

**INTERNATIONAL JOURNAL OF
PEDAGOGY, POLICY AND ICT
IN EDUCATION**

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For further information, please consult our *call for papers* at the end of the Journal.

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EDITORIAL

This 9th volume is the second issue since the corona virus pandemic began. We extend a very warm welcome to our authors and readers. The pandemic rages on and researchers round the globe are doing various investigations related to it. We made a call for papers in 2019 and published in June 2020. Right after that, we made another call in August 2020. We are just lucky to maintain our minimum target of one publication per year (12-month intervals). We are grateful that God is helping us to hang in there.

Our call for papers for the current issue (Volume 9) had the theme, *the Global impact of The Corona Virus Disease on Education*.

Once again, our first article of Volume 9 is written by Inaku Egere, who responded specifically to our call for papers on the corona virus. Egere investigated mobile-learning (M-Learning) of undergraduate students in private universities in Nigeria during the COVID-19 pandemic lockdown. According to him, COVID-19 protocols caused a paradigm shift of pedagogy. To evaluate students' performance based on the shift of the learning pedagogy from face to face (F2F) to m-learning, a non-experimental quantitative design was used. A questionnaire was used to gather data from undergraduate students of the Faculty of Education, Veritas University Abuja and the Faculty of Arts and Social Sciences, Catholic Institute of West Africa Port Harcourt, Nigeria. The sample of 233 was derived from a total population of 560 students. Data analysis revealed that, m-learning improved students' performance. To get even better results the study recommended the embellishment of ICT hubs with e-learning facilities throughout Nigeria.

The second article of Volume 9 was authored by Abdulai and Diedong, who examined service quality and customer satisfaction of Mobile Telecom services in Tamale Metropolis in Northern Ghana. The study employed a mixed method research design. The sample size for the study was 401 respondents. Data was sourced from key informant interviews, questionnaires and focus group discussions. The results showed that customers perceived service quality and satisfaction differently. While most Vodafone customers were satisfied with their service, customers of MTN were dissatisfied. The study concluded that some aspects of the operations of both MTN and Vodafone networks require improvement. Service providers need to improve service quality.

The third and final article of the ICT section was conducted by George.

George, Rahman and Ofori believe that since the development of digital media technology, students have embraced the use of Information and Communication Technology (ICT) creativity. However, most of the students have challenges in the use of ICT and this has a negative impact on the pedagogy of creativity in education. To address this issue George sets out to investigate the challenges of using ICT in the creative process. This qualitative approach, a purposive sampling method used a sample of 150 students from the Communication Design Programme. The Statistical Package for Social Sciences (SPSS) was used to analyze the data. The results indicated that most of students lacked competence in using ICT on creativity. It is recommended that students are taught how to develop new concepts and ideas for creativity.

In the Pedagogy subsection, Nabie investigated the interactions of Circuit Supervisors (CSs) with basic school teachers in Ghana. The objective of these interactions was to facilitate the effective teaching of mathematics. The participants of the study were 55 basic school teachers (43

males 21 females). A 20-item anonymous questionnaire was used to gather data regarding CSs activities in the schools of participants. The data were descriptively analysed. The results showed that the feedback provided by CSs, which was intended to support instructional delivery was “at variance with mathematics teacher needs for effective practice and contrary to curriculum recommendations.” The researcher suggested a qualitative study involving the CSs to generate further data to analyse with a view to address the challenge of effective mathematics instruction at basic schools in Ghana.

Adiyiah, Dieudonne and Ameyaw investigated the effect of teachers’ self-efficacy on students’ performance. They asserted that lately, data on Senior High students’ Biology performance had been on serious decline nationwide. They therefore set out to examine the effect of teachers’ self-efficacy on students’ motivation and performance in biology. Six teachers and one hundred and twenty students from two Senior High schools in the Ashanti Mampong municipality of Ghana were the participants. The data collection involved the use of three instruments namely teacher self-efficacy questionnaire, students’ motivation questionnaire and photosynthesis achievement test items. The results were analysed using Pearson product-moment correlation and one-way ANOVA. The findings revealed that teacher’s self-efficacy motivated students and resulted in better academic performance in biology.

