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The Impact of Self and Peer Rating Assessments on Conventional Techniques through Cooperative Learning in Project-Based Learning Strategies

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ABSTRACT

CONTEXT

A lot of queries and worries of the existing assessment practices in the teamwork for effective learning of critical engineering courses are undermining the objectives of self and peer rating assessments (SPRA) through cooperative learning (CL) or peer learning (PL) in project-based learning (PjBL). Poor assessment techniques may lead to catastrophic attitudes of teammates inactive due to negative impressions, reduction of their seriousness and focus, influence their competitions within and outside their various teams, and thereby prevent them to achieve the set goals for the course learning outcomes (CLOs).

PURPOSE

This paper examines the impact of self and peer rating assessments along with the standard formal assessment methods of the course lecturer's moderated model answers for the individual assignments, team-based assignments through CL or PL in PjBL in comparison with the current traditional practices for the assessments of paper-based test (PBT) continuous assessments (CA).

METHODOLOGY

Comprehensive assessment sheets for the self and peer rating assessments (SPRA) of the students' behavioral attitudes in teamwork of their team-based assignments (TBA) during CL in PjBL were administered to a cohort of 157 candidates in Process Dynamics and Control (CHEN 502) for 2023/2024 session. The candidates rated themselves and their teammates of 23 different teams thirty-three (33) behavioral attitudes.

OUTCOMES

The scores for the results of individual assignments (IACA) and TBA were analyzed in comparison with the conventional formal assessment techniques for the PBT based on the mean scores with their standard deviations. Detailed discussions of the research findings with their deductions are reported.

CONCLUSIONS

This study discloses the research findings based on the accomplishment of CLOs with respect to the research investigations.

KEYWORDS

Teamwork, Effective assessment, Conventional formal assessment, Self and peer rating, Project-based learning, Cooperative learning or Peer learning.

Introduction

The acquisition of teamwork skills through some of the dividends for the effective peer learning (PL) or cooperative learning (CL) in project-based learning (PjBL) techniques cannot not be overemphasized among the required attributes, capabilities and qualities of Engineering Professionals for the talents survival in today's competitive global labour market environments (Isah et al. 2023; Isah et al. 2022; Al-Hammoud et al. 2017; Murzi et al. 2020; Mahmood et al. 2016; Mujika et al. 2013; Edgar et al. 2006; Cooper et al. 2003; Fruchter, 2001; Felder et al. 2000; Kaufman et al. 1999; Lewis et al. 1998). Peer assessment techniques can be used as promising tools for examining, monitoring, controlling, and ensuring effective performance of teammates in teamwork such as team-based assignments (TBA) by satisfying all the criteria set by the program learning outcomes (PLO) as well as the course learning outcomes (CLO) during PL or CL in PjBL (Aminu et al. 2021; To and Panadero, 2019; Stonewall et al. 2018; Ndoye 2017; Van Zundert et al. 2010; Boud and Falchikov, 2007; Boud et al. 1999). However, there are a lot of queries and worries about the current assessment practices that appear to undermine the goals of PL or CL in PjBL pedagogies in teamwork raised by the educational administrators, consultants, and other stakeholders (Stonewall et al. 2018; Boud et al. 1999). Undoubtedly, poor assessment techniques may lead to catastrophic attitudes of teammates inactive due to negative impressions, affect their seriousness and focus, influence their competitions within and outside their various teams, and thereby prevent them to accomplish the set goals for the CLOs as well as realization of PLOs (Stonewall et al. 2018; Boud and Falchikov, 2007; Boud et al. 1999). The main objective of this conference paper is to examine the impact of self and peer rating assessments along with the standard mode of assessments of the course lecturer's model answers for the unique self (individual) assignments (ICA), team-based assignments (TBA) through CL or PL in PjBL in comparison with the traditional practices for the assessments of paper-based test (PBT) for the components of the continuous assessments (CA) in any kind of program for the semester systems.

