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A Case Study: Implementation of Innovative Educational Strategies on Teaching Nuclear Chemistry at the College of Engineering Laguna State Polytechnic University – Sta. Cruz Campus

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Abstract:- The outcome of the evaluation shows the level of students' consistency with the expected learning outcomes and identifies the weaknesses that are present in them for training rationale.

As a result, the data highlight the necessity of the creation of certain instructional techniques that would help the students confront the challenges that arise due to nuclear chemistry. Probably this would improve the understanding p of nuclear structure and properties when jigsaw and practical strategies are used to teach. A noticeable growth of homogeneity between subjects around the engineering specialization spectrum provides an idea of what works best. High marks achieved early may indicate deficits within the domain while progressing uniformly points towards learning needs being unaddressed. Learners' interests and the perception of their knowledge may be enhanced by employing diverse tasking and assessment strategies within the instructional applications. Nuclear chemistry may remain a challenging science that does not motivate students to learn or retain information if its delivery does not change. The action plan is part of follow-up activities like conducting active learning through group work and experiments. Such procedures are reasonable as they provide and support evidence of understanding through feedback. Adjust the existing curriculum as a pedagogical strategy for generating credible new information supported by practical benefits. Impart additional learning and teaching in a way that assists challenged or struggling learners in adapting. Be open and discuss positive outcomes so that students become more self-assured and confident.

As the above recommendations and action plans were also suggested by them, it is expected that engineering students who adopt nuclear chemistry will have their education experiences enhanced. This strategic approach does more than solve the challenges noted but also employs the resources and opportunities available to promote understanding of the subject. It is also expected that these strategies will be subjected to constant evaluation to improve their effectiveness and the students' addresses.

Keywords:- *Nuclear Chemistry, Collaborative Learning, Action Plan, Hands-on Experiment, Real-Life Applications.*

I. INTRODUCTION

A. Internal Environment

➢ *Analysis of Data*

- *General Assessment*

The average result of the participants in the pretest examination was 58.4 correct questions suggesting a depth of knowledge in the concepts of nuclear chemistry but at the same time a deficiency in material understanding. However, as for post-test scores, the learners scored 68.4 and it can be enhanced that the instructional methods used had positively impacted students' knowledge.

- *Discipline Comparison*

Each discipline is reported to increase post-test scores by ten points on average for all engineering disciplines. Such uniformity may suggest that the teaching methods were as effective in all the branches of engineering as was anticipated. Mechanical Engineering students scored the highest pretest mean of 62, gathering that it is the students who had a slightly better perception of the subject than the other students at the start.

- *Challenges of Nuclear Chemistry*

However, all groups scored much lower than seventy, which is typically seen as an acceptable mark while studying Nuclear Chemistry, which then makes this topic hard its learn. This translated into better scores meaning that even though the students described the subject as difficult, they were in a position to understand the lessons when they got proper coaching and study.

- *Implications for Teaching*

The results point to the fact that even more specific approaches in nuclear chemistry teaching need to be adopted because of their complexity. This could include for instance more experiments, models and figures, and or group work. Alternatively, semi-continuous methods like quizzes and formative assessments could also be useful in supporting

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elsewhere which students may be prone to finding difficult thus targeting them.

II. EXTERNAL ENVIRONMENT

➢ *SWOT Analysis*

The SWOT analysis presented here brings a structured way of looking at the benefits and costs of the nuclear chemistry module from the perspective of the engineering students. In our opinion, the analysis of strengths and opportunities, as well as weaknesses and threats, will enable the teachers to bring to the table positive contributions towards enhancing efficiency in the teaching of the subject and achieving better results for the students.

➢ *Strengths*

- **Significant Improvement:** The addition of +10 across the board on each discipline speaks to good quality of training and effective teaching methods.
- **Diverse Engineering Disciplines:** Since the subjects in question included civil engineering, computer engineering, electrical, mechanical engineering, and electronics engineering, varying cross-discipline perspectives of nuclear chemistry may be brought forth.
- **Data-Driven Insights:** The research is in a position to provide statistics that would further enhance the analysis of the teaching methods and the subjects offered in the future.

