduct this study, which is aligned to the study of Rojo [5] entitled: “Studying the Effects of Differentiated Instruction in the Science Classroom”. Unlike Rojo’s study [5], the researcher wanted to determine the evaluation of educators in the developed Differentiated Learning Module It is different from other previous studies because this researcher developed a Learning Module and acquired educator’s evaluation and self-reflection which could be an opportunity to draw out their readiness to accept and embrace the different differentiated strategies that will target 21st century learning styles and intelligences of students. Differentiated activities were varied and are contextualized to students’ household and community giving students choices, opportunities and avenues to excel, enjoy, and find meaning, interest and relevance in their learning. This study sought the answer to this question: What made a Non-differentiated Learning Module better than a Developed Differentiated Learning Module as evaluated by educators? The purposes of this study were to 1) design differentiated, localized and contextualized activities in Science. 2) determine a) evaluators’ comments and suggestions of the Developed Differentiated Activities in the Learning Module b) evaluators’ ratings on the Developed Differentiated Activities in the Learning Module 3) compare evaluators’ ratings between the Non-differentiated Learning Module and \Differentiated Activities in the Learning Module. 4) identify evaluators’ self-reflection on the use of the Differentiated Activities in the Learning Module.

2. Theoretical Background

The concepts and ideas of differentiated instruction or differentiation is connected to the theory of flexible learning. Flexible learning [6] gives students choices about when, where, and how they learn. It denotes that teachers and educators intensively assess, reassess and evaluate instruction continuously and endlessly as shown in figure 1 below.
Figure 1. Flow of Flexible Learning Instruction [7]

Flexible learning is often being referred to as the pace, place, and mode of learning [6]. It is the “adaptability of learning to learners’ needs and circumstances” and the instructor’s role as someone who “monitors, directs, and regulates actions towards goals of information acquisition, expanding expertise, and self-improvement” [7].

This study also integrates the VARK (Visual, Auditory, Reading/Writing Preference, and Kinesthetic) model [8].

Figure 2. The VARK Model [8]

Since it is the educators’ task is to make sure that students learn best, the responsibility to improve and better instruction rest among them. However, contrary to the many studies and researches about “differentiation” and “flexible learning”, we cannot escape the fact that teachers lack trainings and workshops to embrace fully and implemented differentiated instruction inside the classroom. Thus, it is necessary to make teachers and educators aware about this and get data on what they feel about this new movement in the educational system around the globe.

3. Methods
3.1 Research Design
In this study, the researcher made use of a mixed-method research design [9] where quantitative, qualitative, and experimental designs are utilized to determine the significant difference in the evaluators’ ratings of Non-differentiated Learning Module and the Developed Differentiated Learning Module.

3.2 Participants
Three academic administrators, two of which are science teachers, six junior high school science teachers of La Salle Academy and four in-service Department of Education teachers participated in this research study.
3.3 Data Gathering Method
Before the development started, the researcher identified from the DepEd’s Curriculum Guide the standards and learning competencies where the designing phase will be drawn out. Secondly, the school’s curriculum was then integrated with the identified standards and competencies of DepEd’s Curriculum. The said competencies and standards are part of the learning progression and learning continuum used by La Salle Academy which is also aligned in the DepEd K-12 Grade 7 Science Curriculum. Face and content validation followed to make the Differentiated Activities in the learning module valid and reliable. Three academic administrators, two of which are science teachers, six junior high school science teachers and four in-service DepEd teachers participated in the evaluation process. Based from the comments and suggestions of the evaluators, the Differentiated Activities in the learning module were revised before its planned implementation. Validated questionnaires were administered to all of the participants to determine their ratings, comments and suggestions accurately. The results from the data gathered were analyzed and treated with utmost confidentiality to ensure reliability and validity.

3.4 Instrument and Scoring Procedure
The researcher used a rubric for rating both the Non-DI and DI Learning Modules. The said rubric was went face and content validation by the evaluators and was also used by Liwanag [10]. The scoring of the instrument ranges from one to four, one as the lowest degree and four of which is the highest. The numerical scale describes the degree to which evaluators have assessed each criterion in the rubric. Another instrument that was used in this study was Self-Reflection (Open-Ended) Questionnaire adapted from Liwanag [10] and was modified to fit in the study. To assure validity, statements in this questionnaire were modified and anchored to measuring the experiences and benefits adapted from the attributes of an effective differentiation activities published by Tomlinson [2].

3.5 Statistical Treatment
The following treatments of data were used in the presentation of the results in this paper.

2.5.1 Independent Sample T-test. This was used to compare the mean score of the evaluators between the Non-DI Learning Module and DI Learning Module.