Research Methodology

A cohort of 157 students were taught the Introduction to Process Dynamics and Control (CHEN 502) using the combined techniques for deductive and inductive learning pedagogies for the 2023/2024 academic session. For the effective assessment of their team-based assignments during PL or CL in PjBL, comprehensive assessment sheets for the self and peer rating assessments (SPRA) of the students' behavioral attitudes in the teamwork were administered to the cohort of 157 candidates. The candidates rated themselves and their respective teammates thirty-three (33) behavioral attitudes based on contribution to teamwork, interacting with the individual teammates, expecting quality from the teammates' work, keeping the team on track, and having relevant knowledge, skills, and capabilities. The ratings were analysed along with the scores of the team-based and individual unique assignments in comparison with the conventional formal assessment techniques used in the paper-based test (PBT) for the component of the continuous assessments (CA). Moreover, the lecture guidance and facilitation of the course incorporated the elements of active learning for the student-centred teaching and learning the aspects of inductive teaching through PL or CL in PjBL with the aid of Control Station Inc®, a suitable computer-aided learning program (CALP) capable for satisfying most of the requirements by the CLOs as well as PLOs. The topics of the course synopsis included the following skills and capabilities for the CLO:

- ❖ To study process dynamics and control by first introducing the aims, objectives, and tools for process control strategy and defining dynamics and control terminologies,
- ❖ To describe the dynamics of process systems and analyse the responses to forcing functions,
- ❖ To characterize the process dynamics by finding the process parameters: process time constants, process gain, and process deadtime,
- ❖ To study the techniques for linearization and coupling of process systems,

- ❖ To learn the instrumentation techniques for flow, level, pressure, temperature, and composition measurements,
- ❖ To study different types of controllers and the modes of operation for on/off, proportional (P-Only), proportional/integral (PI), and proportional/integral/derivative (PI&D),
- ❖ To study the various types and characteristics of control valves, transmitters, and transducers,
- ❖ To design and test a P-Only, PI, PI&D controllers for tracking changes in the setpoint, and rejecting disturbances, respectively,
- ❖ To explore how controller tuning parameters such as controller gain (K_c) impact on P-Only, PI, PI&D controller performances,
- ❖ To study the control schemes and modes for the control of key process variables of the unit operations and unit processes overall process control.

Twenty-three (23) teams with teammates ranging from 6 or 7 to 8 were formed after the first in-class demonstrations for the cooperative learning or peer learning in the project-based learning (PjBL) with the assigned stated objectives and other responsibilities for the achievements of the CLOs based on the four (4) major groups for the above-mentioned academic session. Then, the teams were given their unique individual project-based learning (PBL) assignments for the execution individually, according to the four (4) distinct PjBL case studies in describing the operations of processes under both steady and unsteady states, finding the process dynamics and characterizing the dynamics into process gain, process time constants, and process deadtime, designing controllers, and determining the controller gain tuning parameters for P-Only, PI, and PI&D controllers, controller testing, and controller tuning for tracking changes in the setpoint and rejecting disturbances.

Results And Discussion

CHEN 502 Class Profile for Demographic and Gender Distributions

The course Introduction to Process Dynamics and Control (CHEN 502) is one of the core courses in the curriculum for the Bachelor of Engineering in Chemical Engineering Programme at Ahmadu Bello University Zaria. Figures 1(a),(b); 2(a) and (b) depict the demographic and gender distributions of the class profile based on geopolitical zones, the main three (3) different tribal groups, and other major and minor ethnic tribes for 2023/2024 sessions. It can be observed that 79.62% represents the male candidates while 20.38% exhibits the female candidates' participation in the class. This result shows a good development in the increase of almost 10% female candidates enrollments in Chemical Engineering programme in comparison with our previous records over the years. In the demographic distributions, it can be observed that the class was dominated by the candidates from the North-Central Geopolitical Zone accounting for 36.94%, followed by the zone hosting the University, the North-West Geopolitical Zone having 34.39%. There were 16.56% from North-East, 7.64% from South-West, 2.6% from South-South, and 1.9% from South-East Geopolitical Zones. Among three different major tribal groups, the Hausa/Fulani dominated the class with a population of 46.5%, followed by the Yoruba with 10.7%, and the Igbo with only 2.6% for this academic session.

