



The Effect of Teacher Coaching on Pedagogical Competence in Public Secondary Schools in Kenya

Kennedy Amadi Omega ^{a*}, Manasi Echaune ^a
and Tecla Kirwa ^b

^a Department of Educational Planning and Management, Kibabii University, Kenya.

^b Department of Economics, Finance and Accounting, Kibabii University, Kenya.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: <https://doi.org/10.9734/ajess/2024/v50i91586>

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/122608>

Original Research Article

Received: 27/06/2024

Accepted: 31/08/2024

Published: 05/09/2024

ABSTRACT

Aims: To determine the effect of teacher coaching on pedagogical competence in public secondary schools in Kenya.

Study Design: The study used mixed methods research design, grounded in pragmatism philosophical approach.

Place and Duration of Study: The study was carried out in Public Secondary Schools in Kenya from December 2023 to December 2024.

Methodology: Target population was 105,234 teachers from 8,933 public secondary schools in 47 counties in Kenya. A sample size of 440 respondents comprising 72 Principals, 184 teacher mentors and 184 novice/teacher mentees. Data were collected using focused group discussion

*Corresponding author: Email: amadioga@gmail.com;

Cite as: Omega, Kennedy Amadi, Manasi Echaune, and Tecla Kirwa. 2024. "The Effect of Teacher Coaching on Pedagogical Competence in Public Secondary Schools in Kenya". *Asian Journal of Education and Social Studies* 50 (9):264-80. <https://doi.org/10.9734/ajess/2024/v50i91586>.

(FGD) and online questionnaires and analyzed qualitatively in themes as well as quantitatively using frequencies, means, standard deviations, Pearson correlation, ANOVA and simple linear regression analysis.

Results: The findings revealed that teacher coaching has statistically significant effect on pedagogical competence in public secondary schools in Kenya, ($t= 7.325$, $B=0.000$) $p = .0001$).

Conclusion: The results suggest that teacher coaching has a significant effect on pedagogical competence. An increase of 1 unit in effects of Teacher coaching leads to an increase in pedagogical competence by 0.095 units. Further it was found most teachers had a good understanding of teacher coaching and had participated in teacher coaching practices which influenced their strong pedagogical competence. It was also found that some schools had adequate teacher coaching programmes in place

Keywords: Teacher coaching; pedagogical competence; public secondary schools; Kenya.

1. INTRODUCTION

Teaching strategies of the 21 century worldwide are ever-changing and need constant upgrading through Teacher Mentorship Practices (TMP). Teacher coaching being a key component of teacher mentorship practice prepares teachers to face any challenge by equipping them with the necessary pedagogical competence they need to thrive in a rapidly changing teaching world.

According to the World Economic Forum [1], 90% of the world work force will need to be reskilled by the year 2025. It further underlines the preparation of learners for the fourth industrial revolution and leverages technology and pedagogical innovation to put learners at the center of learning. To this end, teachers need to be prepared and allow for new skills and competencies in teaching and learning. Reskilling of teachers by 2025 is necessary and the TSC can help teachers to adapt to 21st century teaching strategies through teacher coaching practices. There is broad agreement that teachers play a key role in providing high-quality learning opportunities to students and fostering students' teaching Schleicher, [2] by leveraging their expertise in, facilitating learning and serving as mentors and role models.

Teacher coaching refers to the assistance that teacher mentors provide to teacher mentees in the development or enhancing their pedagogical competence. Cauto and Jaureji (2017), posits that coaching is a professional dialogue designed to aid the coaches in developing specific professional skills to enhance teachers teaching repertoire. Bainton, et al., [3], "observes that Master Card Foundation (MCF) recognizes that teachers are central to an education system and that teacher quality is the single most important school-based variable affecting student

performance, they further assert that strengthening schoolbased support is essential for developing the professional capabilities of teachers including in-service training workshops, mentoring, and peer learning". Okumu, et al., [4] "reaffirms that mentorship is an interactive process that helps individuals acquire teaching skills based on lesson design, methods of delivery, stimulating interests in the subject and motivating students to learn more effectively and efficiently thus to improve teacher effectiveness mentoring is to be a continuous process".

Teacher coaching helps novice teachers in enhancing their pedagogical competence, Kraft, et al., [5] Effective teacher coaching programmes have been linked to higher job satisfaction, teacher retention and professional growth for example Will [6] reported that in the United States 86% of new teachers supported by a mentor teacher in the first years of their career remain in the classroom, while 71% of those without mentors leave the profession. This study underscored the importance of teacher coaching programmes for new teachers. Having a teacher mentor provides valuable support, guidance and Professional Development (PD) opportunities that can help novice teachers navigate the challenges of their early career years. When teachers' mentees feel supported, valued and empowered through teacher coaching, they are more likely to thrive in their classroom practices.