2.5.2 Weighted Mean. In the presentation of the comparison of ratings of the evaluators of the Learning Modules, the weighted mean was employed and used.

4. Results and Discussion

1. Designing Differentiated, Localized and Contextualized Activities in Science

Table 1. Alignment of Standards and Competencies

| Standards                      | Competency                                    | Learning Targets                                                                 |
|-------------------------------|-----------------------------------------------|-----------------------------------------------------------------------------------|
| some important properties of solutions | investigate properties of unsaturated or saturated solutions | Learners will be able to:                                                         |
|                                |                                               | ✓ Identify saturated and unsaturated solutions                                     |
|                                |                                               | ✓ relate uses of common solutions found at home.                                   |
|                                | express concentrations of solutions quantitatively by preparing different | ✓ Investigate properties of unsaturated and saturated solutions                   |
|                                |                                               | Learners will be able to:                                                         |
|                                |                                               | ✓ describe saturated and unsaturated solutions                                     |
concentrations of mixtures according to uses and availability of materials; solutions ✓ relate uses of common solutions found at home. ✓ Express concentrations of solutions quantitatively by preparing different concentrations of mixtures according to uses and availability of materials through laboratory activity.

Learning Targets

Learners will be able to:
✓ determine properties of mixtures
✓ share distinguished properties of common mixtures found at home and in the community.
✓ give examples of common mixtures at home.

Standards

the properties of substances that distinguish them from mixtures

Competency

distinguish mixtures from substances based on a set of properties

Learning Targets

Learners will be able to:
✓ identify properties of pure substances
✓ describe properties of elements and compounds
✓ share examples, of common substances found at home.
✓ write usefulness of common substances found at home.

classifying substances as elements or compounds

recognize that substances are classified into elements and compounds;

Learning Targets

Learners will be able to:
✓ describe properties of acids and base
✓ investigate properties of acidic and basic mixtures using natural indicators
✓ share common examples of acids and bases.
✓ Relate uses acids and bases in real-life context
✓ demonstrate ways of safety handling with acidic and basic substances

the common properties of acidic and basic mixtures

investigate properties of acidic and basic mixtures using natural indicators; and

Learning Targets

Learners will be able to:
✓ determine properties of metals and nonmetals
✓ compare and contrast acids and base according to their properties.
✓ share common examples of acids and bases.
✓ Relate uses acids and bases in real-life context
✓ demonstrate ways of safety handling with acidic and basic substances

properties of metals and non-metals

describe some properties of metals and non-metals such as luster, malleability, ductility, and conductivity.

Learning Targets

Learners will be able to:
✓ determine properties of metals and nonmetals
✓ compare and contrast acids and base according to their properties.
✓ share common examples of acids and bases.
✓ Relate uses acids and bases in real-life context
✓ demonstrate ways of safety handling with acidic and basic substances

Discussion

Table 1 shows the alignment of the Developed Differentiated Activities to DepEd Grade 7 Science K-12 curriculum. It was designed by the researcher with the evaluation of another Grade 7 science teacher and Science Subject Area Head of La Salle Academy which forms as Grade 7 Professional Learning Community (PLC) Team. It is all about Matter (Substances, Mixtures, Solutions, Acids, Bases, Elements and Compounds). The Learning Module has four stages namely: Explore, Firm-up, Deepen and Transfer. The learning targets were the daily objectives aligned to the standards of the quarter and the learning competencies.
The developed activities were then evaluated by six Junior High School science teachers and four In-Service DepEd teachers participated in the evaluation process. Based from the comments and suggestions of the evaluators, the Differentiated Activities in the learning module were revised before its implementation. Towards the last week after the making of their performance tasks, validated questionnaires were administered both to the controlled and experimental groups to determine students’ perception and motivation level of the instruction they have received. The results from the data gathered were analyzed and treated with utmost confidentiality.

2. Evaluators’ Comments and Suggestions of the Developed Differentiated Activities in the Learning Module.

Table 2. Evaluators’ Comments and Suggestions on the Developed Differentiated Activities in the Learning Module

| Criteria/Standard                  | Summary of Evaluators’ Comments and Suggestions                                                                 |
|-----------------------------------|---------------------------------------------------------------------------------------------------------------|
| Introduction                      | Evaluators commented that in the explore part where introduction is found, performance task must already be presented to make learners be aware what they will be their final output; learners can research or plan ahead of time. |
| Objectives/Goals                  | According to the evaluators, objectives must be in CAP, Cognitive, Affective and Psychomotor. Also, they made comments on formulating objectives that are time-bounded and attainable. |
| Activities                        | Some activities served as assessments, it would be good to label what learning style or intelligence these activities are targeting. |
| Instructional Materials           | Evaluators commented that some instructional materials used terms and examples are moving away from the contextualization and localization purpose of the study. |
| Students’ Engagement, Motivation and Autonomy | There are varieties of ways to have communication and collaboration activities but it was suggested by the evaluators that more small-group activities will be done to ensure engagement and participation of each and every member. Activities such as laboratory activities promote autonomy. Have students formulate their own procedure. |