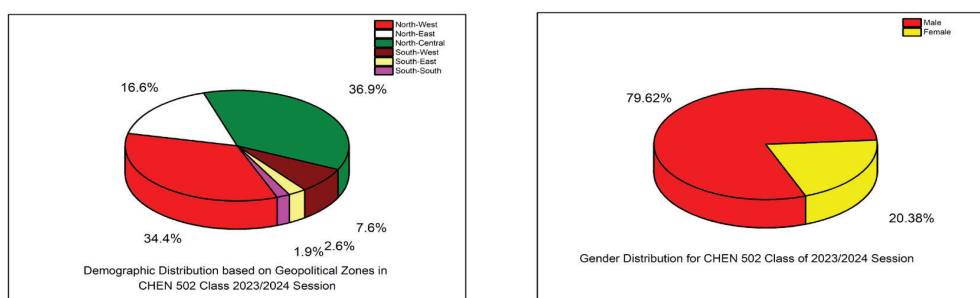


Figure 1: (a) Demographic and (b) gender distributions of the class profile based on geopolitical zones in Process Dynamics and Control (CHEN 502)

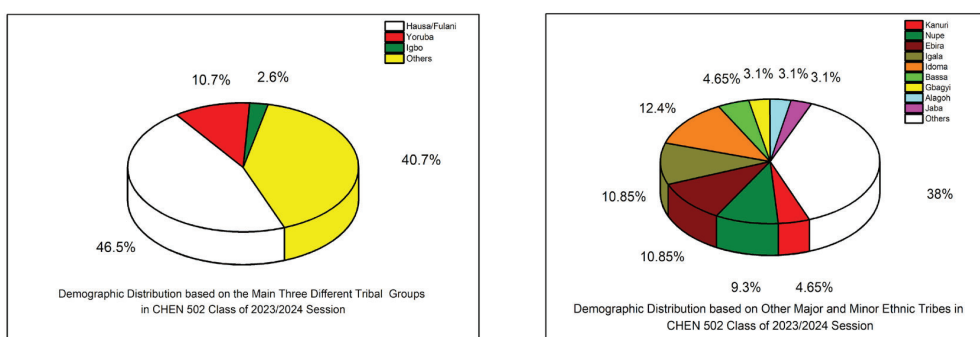


Figure 2: Demographic distributions of the class profile based on (a) the main three tribal groups and (b) other major and minor ethnic tribes in CHEN 502

On the other hand, the other major and minor ethnic tribes accounted for a large share of 40.7% in the overall population. In these major and minor ethnic tribes, Kanuri has the least population in the class with only 4.65% representation, Nupe has 9.3%, Ebira and Igala have equal participations of 10.65%, while the representations of Idoma and Bassa have 12.4% and 4.65%, respectively. Gbagyi, Jaba, and Alagoh have equal representations of 3.1%. The other ethnic minority tribes included Shuwa, Afo, Atyp, Berom, Bura, Higgi, Magongo, Mishiri, Kakanda, Kanakuru, Ogoni, Okehi, Okun, Waja, Wurkun, Tiv, Zarma, Zuru, Edo, Enjema, Etunk that accounted for the remaining 38% of the demographic distribution. From the demographic analysis of CHEN 502 class profile, the class of CHEN 502 for 2023/2024 academic session can be considered as a multi-lingua class based on the presence of more than 33 different spoken languages by the candidates pursuing their Bachelor of Engineering in Chemical Engineering.