➢ *Weaknesses*

- **Initial Low Scores:** The average score of 58.4 on the pretest does on the learners may suggest these learners possess nuclear knowledge just enough to cage them in answering the post-test questions efficiently.
- **Uniform Improvement:** Nevertheless, it has been constant over time and for this reason, the +10 may suggest that little effort is made in attempting to tailor the teaching to suit different learners in different disciplines.
- **Perceived Difficulty:** Students' average scores recorded at the pretest for this activity scored average low, which demonstrated that Nuclear chemistry could be a hard course. This can also be a demotivating factor for the students.

➢ *Opportunities*

- **Targeted Instructional Strategies:** They mean that it is possible to suggest the development of specific teaching techniques experiments, and teamwork - due to the account of the intricacies of nuclear chemistry.
- **Continuous Assessment:** Another effective practice is to make use of a quiz or a sub-assessment form which helps in the self-evaluation of the learners and areas considered hard on the part of the learner are identified.
- **Curriculum Development:** Such outcomes can be used in developing updated curricula, and have already been used in cases where students' performance is low in order to enhance students' cognitive ability.

➢ *Threats*

- **Retention of Knowledge:** There is a downside too, for the retention of information about key concepts which are likely to change over time could be a risk factor to the improvements in scores.
- **Student Motivation**: If nuclear chemistry remains a difficult area of study, then it also means that there will be little or no interest and motivation amongst students to study the subject at all, thus reflecting on feedback scores and performance overall.
- **Resource Limitations**: New methodologies and other pertinence in teaching approaches and numerous assessments in a day may necessitate additional resources that may not be available for some institutions.

III. FUTURE DIRECTIONS

Educational institutes can implement these recommendations and action plans to improve the learning experience of engineering students who are taught nuclear chemistry. This does not just solve the problems encountered in the SWOT analysis, it also optimizes the strengths and opportunities to increase the comprehension level of the learners. However, there should be regular assessments of the efficacy of these strategies to guarantee their improvement and allowance for the students' evolution.

Based on the SWOT analysis, here are some recommendations and an action plan to increase the nuclear chemistry knowledge of the engineering students:

IV. RECOMMENDATIONS

➢ *Improved Teaching Approaches*

- Formulate and employ practical activities in nuclear chemistry to develop the subject and in turn, be easier for students to learn.
- Include students in group work assignments and peer tutoring as ways of learning so that they can thoroughly grasp some difficult topics.

➢ *Do Assessments at Regular Intervals*

- Regular quizzes, formative evaluations, and feedback should be approached so that all students and their improvement are being monitored continuously.
- Technology can help in using assessment and feedback tools that assist in giving instant feedback and improving the instructional methods implemented.

➢ *Curriculum Development Planning*

- Update the curriculum so that there are introductory topics that contain a sort of prior knowledge required for the student to be able to understand the advanced topics.
- Introduce nuclear chemical problems that pertain to each engineering field to stimulate the student's interests and motivation.

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➢ *Support Resources*

- Offer extra measures in the form of nuclear chemistry tutoring, reading materials, and other relevant internet sites for students finding nuclear chemistry hard.
- Invite and motivate the faculty for training programs aimed at developing a new approach to the way subjects are taught and how learning outcomes are achieved.

➢ *Foster a Positive Learning Environment*

- Encourage an environment that is geared towards asking and discussing any nuclear chemistry topic to beat any fear that the topic may evoke or cause.
- Use the collection of the accomplishments and the positive changes in students' achievement to increase motivation and self-esteem.

V. ACTION PLAN

Table 1 Action Plan Proposed by the Researcher

Action Item	Responsible Party	Timeline	Resources Needed
Come up with and develop hands-on experiments and projects	Faculty and Curriculum Team	1-2 semesters	Lab equipment, materials
Administer frequent quizzes and tests.	Faculty	Ongoing	Assessment tools, software
Revise curriculum to resolve the gaps in foundation knowledge	Curriculum Development Team	1 semester	Curriculum review resources
Give out tutoring and other forms of additional support	Academic Support Services	Ongoing	Tutors, online resources
Organize faculty development workshops	Administration	1 semester	Training materials, facilitators
Make students feel secure that their learning is inclusive and supportive and participation is rewarded.	Faculty and Administration	Ongoing	Communication channels, events

The table below illustrates the mechanism aimed at improving the practices of the respective institution. Each column serves its purpose, whether it describes particular action items or defines its executors, dates, and the funds available for the required task.