These authors conducted a quasi-experimental study using concept mapping and its closeness indices assessment scheme as an alternative learning and assessment strategy. This was necessitated by prevailing inefficient rote learning technique, which could not help students to understand concepts and perform well in biology. A sample of students in the Ashanti Region of Ghana participated in the study. Data collection involved the use of an interactive 5-Es constructivist instructional model delivery, regularly using closeness indices scores and students’

performance test scores in photosynthesis. Analysis was done via one-way Anova statistical tool of SPSS version 21 software. The findings indicated that regular use of closeness indices assessment strategy positively influenced students learning outcomes. Specifically, it promoted their critical thinking and enhanced their conceptual understanding, which resulted in improved academic performance in photosynthesis among participating students of different abilities.

African Studies is the final section of IJOPPIE Vol 9. Dseagu's article on folktales starts the section. Dseagu's paper takes exception to Bascom's (1965) definition of African folktales as fiction that is not taken seriously in traditional societies in contrast to legends and myths. The paper adduces evidence to support the assertion that Bascom's (1965) view of African folktales is "unsustainable". It further asserts that Bascom's definition of folktales had been "discredited long ago". The paper therefore calls on African educators to discard Bascom's (1965) "fallacious" views on African folktales.

Next, under African Studies is Zuure's article on legal systems.

The study examined similarities and differences between the traditional court in Kongo and the modern state-court operating in the area. Additionally, the study explored the prospects of the traditional court in conflict resolution. This qualitative study used the case study design. Sixteen participants were purposively and conveniently sampled and interviewed for data. The findings revealed that the Kongo traditional court and the modern state court had similarities and differences in their approach to conflict resolution. It was also revealed that the Kongo indigenous mechanism to conflict resolution had great prospects. It was therefore, recommended that the two court systems in the area should collaborate for more effective conflict resolution, leading to a more peaceful and harmonious life.

In the third article under African Studies, Zuuri examined the influence of Livelihood Empowerment Against Poverty (LEAP) on household food consumption, access to health services, and children's school attendance of persons with disabilities in the Effutu Municipality in the Central Region of Ghana. The study adopted the qualitative research approach. A sample of thirty-four persons was purposively and conveniently selected to participate in the study. A semi-structured interview guide was used to gather data. The findings revealed that the LEAP programme had a positive influence on household food consumption, access to healthcare, and children's school attendance among PWD beneficiaries in the Effutu Municipality. Zuuri recommended that the programme be regularly reviewed to ensure that it achieves its goals.

Editor – in – Chief

September, 2021

**IMPACT OF CLOSENESS INDICES ON STUDENTS CONCEPTUAL
UNDERSTANDING IN TEACHING AND LEARNING OF PHOTOSYNTHESIS AS A
BIOLOGICAL CONCEPT**

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ABSTRACT

This participatory quasi-experimental study used concept mapping and its closeness indices assessment scheme as an alternative learning and assessment strategy as a result of inefficient rote learning technique, which fails to enhance conceptual understanding and good performance in biology among some selected students in Ashanti Region of Ghana. The data collection instrument was an interactive 5-Es constructivist instructional model delivery with effective regular use of closeness indices scores and students' performance test scores in photosynthesis.

The analysis was done through one-way Anova statistical tool of SPSS version 21 software. The findings indicated that regular use of closeness indices assessment strategy impacted positively on students' learning outcomes. It motivated students to think critically leading to better understanding and increased academic performance in photosynthesis among students of different abilities.

Keywords: Academic performance, conceptual understanding, rote learning, memorization

INTRODUCTION

The desire to improve students' conceptual understanding to increase their academic performance through effective instructional and assessment strategies has motivated many biology educationists to use concept mapping (Ameyaw, 2012; Ameyaw, & Okyer, 2018; Ajaja, 2011) and its closeness indices as an alternative self-assessment tool for evaluating students' progress in learning. The increased awareness of using a more effective assessment tool (Ameyaw, 2012) is also a major development aimed at making learning easier for students. Additionally, it would help explain how learners learn and show how to assist students learn the concept of photosynthesis better.