The distribution profiles for the age and percentage scores of the self and peer rating assessments (SPRA) in teamwork by teammates of 23 different teams during cooperative learning (CL) or peer learning (PL) in project-based learning (PjBL) are displayed in Figure 3 (a) and (b), respectively, for CHEN 502 class of 2023/2024 academic session with the mean average age and standard deviation; mean percentage scores and standard deviation of 26.11 years and 2.585; 86.24% and 9, respectively. It can be deduced from the statistical analysis for the SPRA that approximately 68% of the scores are between 77.09% and 95.24%, 95% of the scores are between 67.94% and 104.54 %, and almost all the scores are between 58.79% and 113.69% under normal distribution curves.

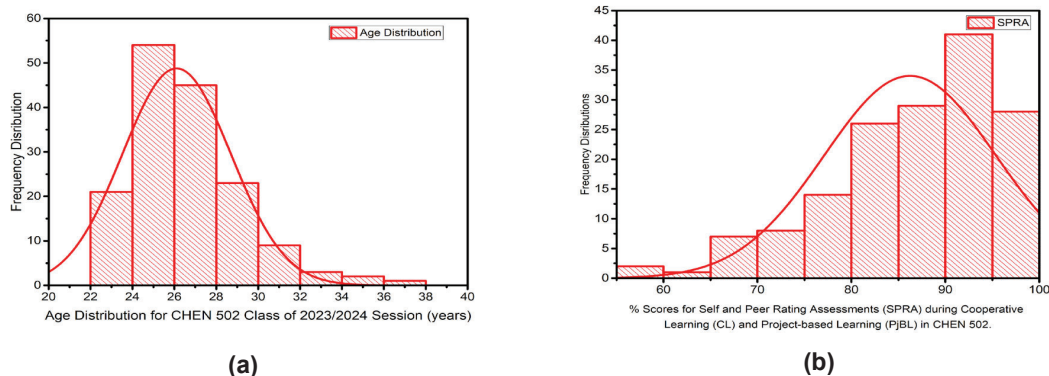


Figure 3: The distributions of age and percent scores for self and peer rating assessments (SPRA) in teamwork during cooperative learning (CL) in project-based learning (PjBL) for CHEN 502

The statistical analysis carried out for the scores obtained in the team-based assignments assessments (TBAA) carried out by the teammates of each team for the 23 teams, and the unique self or individual assignment for the continuous assessments (IACA) can be seen as exhibited in Figure 4 (a) and (b) with their mean percent scores and standard deviations of 89.28% and 13.14; 41.77% and 29.52, respectively.

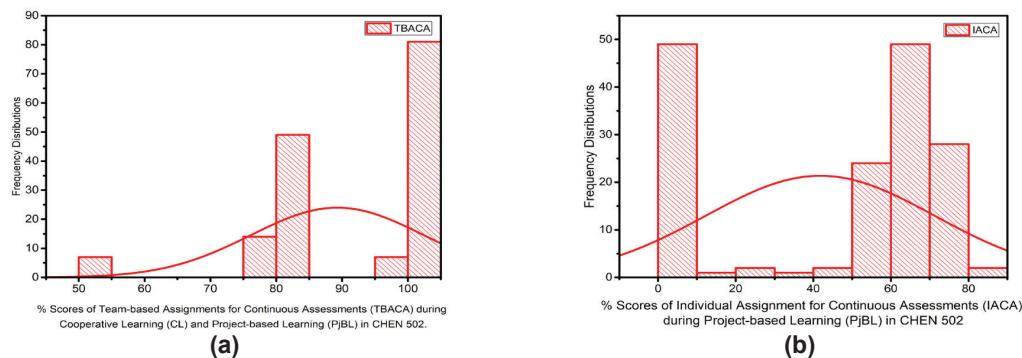


Figure 4: The distributions of percent scores for the team-based assignments (TBAA) and individual assignments for the continuous assessments (IACA) during project-based learning (PjBL) in CHEN 502

Therefore, it can be inferred from the statistical analysis for the results of TBAA in comparison with that of ICAA that approximately 68% of the scores are between 76.28% and 102.42%, 95% of the scores are between 63% and 115.56%, and almost all the scores are between 49.86% and 128.7%; while approximately 68% of the scores are between 12.25% and 71.29%, 95% of the scores are between -17.27% and 108.81%, and almost all the scores are between -46.79% and 130.33%, respectively, all under normal distribution curves as exhibited in Figure 4 (a) and (b).

