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ADAPTING HANDS-ON AND MINDS-ON MODEL AS EFFECTIVE TEACHING METHODS OF BIOLOGY AND INTEGRATED SCIENCES

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ABSTRACT

The purpose of the study was to adapt the hands-on and minds-on model for teaching methods of biology and integrated sciences and measure its effectiveness through the performances of practitioners.

Mixed, descriptive, exploratory and conclusive design methods were employed. Situational sampling techniques were used to determine and select 40 academically low mark achiever research populations with equal gender parity practitioners from Jima and Hawassa Universities and Fitche and Mettu Colleges of Teacher Education. Data collection was through overt observation Likert scale checklists and interviews conducted with practitioners.

As a result, the average performance effectiveness of practitioners of both Universities in teaching biology showed 35.35% whereby performances in teaching integrated sciences of both CTEs scored 32.5% improving effectiveness by 33.93% against using the formal teaching styles. In response to interviews made with practitioners, all participants confirmed average performance effectiveness of 43.97%in the teaching profession.

As final, the overall average teaching effectiveness of using the hands-on and minds-on model was 38.945% showing that much improvement of professional qualifications.

In conclusion, using the Hands-on and Minds-on model for the delivery of biology and integrated sciences was found as the most superlative effective teaching methods to improve conceptual understanding through doing lab works, experiments, tests and field based lessons activities, construction of rich experiences and upgrading the retention capacity of learners.

KEYWORDS*:* Adapt, Effective, Hands-on, Minds-on, Model, Performance and Practitioner

INTRODUCTION

Educators are always in search of better ways of improving education systems and teaching methods and the quality of education. Education systems are methods of teaching, learning with pertinent feedbacks and assessments techniques employed to address the process of transferring the knowledge of a particular subject from a specific source to learners in all levels of schooling schema.

Human beings constantly generated and transmitted the fond of knowledge to the world through the development of educational systems and professional careers still in progresses.

Educating is the process of simplifying learning to achieve skills, values and behavioural changes whereby teaching deals with instructing, training and structured lesson delivery and researches.

There are efforts in modernizing to improve the quality and efficiency of education for problem solving relevant

to the lives of mankind.

The ancient education was learning focused on specialized skills of *scribe* or the advent value on writing whereas the medieval education dealt with teaching children using elements of Sciences.

The 19th century education required mandatory classroom management skills whereby the 20th century education appeared with modern teaching methods that incorporated devices like televisions, radios, computers with qualified instructors, arranged classrooms and management systems.

The curren t21st education system is the most facilitated mode of student-centered teaching methods accompanied by latest technological devices with a paradigm shift from theory to practical knowledge. It includes modern instructional designs and avant-garde teaching models emerging from long experiences to promote practical, productive and lifelong knowledgeable experiences.

Nonetheless, this article dealt with attesting the effectiveness of the model Hands-on and Minds-on as teaching methods as one of the student-centered teaching strategies engaging students into learning by doing activities of biology and integrated sciences.

Hands-on is a way of involving students in various learning activities, manipulating with objects and foster experiences to learning by playing.

Minds-on is the situation of connecting human minds to various activities that involve brains in thinking and doing tasks. Applying the hands-on and minds-on model as teaching methods makes powerful combinations of mental and physical activities in the processes of learning.

Hands-on and Minds-on model is a learning concept of various activities like tastes, experiments, field-based and lab activities enjoying practical exercises, helpful in escaping passive mode of learning and augments to do tasks actively through all senses

Adapting the model as teaching methods means modifying or redesigning a suitable daily lesson plan containing reliable steps of lesson delivery involving learners in various practical activities and strengthening student-centeredness of delivery.

According to (Sutuma Edessa, 2019), integrating the 5E model cycles into a daily lesson plan as steps of lesson delivery of teaching biology is effective in improving teaching profession and educational quality.

The major objective of this research was to adapt the model hands-on and minds-on as teaching methods of biology and integrated sciences by setting the 5E model cycles as steps of lesson delivery and evaluating its effectiveness through the teaching performances of practitioners.