According to Novak (2002), research has shown that few students at the senior high school level have had formal instruction in learning how to learn. The interest in assisting the learner to conceptualize concepts has led to the development of many cognitive instructional methods, which aim to ensure meaningful learning; among them are the popular computer simulation, demonstration and many others. However, there has been a lack of emphasis on the application of concept mapping and its closeness indices (Goldsmith et al 1991) as one of the effective scoring schemes that can assist slow learners and less motivated students to perform better in

understanding theories and other concepts. It is in the light of the above that this study aims to address closeness indices as effective formative assessment tools for improving conceptual understanding to achieve increased academic performance in biology. It is one of the most recent developments in cognitive science pedagogy and the new philosophy of science innovations that helps students to remember learned concepts longer and be able to use such concepts and knowledge effectively (Adiyah, 2011).

This research is a direct response to two issues. The first is poor performance in biology as a result of non- motivational instructional strategies. The second is the inefficient formative assessment tool that fails to help students in critical thinking to bring about relational and conceptual understanding.

The assessment procedure for measuring how effective students have relationally understood taught concepts in biology are not significantly different from other realms of knowledge, though biology has its own uniqueness in knowledge structure. Among some of these tools is the subjective essay type test, the multiple objective tests, simple matching type test, true or false etc. Many students experience some level of difficulty in identifying the important underlying relationship with concepts in a text presented. As a result, students failed to construct clear meta-cognitive concepts and propositional frameworks. This often led them to see learning of biology as a myriad of facts, concepts, names, theories, or procedural rules to be memorized, recalled and forgotten (Ajaja, 2011).

For most of these students, learning a concept like photosynthesis seemed very difficult and understanding and mastering the subject seemed impossible. Hence, most treated the subject as a body of information to be memorized. Little wonder that they found it boring and not deserving much attention. Therefore, concept mapping and closeness indices scoring scheme would seem an

excellent alternative to enable the students to think about connections between abstract biochemical terms and concepts being presented and learned. It would also help them to organize their facts and thoughts, visualize relationships between major concepts in a systematic way and reflect on their conceptual relations, thus promoting meaningful learning and conceptual understanding.

Concept mapping in biology Instruction

The concept and practice of assisting students to represent their cognitive understanding in concept maps (Novak & Gowin, 1984) have been very useful for enhancing performance in sciences especially biology education. This learning technique has been supported in many researches in biology education (Ajaja, 2011; Ameyaw, 2012). The process of constructing concept maps assists students to understand concept relationships between different ideas. Concepts of biology require understanding of related abstraction on concrete, semi-concrete or abstract experience of students. Practical representation and organization of biological ideas or relations are therefore important and most students have challenges in developing relational and conceptual understanding. Engaging students in meaningful learning requires the use of relevant prior knowledge application, use of meaningful material and the choices of the learner in question. Concept maps helps learners to relate newly learned ideas. It also helps students connect new ideas to old concepts (Ajaja, 2011; Ameyaw, 2012).

The application of concept mapping has its theoretical framework based on the principle of Piaget and Ausubel. Newly learned piece of knowledge causes some disequilibrium with old concepts, until students later achieve a cognitive equilibrium by assimilation or accommodation. Reaching cognitive equilibrium means that students form new cognitive or conceptual organizations. Concept maps intrinsically guide students to organize their conceptual schema and

represent their cognitive ideas in a peculiar way (Roth & Roychoudhury, 1992, p. 357). This organization gives teachers and students the opportunity to evaluate their progress in instructional delivery and learning, respectively. Misconceptions and alternate concepts can be revealed by asking students to construct concept map, and therefore, due remediation becomes effected.

Concept maps are dynamic, and therefore enable students to add new components based on their experiences. Since biological ideas and concepts consist of complicated and complex forms of relations, students therefore gain more insight, develop complicated and integrated concept maps. Concept maps were constructed mostly at the end of an instructional period and /or subject but it is now most appropriate to be ongoing to reorganize students' ideas, and help them to make connections between smaller elemental components during the subject instructional process.