The distribution profiles of all collated overall percent scores for non-conventional continuous assessments (NCCA) in teamwork by teammates of 23 different teams during cooperative learning (CL) in project-based learning (PjBL) in comparison with that overall percent scores of the conventional continuous assessments (CCA) are depicted in Figure 5 (a) and (b), respectively, for CHEN 502 class of 2023/2024 academic session with their mean average overall percent scores and standard deviations of 68.17% and 15.47; 26.58% and 11.32, respectively.

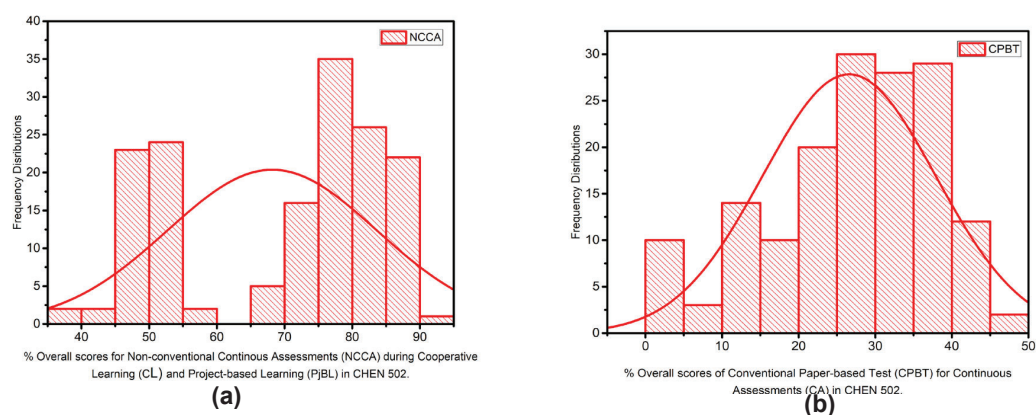


Figure 5: The distributions of overall percent scores for all collated non-conventional continuous assessments (NCCA) during cooperative learning in project-based learning (PjBL) in comparison with that of conventional paper-based test (CPBT) continuous assessments (CCA) in CHEN 502.

Based on the statistical analysis conducted as shown in Figure 5 (a) and (b) of the overall percent scores of non-conventional continuous assessments (NCCA) during cooperative learning (CL) in project-based learning (PjBL) in comparison with that of overall percent scores of conventional paper-based test (CPBT) continuous assessments (CCA), the following deductions can be drawn that approximately 68% of the scores are between 52.7% and 83.64%, 95% of the scores are between 37.23% and 99.11%, and almost all the scores are between 21.76% and 114.5%; whereas approximately 68% of the scores are between 15.26% and 37.9%, 95% of the scores are between 3.94% and 49.22%, and almost all the scores are between -7.38% and 60.54%, respectively, all under normal distribution curves as shown in Figure 5 (a) and (b).

The overall performance of all candidates in CHEN 502 can be seen from grade distribution for 2023/2024 academic session as shown Figure 6. For cumulative frequencies of 157 candidates, the mean scores and standard deviations were found to be 50.20 marks, and 0.977, respectively. The distribution of all collated scores in the self and peer rating assessments (SPRA), team-based assignment assessments (TBAA), unique individual assignment continuous assessments (IACA), and conventional paper-based test assessments (CPBTA) for the overall grade marks of all candidates in CHEN 502 for 2023/2024 academic session can be observed from Figure 6. The candidates' scored 5 A's, 12 B's, 40 C's, 87 D's, 9 E's, and 5 F's. The total number of passes (A, B, C, D, and E) and failures (F) were 152 and 5, respectively.