Discussion
- Table 2 shows the comments and suggestions of the evaluators on the areas of introduction, objectives/goals, activities, instructional materials, students’ engagement, motivation and autonomy. The evaluators’ comments and suggestions suggest that respondents need to know
what to achieve prior to the start of their Science class. Thus, daily learning target(s) that are sequenced in cognitive, attitude and psychomotor was suggested to be included. Furthermore, evaluators emphasized that labeling Developed Activities as to what particular intelligence or learning style it is focused were to be included in the Learning Module. These comments and suggestions of the evaluators aligned to what Mangalio [11] posited that in 21st century or millennial setting, it could now be noted that there is more to classroom instruction and management: it should enhance pro-social behavior and increase student academic engagement and awareness on what to learn; this awareness give students interest and motivation to achieve what is expected from them.

Table 3. Comments and Suggestions of the Professional Learning Community (PLC) Team on the Developed Differentiated Activities in the Learning Module

| Area                   | Summary of Comments and Suggestions                                                                                   |
|------------------------|----------------------------------------------------------------------------------------------------------------------|
| Daily Learning Targets | Members suggested that Learning Targets/Objectives should be aligned to the learning competency. Inclusion of learning competency as one of daily learning targets/objects can be done. – 05/22/18 |
| Assessments            | Rubrics must be attached in the Learning Module and be labeled. – 05/24/18                                               |
| Instructional Materials| To contextualize and localized the knowledge formed, instructional materials such as pictures must be familiar to students. Use brand of soda, students are familiar of example Coca-Cola and the likes. – 06/01/18  |
| Activities             | Self-Regulated activities such as self-evaluation must be varied, not only using checklist, (examples: Emoticons, Sentence Completion, use of Sticky Notes and graphic organizers. – 06/04/18 |
| Process Questions      | Process questions must start with the basic information going to high level thinking-type questions. - 06/07/18         |

Discussion

- Summarized in Table 3 are the comments and suggestions of the Professional Learning Community (PLC) Team Members composed of a Subject Area Head and another Grade 7 Science Teacher. The comments focused on the areas of daily learning targets, assessments, instructional materials, activities and process questions.
- Based from the accumulated comments and suggestions, teacher’s instruction is effective if it is inclusive, caters diversity and contextualization. This connects to the ideology of Levy (2008) cited by Willey [12]. that flexibility in content, process and assessment based on student strength, needs and learning styles is the way for students to succeed.
- Moreover, Viray [13], stated that effective knowledge transmission – that is effective and contextualized activities produce greater connections to students’ understanding and the engagement which connects to the main purpose of this study – flexible and contextual learning.
**Figure 3.** PLC (Professional-Learning Community) Science Teachers giving comments and suggestions on the DI Learning Module

**Table 4.** Mean rating of the Developed Differentiated Activities in the Learning Module

| Criteria                                      | Rating | Description |
|-----------------------------------------------|--------|-------------|
| Introduction                                  | 3.69   | Excellent   |
| Objectives/Goals                              | 3.15   | Very Good   |
| Activities                                    | 3.85   | Excellent   |
| Instructional Materials                       | 3.46   | Excellent   |
| Student Engagement, Motivation and Autonomy   | 3.92   | Excellent   |
| Overall Rating                                | 3.6    | Excellent   |

**Discussion**

- Table 4 presents the ratings given by the expert evaluators on the developed Differentiated activities based on the identified criteria. All of the criteria were rated Excellent except for the Objectives/Goals which were rated as Very Good. Based from the overall rating of 3.6 which is Excellent, it can be said that the experts agreed that the developed Differentiated activities in the Learning Module was well developed. The result of the ratings connects to the study of Bernardo, et. Al [14], that perceptions of science classes in the Philippines is brought about by five factors, two of which are a) student-centered activities and b) science inquiry activities. These two factors were found in the activities and instructional materials included in the Developed Learning Module.
3. Comparison of the evaluators’ mean ratings between the Non-differentiated Learning Module and Differentiated Activities in the Learning Module.

![Figure 4. Comparison of the Mean Ratings of the Evaluators between the Non-Differentiated Learning Module and Differentiated Activities in the Learning Module](image)

Discussion

- As seen in the result of evaluators’ ratings between the Non-Differentiated Learning Module and Differentiated Learning Module, the Activities and Students’ Engagement were rated excellently in the Differentiated Learning Module. Also, Objectives and Goals ratings were rated almost the same by the evaluators.