Therefore, this study looks at the impact of closeness indices on students conceptual understanding in teaching and learning of photosynthesis as a biological concept in Mampong municipality of the Ashanti Region of Ghana.

METHODOLOGY

The study was conducted using thirty-six elective biology students from Amaniapong senior high school in Mampong municipality, Ghana. Concept mapping and its closeness indices were use as participatory design for regular learning and formative assessment strategy in monitoring and evaluation of students' progress in learning for a period of four weeks teaching the concept of photosynthesis. The three ability levels of students were further subdivided into nine smaller groups of each ability level (high, average and low) having three sub-groups. They were regularly and frequently given assigned projects to discuss and present individually,

and in groups on concept maps. They were encouraged to use closeness indices for their self-evaluation in order to ascertain their performance in learning photosynthesis. Their performances were measured using photosynthesis achievement test while their conceptual understanding of Calvin cycle was obtained using closeness indices scoring computation explained below. In addition, their academic ability levels and means scores were analyzed.

Closeness indices scoring computation

In order to determine the students' conceptual performance achieved on the concept, Calvin cycle in photosynthesis, the students' maps drawn are scored by comparing with the instructors' map as a standard for making judgement of the students' effort. Using, Fig.1 (a) as expert map, $G_e = (V_e, E_e)$, where V_e and E_e are the sets of concept nodes and relation links in the map, respectively. Figure 1(b) as student map, $G_s = (V_s, E_s)$. For effective comparison of the maps, there was a first search in each of them for concept nodes that are connected to each node n from $V = V_e \cup V_s$. The sets of nodes are represented as $N_n^{(E)}$ and $N_n^{(S)}$. In Fig. 3a node A is links to nodes B and C in G_e , while in G_s , A is connected to nodes C, D, and E, in Fig.3b. Therefore, $N_A^{(E)} = \{B, C\}$ and $N_A^{(S)} = \{C, D, E\}$. After the sets of adjacent nodes for all given nodes are determined, intersection of the two sets ($I_n = N_n^{(E)} \cap N_n^{(S)}$) and their union ($U_n = N_n^{(E)} \cup N_n^{(S)}$) are determined. Going back to the example above, the intersection of $N_A^{(E)}$ and $N_A^{(S)}$ was $I_A = \{C\}$, and their union was $U_A = \{B, C, D, E\}$. Now I_n and U_n , we then define the closeness index for node n as $C_n = |I_n| \div |U_n|$, where $||$ means the number of nodes in the set. By this definition, the closeness index for node A in Fig. 3 is calculated as $C_A = |I_A| \div |U_A| = 1/4 = 0.25$. When closeness indices for all nodes in the two maps are calculated, we define the closeness index of the two maps as: $C(G_e, G_s) = 1 \div |V| \sum C_i$, Where $V = V_e \cup V_s$.

From the above discussion, Fig. 1b below is poorly constructed, its indices value ($c=0.321$) is less than 0.5 approaching (0.0). A concept-map predicts conceptual understanding when its indices score is high (0.9) approaching one or unity.

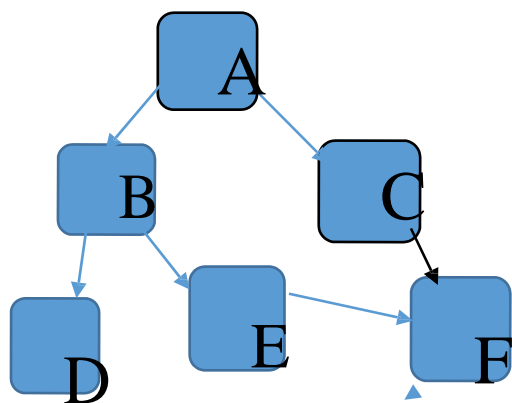


Fig.1a: Expert concept map

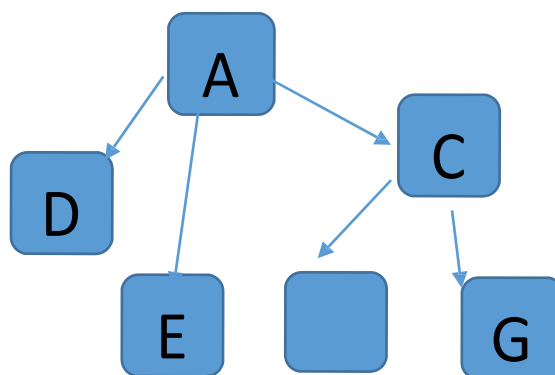


Fig.1b: Student concept map

RESULTS

Assessment of students' concept maps in comparison to a teacher (expert) map.