Practitioners are trainees of teaching biology at the undergraduate program of Jima and Hawassa Universities who will be Secondary School biology teachers and trainees of Fitche and Mettu Teacher Education Colleges who will be Primary School Integrated Sciences teachers after graduation.

METHODS

The research was conducted in Jima and Hawassa Universities of Center of Excellence at the undergraduate program of Bachelor of Education (B.Ed.) in Biology Education and Colleges of Teacher Education of Fitche and Mettu training

teachers in teaching Integrated Sciences.

Accordingly, 20 (10 females and 10 females) third year students specializing in the field of Biology Education of Jima and Hawassa Universities (JU & HU) and 20 (10 females and 10 males) graduating class students specializing in teaching Integrated Sciences of Fitche and Mettu College of Teacher Education (CTE)were engaged as research practitioners.

Situational sampling methods were used to select research practitioner population based on the condition of academic performances of each student during the last 3 semesters among which academically poor or low mark achiever 40 students were selected with equal gender parity. Data collection methods were through overt observation using Likert scale checklist while the practitioners conducted peer-teachings with the formal teaching styles and the hands-on and minds-on model steps.

Mixed, descriptive with the purpose of applied, exploratory and conclusive research methods were used. Strategically, discussions and orientation on how to conduct peer-teachings twice on various activity based lesson topics with all practitioners at each institute.

Accordingly, in peer-teaching one, the practitioners were explained to select lesson topics from all learnt portions freely and conducted peer-teaching using the formal teaching styles through a daily lesson plan steps of introduction, presentation, recapitulation, discussion and evaluation.

Consequently, the practitioners conducted peer-teachings on self-selected topics using the formal teaching styles and the performances of each practitioner were observed using Likert scale checklists set on the basis of daily lesson plan contents and displayed in tables (1- 4).

Table 1: Performance of JU Practitioners

Variables (topics)	Performances (100%)
The function of leaves	32
The function of roots	35
Foods containing starch	30
The human boy systems	31
The human auditory systems	29
The function of human eye	33
The importance of trees	36
Germination of seeds	25
Plant reproductive parts	40
The cells	28

Table 2: Performances of HU Practitioners

Variables (topics)	Performances (100%)
The function of leaves	49
The function of roots	35
Foods containing starch	36
The human boy systems	35
The human auditory systems	30
The function of human eye	39
The importance of trees	42
Germination of seeds	41
Plant reproductive parts	40
The cells	25

Table 3: Performances of Fitche CTE Practitioners

Variables (topics)	Performances (100%)
Air pollution	65
Importance of forests	60
Importance of plants	45
The use of water	52
Plants	45
Importance of wildlife	60
Waterborne diseases	55
Sense of organs	55
Plant reproduction	51
Deforestation	65

Table 4: Performances of Mettu CTE Practitioners

Variables (topics)	Performances (100%)
Air pollution	36
Importance of forests	35
Importance of plants	31
The use of water	35
Plants	36
Importance of wildlife	45
Waterborne diseases	38
Sense of organs	46
Plant reproduction	35
Deforestation	45

In order to conduct peer-teaching two, training was given on how to effectively employ the model hands-on and minds-on. Practitioners were provided with the schema of a template daily lesson plan contents and exercised lesson plan designing on sampled lesson topics of experimental activities by incorporating the 5E model cycles (engagement, exploration, explanation, elaboration and evaluation) into the schema of the daily lesson plan and used as steps of lesson delivery.

Accordingly, practitioners selected topics from various experimental activities, lab works, tests and field based activities, prepared lesson plans and conducted peer-teachings.

The performances of each practitioner was evaluated while using the hands-on and minds-on model for teaching biology and integrated sciences through Likert scale observation checklists and displayed in tables (5-8).