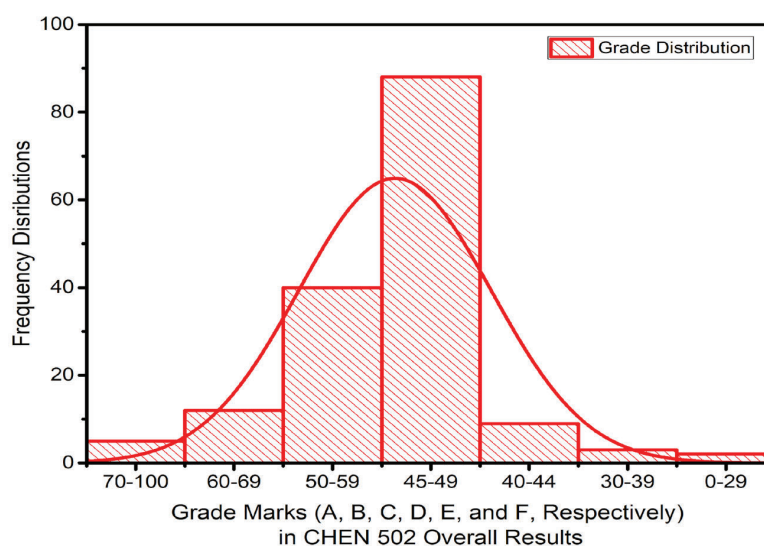


Figure 6: Grade distribution of collated scores in CHEN 502 for the overall results 2023/2024 academic session

It can be inferred from the research findings found in statistical analysis that approximately 68% of the scores are between 49.22 and 51.18 marks, 95% of the scores are between 48.25 and 52.15 marks, and almost all the scores are between 47.27 and 53.13 marks under normal distribution curves as exhibited in Figure 6.

Conclusions

This research was successful in examining the influence of self and peer rating assessments (SPRA) in teamwork by the teammates of 23 distinct teams on conventional techniques through cooperative learning (CL) or peer learning (PL) in project-based learning (PjBL) approaches in Multi-lingua class of more than 33 different spoken languages for the student-centred teaching and learning the Introduction to Process Dynamics and Control (CHEN 502), one of the crucial core courses in the curriculum of Chemical Engineering Programme for the Bachelor of Engineering (B.Eng) in Chemical Engineering at Ahmadu Bello University, Zaria-Nigeria. The investigation employed the use of comprehensive assessment sheets for the self and peer rating assessments (SPRA) of 33 different behavioral attitudes in teamwork from the team-based assignments (TBCA) of 23 teams for a cohort of 157 candidates during cooperative learning (CL) or peer learning (PL) in project-based learning (PjBL). Moreover, the research findings from the studies compare the overall percent scores of SPRA, TBCA, and IACA components of the non-conventional assessments (NCCA) techniques, overall percent of all collated scores for NCCA with that of the overall percent scores of conventional paper-based test assessments (CPBTA). The findings for the SPRA was that approximately 68% of the scores are between 77.09% and 95.24%, 95% of the scores are between 67.94% and 104.54 %, and almost all the scores are between 58.79% and 113.69%. It can be deduced from the analysis of NCCA and CPBTA that approximately 68% of the scores are between 52.7% and 83.64%, 95% of the scores are between 37.23% and 99.11%, and almost all the scores are between 21.76% and 114.5%; and that approximately 68% of the scores are between 15.26% and 37.9%, 95% of the scores are between 3.94% and 49.22%, and almost all the scores are between -7.38% and 60.54%, respectively. In addition, it can be inferred from the overall results of CHEN 502 that approximately 68% of the scores are between 49.22 and 51.18 marks, 95% of the scores are between 48.25 and 52.15 marks, and almost all the scores are between 47.27 and 53.13 marks.

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