Each of the three sub-groups concept maps of all the three ability levels were calculated to determine the students' level of conceptual performance on the concept of Calvin cycle obtained using the closeness indices computation scoring scheme shown in Tables 1 to 7.

Table 1: Representation of the Key Nodes of the concepts in Calvin cycle.

A= LIGHT INDEPENDANT	D= ATP	G= LEAVE
B= CARBON DIOXIDE	E= GLUCOSE	H= CHLOROPHYLL
C= NADPH	F= STROMA	I= STEM

Table 2: Scoring Group 1: High achievers' concept map in comparison with teacher (expert) concept map.

U	Nn(E)	Nn (S)	In	Un	C n
A	{B,C,D,F}	{ B,C,D,F}	{B,C,D,F }	{B,C,D,F }	1
B	{A,G,H,I}	{A,C,G}	{ A,G}	{A,C,G,H,I}	0.4
C	{A,E}	{A,E}	{A,E}	{A,E}	1
D	{A,E,}	{A,E, }	{A,E}	{A,E, }	1
E	{C,I,D,G}	{C,I,D,G}	{C,I,D,G}	{C,I,D,G}	1
F	{A,I,G}	{A,I,G}	{A,I,G}	{A.I,G}	1
G	{B,E,F,H}	{B,E,F,H}	{B,E,F,H}	{B,E,F,H}	1
H	{B,H,I}	{G,I}	{I}	{B,H,G,I}	0.25
I	{B,E,F,H}	{B,E,F,H}	{B,E,F,H}	{B,E,F,H}	1

Therefore, $C.I (G_e, G_s) = 1 \div |V| \sum C_i$, Where $V=V_e \cup V_s$, the total closeness index, $C = 0.85$

Table 3: Calculating the mean closeness indices of the High Achievers

High Achievers	GP1	GP2	GP3	Mean scores
Total closeness indices scores	0.86	0.85	0.84	0.85

Table 4: Scoring Group 1: Average achievers' students' concept map in comparison with teacher (expert) concept map.

U	Nn(E)	Nn (S)	In	Un	C n
A	{B,C,D,F}	{ B,C,D,F}	{B,C,D,F }	{B,C,D,F }	1
B	{A,G,H,I}	{A,C,G}	{ A,G}	{A,C,G,H,I}	0.40
C	{A,E}	{A,E}	{A,E}	{A,E}	1

D	{A,E,}	{A,C,E, }	{A,E}	{A,C,E, }	0.67
E	{C,I,D,G}	{C,I,D,G}	{C,I,D,G}	{C,I,D,G}	1
F	{A,I,G}	{A,I,G}	{A,I,G}	{A.I,G}	1
G	{B,E,F,H}	{B,E,F,H}	{B,E,F,H}	{B,E,F,H}	1
H	{B,H,I}	{G,I}	{I}	{B,H,G,I}	0.25
I	{B,E,F,H}	{B,E,F,H}	{B,E,F,H}	{B,E,F,H}	1

Therefore, $C.I (G_e, G_s) = 1 \div |V| \sum C_i$, Where $V=V_e \cup V_s$, the total closeness index, $C = 0.81$

Table 5: Calculating the mean closeness indices of the Average Achievers

Average Achievers	GP1	GP2	GP3	Mean scores
Total closeness indices scores	0.81	0.82	0.83	0.82

Table 6: Scoring Group 1: Low achievers' students' concept map in comparison with teacher (expert) concept map.