Table 5: Performances of JU Practitioners

Variables (Topics)	Performances (100%)
The parts of a leaf	62
The function of stems of a plant	65
Test for starch	78
The parts of human heart	68
The parts of human ear	66
The parts of human eye	67
The parts of a plant	77
Osmosis in potato cells	70
The parts of a flower	65
The function of roots	64

Table 6: Performances of HU Practitioners

Variables (topics)	Performances (100%)
The parts of a leaf	78
The function of stems of a plant	67
Test for starch	73
The parts of human heart	81
The parts of human ear	68
The parts of human eye	69
The parts of a plant	70
Osmosis in potato cells	71
The parts of a flower	77
The function of roots	65

Table 7: Performances of Fitche CTE Practitioners

Variables (topics)	Performances (100%)
Chemical changes	88
Physical changes	92
Monocots and dicots	70
Test for acidity	93
Test for basicity	90
Test for starch	90
The parts of a plant	95
The parts of human heart	97
The parts of human eye	90
Water cleaning methods	87

Table 8: Performances of Mettu CTE Practitioners

Variables (topics)	Performances (100%)
Chemical changes	80
Physical changes	78
Monocots and dicots	70
Test for acidity	60
Test for basicity	68
Test for starch	65
The parts of a plant	69
The parts of human heart	65
The parts of human eye	68
Water cleaning methods	69

Table 9: Performance Differences of JU Practitioners

Peer-Teaching 1	Peer-Teaching 2	Differences
Formal Teaching Style	Hands-on Minds-on Model	Percentile %
32	62	30
35	65	30
30	78	48
31	68	37
29	66	37
33	67	34
36	77	41
25	70	45
40	65	25
28	64	36
31.9	**68.2**	**36.3**

Table 10: Performance Differences of HU Practitioners

Peer-Teaching 1	Peer-Teaching 2	Differences
Formal Teaching Style	**Hands-on Minds-on Model**	**Percentile %**
49	78	29
35	67	32
36	73	37
35	81	46
30	68	38
39	69	30
42	70	28
41	71	30
40	77	37
25	65	40
37.2	**71.9**	**34.7**

Table 11: Performance Differences of Fitche CTE Practitioners

Peer-Teaching 1	Peer-Teaching 2	Differences
Normal Teaching Style	**Hands-on Minds-on Model**	**Percentile %**
65	88	23
60	92	32
45	70	25
52	93	41
45	90	45
60	91	31
55	95	40
55	97	42
51	90	39
65	87	22
49.8	**89.3**	**34**

Table 12: Performance Differences of Mettu CTE Practitioners

Peer-Teaching 1	Peer-Teaching 2	Differences
Normal Teaching Style	**Hands-on Minds-on Model**	**Percentile %**
36	80	44
35	78	43
31	70	39
35	60	24
36	68	32
45	65	20
38	69	31
46	65	20
35	68	33
45	69	24
38.2	**69.2**	**31**

The effectiveness of the model hands-on and minds-on as teaching methods of biology and integrated sciences was measured by finding performance value differences of practitioners in conducting peer-teaching 1 against peer-teaching 2 as displayed in tables (9-12).

Table 13: Comparative Results of peer Teaching One and Interviews

Universities and CTEs	Peer-Teaching Performance Improvement Values	Responses to Interviews	Differences(100%)
JU	31.9	78	46.1
HU	37.2	80	42.8
Fitche CTE	49.8	85	35.2
Mettu CTE	38.2	90	51.8
Total	157.1	333	175.9
Average	**39.28**	**83.25**	**43.97%**

Responses to interviews of practitioners on the effectiveness of the hands-on and minds-on model were summarized and presented in table (13).

DATA ANALYSIS AND EVALUATION

Collected data on the effectiveness of using hands-on and minds-on model as teaching methods of biology and integrated sciences employed through peer-teachings in Jima and Hawassa Universities and Fitche and Mettu College of Teacher Education were analyzed.