➢ *Action Item*

- **Come up with and develop hands-on experiments and projects:** The main aim of this initiative is to develop amenable learning contexts for the students and through these learning contexts, students can apply what they have learned in theory.
- **Administer frequent quizzes and tests:** The regular aims to gauge the student's understanding of the content taught over a certain period and the effectiveness of learning objectives.
- **Revise curriculum to resolve the gaps in foundation knowledge:** This has to do with the evaluation of the current curriculum to be able to determine lapses in basic knowledge that would contribute to the student's difficulties in understanding.
- **Give out tutoring and other forms of additional support:** This action has the objective of providing more guidance to such students especially when they appear to be struggling and thereby equipping them with the knowledge needed for success.
- **Organize faculty development workshops**: Dissemination of this initiative is useful to improve the faculty members` skills and or the methods used in teaching the subjects.
- **Make students feel secure that their learning is inclusive and supportive and participation is rewarded:** This seeks to develop a welcoming and encouraging venue and mood that will be able to spur the students' involvement and experience.

➢ *Responsible Party*

- **Faculty and Curriculum Team**: Jointly tasked with the development of hands-on projects, drawing on their knowledge from teaching and curriculum development.
- **Faculty:** Responsible for delivery of quizzes and assessments, making sure they are part of the learning process.
- **Curriculum Development Team:** Responsible for reviewing the curriculum, and coordinating educators and specialists so that it is proper and useful.
- **Academic Support Services**: In charge of offering tutorials and supplementary materials and hence, play an important part in student assistance.
- **Administration:** Conducts workshops for faculty development so that they receive appropriate training and materials.
- **Faculty and Administration:** There is a collective responsibility to enhance the learning culture with an emphasis on cooperation between teachers and administrative staff.

➢ *Timeline*

- **1-2 semesters:** Implies a moderate period in which a hands-on learning experiment and projects could be developed to a favorable level for its chances of success to be high.
- **Ongoing:** This will mean that the administration of regular quizzes, assessments, tutoring, etc, and the building of a positive learning atmosphere will be all done on activities with no time frame approach.

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- **1 semester:** A period that is relatively small and settles on the suggested time frame to revise the curriculum and conduct faculty workshops suggesting action should be taken immediately.

➢ *Resources Needed*

- **Lab equipment, and materials:** Enables the students to have the hands-on tools that they would require for practical learning.
- **Assessment tools, and software:** Required for quizzes and other assessments allowing the faculty to assess the performance of students.
- **Curriculum review resources:** Helps the curriculum development team to evaluate and edit some already existing materials.
- **Tutors, and online resources:** Required for the academic support service so that the students can get extra assistance and learning materials.
- **Training materials, and facilitators:** Required for faculty workshops so that the sessions can be organized and informative.
- **Communication channels, and events:** Wanted to ensure that a conducive learning environment is created facilitating the students and the faculty to actively relate while enhancing the community.

In all, this table is also a systematic plan that targets improving the quality of education by defining the actions, the person who is responsible, the time frame, and the resources that would be used. The elements of this overall framework are integrated into each other. Towards this end, all components work towards achieving improvement in students learning outcomes and improvement in faculty effectiveness.

VI. CONCLUSION

To sum up, the application of novel educational technologies for teaching Nuclear Chemistry at the College of Engineering, Laguna State Polytechnic University - Sta. Cruz Campus has greatly improved the student's critical skills. As for the SWOT analysis, critical positive progress is recognized, i.e., the achievement of students and the skill set that revolves around various engineering branches. Nevertheless, the starting low-performance levels suggest a need for tailored approaches that are responsive to the subject problems of nuclear chemistry as the students perceive to be complex.

The opportunities for continuous evaluation and enhancement of the curriculum can be utilized to improve the practice of teaching with the hope that there is a gradual change on the part of the learners. Conversely, the threats of knowledge gaps, lack of student ingenuity, and availability of required resources must be closely monitored to achieve the intended impact. Above all, the key points bring out the rationale for flexible pedagogical strategies and the need for indeterminate resources and support to move nuclear chemistry into an active, efficient, and exciting discipline. Addressing these factors will also allow the College to be able to achieve better educational outcomes and engage the interest to explore this important area of study.

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