U	Nn(E)	Nn (S)	In	Un	C n
A	{B,C,D.F}	{ B,C,D}	{B,C,D}	{B,C,D,F }	0.75
B	{A,G,H,I}	{A,C,G}	{ A,G}	{A,C,G,H,I}	0.40
C	{A,E}	{A,E}	{A,E}	{A,E}	1
D	{A,E,}	{A,E, }	{A,E}	{A,E, }	1
E	{C,I,D,G}	{C,I,D,G}	{C,I,D,G}	{C,I,D,G}	1
F	{A,I,G}	{I,G}	{I,G}	{A.I,G}	0.67
G	{B,E,F,H}	{B,E,F,H}	{B,E,F,H}	{B,E,F,H}	1
H	{B,H,I}	{G,I}	{I}	{B,H,G,I}	0.25
I	{B,E,F,H}	{B,E,F,H}	{B,E,F,H}	{B,E,F,H}	1

Therefore, $C.I (G_e, G_s) = 1 \div |V| \sum C_i$, Where $V=V_e \cup V_s$, the total closeness index, $C = 0.79$

Table 7: Calculating the mean closeness indices of the High Achievers

Low Achievers	GP1	GP2	GP3	Mean scores
Total closeness indices scores	0.79	0.80	0.78	0.79

DISCUSSION

The students' ability levels of low, average and high achievers on the concept, Calvin cycle in terms of their conceptual understanding and performance were calculated using closeness indices scoring computation (Goldsmith *et. al.*, 1991) are presented in Tables 2, 4 and 6, as well as Tables 3, 5, and 7, respectively. A closeness index of 0.85 obtained from the three sub-groups of the high ability groups indicated a high level of conceptual understanding achieved by the group.

On the other hand, the mean score values of 0.79 and 0.82 obtained by the low and average achievers, respectively, also support the assumption that both groups equally developed a high level of conceptual understanding on the Calvin cycle, which enhanced their performance in photosynthesis. It can further be said that the level of their extremely low pre-intervention performance (48.45%, 34.30%, and 24.50% for high, average and low achievers respectively) had been enhance tremendously by the effect of the concept mapping, and its closeness indices efficacy on their photosynthesis performance as indicated in Table 8.

The one-way Anova shows that there is no significant difference in performance between the three ability groups of students that participated in the study, $f(8.320)$, $p > 0.05$,

and therefore,

f- value (0.643) is statistically not significant as shown below.

Table 8: Anova analysis of photosynthesis performance between ability levels of the students

	Sum of Squares	df	Mean Square	f	Sig.
Between Groups	16.639	2	8.320	.643	.532
Within Groups	414.104	32	12.941		
Total	430.743	34			

There were margins of differences that students scored in their concept mapping drawing abilities (closeness indices scores). These scores showed their level of conceptual understanding did not differ much among the nine different groups of the three ability levels. The same could also be said of the performance test mean differences (84.40, 83.63 and 85.71 for low, average and high achievers respectively). This suggest that whenever an effective and appropriate instructional strategy is used in biology lessons, all different academic achieving levels of students benefit equally in terms of levels of understanding. It again indicates, individuals' ability to draw a comprehensive, elaborative as well as integrated concept map as it is not limited to a particular academic ability group. Therefore, students need to be encouraged to practice and improve upon their understanding of concepts using concept mapping and associated closeness indices as a self-assessment strategy in their learning in order to achieve enhance performance in biology instructions.

CONCLUSION

The pedagogical relevance of concept mapping and its closeness indices have been tremendous. Obviously, this can assist students to represent their cognitive understanding in a knowledge framework. Students should be encouraged to use it to practice organizing their knowledge domain and understanding on concepts such as photosynthesis. This would enable

them master facts and avoid undue memorization and recitation through mnemonics that could result in forgetfulness and large percentage in failures due to poor conceptual understanding.

In conclusion, the idea of concept mapping encourages students to represent their cognitive vision of how a knowledge domain such as the concept of photosynthesis is structured in diagrams to show how concepts are interrelated. It provided a means for the students to transfer their visual representations into relational diagrams. It is worthy of note that the use of the closeness indices computational assessment strategy bridges the learning gap among the different ability levels of the achievers.

Acknowledgements

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