Consequently, the practitioners of JU have conducted peer-teachings twice (using the formal styles and the hands-on and minds-on model) and the performances of each practitioner were observed using Likert scale observation checklists as listed in tables (1 and 5). The difference of performance values between peer-teaching one and two showed radical changes of 36.3%of professional enrichments of teaching experiences.

Similarly, the performance values of the practitioners of HU observed through Likert scale checklists while conducting peer-teachings using the formal styles and the hands-on and minds-on model showed quiet differences of 34.7% of effectiveness (tables 2 and6).

Overall, practitioners of both Universities have improved teaching performancesby**35.35%** in employing the hands-on and minds-on model as teaching methods in comparison with the performances of using the formal teaching styles.

On the other hand, the performances difference of Fitche CTE practitioners in conducting peer-teaching using the formal styles and the hands-on and minds-on model evaluated using Likert scale observation checklist showed 34% effectiveness as displayed (tables 3 and 7).

In the same way, the difference of performances values of practitioners of Mettu CTE observed using Likert scale checklists through the formal styles and the hands-on and minds-on model showed 31%(tables 4 and 8).

In general, practitioners of both CTEs have promoted teaching performancesby**32.5%**on an average through the model hands-on and minds-on against the formal teaching styles and that much improved the teaching methods of integrated sciences.

Interviews were conducted with practitioners on how much the model hands-on minds-on was effective as teaching methods against the formal teaching styles.

In response to interviews, practitioners of both Universities (JU and HU) respectively responded as78 to 80% (79%) improvements.

The practitioners of Fitche and Mettu CTEs respectively responded as effective as 85 to 90% (87.5%).

The average responses to interview questions accounted for 83.25% effective against the performances of using the formal teaching styles of 39.28 scoring **43.97%** difference of performance values.

RESULTS

As a result, the average effectiveness of teaching biology of practitioners of both Universities showed 35.35**%** whereby the performances teaching integrated sciences of both CTEs 32.5% improvements were indicating an average effectiveness of **33.93%** against using the formal teaching styles.

In response to interviews made with practitioners, the average improvement of performances was improved by **43.97%** confirming effectiveness of the model of professional careers.

Finally, the overall average teaching effectiveness of using the hands-on and minds-on model was **38.945%** showing that much improvement on teaching professions.

DISCUSSIONS

Hands-on activities are perceived as enjoyable and effective form of learning by doing that enhance learners to develop retention capacities and capitalize conceptual understanding of the substances.

According to Lydia Martin (2020), hands-on learning is a form of education in which children learn by doing, which is an engaging way to learn, leading to increased retention, can offer practice in problem solving, critical thinking and results in a physical creation.

Hands-on activities employed for lesson delivery processes have improved conceptual understanding of the subject matter and enriched the experiences of future teachers.

During hands-on educational activities, learning occurs on multiple levels, including visual, auditory, tactile, kinaesthetic and social (Colleen Beaty, 2017).

Hands-on activities must be explicitly supplemented with reflective observation and abstract conceptualization minds-on exercises to complete the learning cycle and provide meaningful conceptual understanding (Young, M. R., 2015).

Fostering breadth of skills requires a transformation of the traditional education into action employing hands-on and minds-on methods that capitalizes on children's natural propensity to learn (Winthrop, R., Williams T. P. And McGivney E., 2016).

CONCLUSIONS

The Hands–on and Minds-on model adapted for teaching biology in Jima and Hawassa Universities and Integrated Sciences in Fitche and Mettu CTEs was completed successfully.

Although the practitioners of both Universities were not yet attended many of the pedagogical courses except practicum 1, practitioners performed assigned tasks effectively. Practitioners of both CTEs were graduating classes who have completed almost all courses have marvellously conducted peer-teaching with high performances.

The model hands-on and minds-on as teaching methods was effectively used and served as tools for arresting the

attention of learners, innovation of teaching materials, understanding contents and pedagogy deeply and recalling learnt components.

Training teachers using the model is one of the most effective methods of teaching leading to higher levels of production of qualified teachers to nurture and constructs lifelong rich experiences.

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