- Looking at it closely, the result implies that evaluators give value more to activities that are more learner-centered and foster autonomy. This is in line with the concept of Paris & Paris, as cited in Bergamin et al, [15]. that acquisition, expanding expertise, and self-improvement must first be embraced by teachers as they transfer knowledge to its students.

4. Self-Reflection of the Educators on the use of Developed Differentiated Activities

| Table 5. Self-reflection of Educators on the Developed Activities |
|---------------------------------------------------------------|
| **Responses**       | **F** | **%** | **Rank** |
| **Most Relevant Topics**                                   |
| 1. *Elements and Compounds*                               | 5    | 13   | 4       |
| 2. *Acids and Base*                                       | 8    | 21   | 3       |
| 3. *Solutions*                                             | 4    | 10   | 5       |
| 4. *Proper Handling of Substances*                        | 12   | 31   | 1       |
| 5. *Mixtures*                                              | 10   | 26   | 2       |
| **Most Enjoyable Part of the lesson**                     |
| 1. *Performance Task*                                     | 12   | 30   | 1       |
| 2. *Laboratory Activities*                                | 10   | 26   | 2       |
| 3. *Online Activity*                                      | 8    | 21   | 3       |
| 4. *Buzz-Session*                                         | 3    | 8    | 5       |
| 5. *Poster-Making*                                        | 6    | 15   | 4       |
Discussion

- As seen in the result of respondents’ self-reflection, the top two most relevant topics are Proper Handling of Substances and Mixtures. Respondents viewed doing the Performance Task as an enjoyable activity and having Book Activities as the least enjoyable part. Furthermore, respondents claimed that the values of teamwork, patience and safety could be developed by learners as they will be exposed to Differentiated activities in their Science class. Lastly, respondents suggested that following: more small-group and online activities, longer time for bigger task and suggested more discovery-approach activities.

- Looking this result in a bigger picture, we can connect what (Levy, 2008) cited by Willey [12] posited. Levy affirms that appropriate levels of content vary from student to student. Thus, confining gifted students to the mandated curriculum is just as frustrating to the student who needs more time with core concepts. Therefore, teacher’s role of differentiating the content and being flexible with what is being taught, but keeping sight of the mandated curriculum provides students with the appropriate building blocks they need in order to succeed.

IV. Conclusions and Recommendations

Based on the aforementioned findings and analyses, the researcher concluded that the developed Differentiated activity in the Learning Module is significantly relevant to educators. Results revealed there is a significant difference between the Non-differentiated Learning Module and the Developed Differentiated Learning Module. Thus, the use of the Developed Differentiated Activities in instruction is highly favored by them. With an excellent rating of 3.85, 3.46 and 3.92 respectively in the criteria of Activities, Instructional Materials, Students’ Engagement, Motivation and Autonomy, it is clear that respondents believed that the developed Differentiated Activities in the Learning Module foster learner-centered instruction. Lastly, respondents suggested the following: more small-group and online activities, longer time for bigger task and suggested more discovery-approach activities. With these findings, it is therefore concluded that evaluators see differentiation and integrating flexible and contextual learning strategies to be effective compared to Non-differentiated Learning Module. With this result, the following are recommended: a) the Developed Differentiated Activities in the Learning Module may be implemented in Public Schools to test its effectiveness b) to put emphasis on contextualization, instructional materials especially videos and pictures are better if aligned to one’s culture, tradition and religion. c) collaboration among teachers in the same Area, Department or Level can be done during its implementation of Differentiated Activities to ensure the success.

| Least Enjoyable Part                  |       |       |   |
|-------------------------------------|-------|-------|---|
| 1. CER (Claim-Evidence-Reason)      | 16    | 41    | 3 |
| 2. Book Activities                  | 9     | 23    | 1 |
| 3. Posttest                         | 10    | 26    | 2 |
| 4. Video Showing                    | 4     | 10    | 4 |

| Values Embedded in the Learning Module |       |       |   |
|----------------------------------------|-------|-------|---|
| 1. Patience                            | 9     | 23    | 2 |
| 2. Teamwork                            | 18    | 46    | 1 |
| 3. Safety                              | 7     | 18    | 4 |
| 4. Leadership                          | 5     | 13    | 3 |

| Suggestions for the improvement of the |       |       |   |
|----------------------------------------|-------|-------|---|
| 1. More smaller-group activities       | 8     | 21    | 2 |
| 2. Have more interactive activities    | 5     | 13    | 3 |
| 3. Longer time if making poster slogan | 10    | 26    | 2 |
| 4. Give more discovery-approach       | 16    | 40    | 1 |

activities than teachers’ input
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