In Africa, a study by Molla et al., [7], found out that "faculty members' performance on 21 century teaching and learning competencies such as developing skills in critical thinking and problem solving, creativity and innovation, collaboration, communication, and information communication technology could not be considered satisfactory. The findings of the study suggested that urgent interventions are needed

to develop university faculty members' 21 century pedagogical competence in the selected universities of Ethiopia. The 21st century classroom requires 21 century teachers and students”.

Studies conducted in Kenya have shown that quality education, meaningful teaching and positive learning outcomes results from teacher mentorship practices. Watene et al., [8] asserts that, when teachers achieve deeper knowledge of contents in various subjects, it improves their confidence in teaching and ensures students get quality knowledge that translates to improved performance in Kenya Certificate of Secondary Education (KCSE). However, these studies covered a limited scope. This study fills the existing gap with focus on TMP and pedagogical competence in public secondary schools across Kenya.

1.1 Statement of the Problem

In top performing education systems around the world, teachers are highly esteemed and valued by training them to develop the right skills and focus on building their capacity [9]. The government of Kenya is committed to improve teaching standards and quality of education through its policy on Teacher Induction, Mentoring and Coaching, TIMEC (TSC, 2020). To enhance the TSC endeavor, novice teachers are expected to go through teacher coaching programmes initiated by the principals and more experienced teachers in the relevant subjects in order to improve pedagogical competence or their classroom practices.

Teacher coaching equally encourages novice teachers to reflect on their own teaching methods or practices by comparing and contrasting them with what they observe in experienced or teacher mentors. This promotes self-awareness, critical thinking, identify strength plus areas of improvement and continuous improvement in their pedagogical competence.

Despite that, theoretical intentions of teacher coaching do not always translate into practice or expected results in most schools. Thurlings and Brok [10] study findings showed that learning outcomes could be achieved through participating in such activities as teacher coaching. The outcomes were achieved in terms of teacher knowledge, teacher skills, and student learning. However, many studies had methodological weaknesses: many self-report

and self-constructed instruments that were hardly based on theory were applied. Drawing from the research outcomes, the researchers advocate for increased emphasis on more rigorous studies that can advance the realm of teacher coaching forward. The current study provides an understanding of the effect of teacher coaching on pedagogical competence in Kenya. Thus by enhancing teacher coaching in public secondary schools will lead to improved novice teachers classroom practices or pedagogical competence leading to improved learners' outcome.

2. LITERATURE REVIEW

Teacher coaching refers to the assistance that teacher mentors provide to teacher mentees in the development or enhancing of teaching/pedagogical competence. Jaureji and Melchor-Cauto [11] posits that coaching is a professional dialogue designed to aid the coaches in developing specific professional skills to enhance teachers teaching repertoire.

Zhang et al., [12], looked at “peer coaching in teachers’ online professional learning communities. The findings of the study suggest that development of teachers’ pedagogical, content, and technological knowledge may help to improve the effect of peer coaching and conducting training for teachers before the peer coaching process may help”.

Thurlings and Brok (2017) “looked at learning outcomes of TPD activities as a meta-study. In the literature review, they explored a variety of peer TPD activities, conceptually divided into coaching, collaborating, and assessing activities. Findings showed outcomes were achieved in terms of teacher knowledge, teacher skills, and student learning. At the same time, many studies had methodological weaknesses: many self-report and self-constructed instruments hardly based on theory were applied. Based on the findings, they urge for more rigorous studies that can move the field forward”.

Ben-Peretz et al., [13] “discussed the principles of peer coaching in teacher development, by examining peer coaching between two experienced teacher educators. From this analysis, they derive two major concepts as guiding the process of peer coaching: joint deliberation and meta-pedagogy. These two features are conceptualized using excerpts from the case study and from the literature”.

Ma et al., [14], “explored a peer coaching based PD approach to improving the learning participation and learning design skills of in-service teachers. The findings indicated that the post test scores of the experimental group were significantly higher than those of the control group. The peer coaching based personalized learning approach had a much better effect than the expert guidance-based personalized learning approach on the in-service teachers’ learning participation, learning design skills, and in practice teaching abilities”.

Piper et al., (2018),” focused on identifying the essential ingredients to literacy and numeracy improvement: The results showed that the third combination PD, teacher instructional support and coaching, 1:1 student books, and structured teacher lesson plans, was most effective. A cost-effectiveness analysis on the ingredients showed that the option of PD and instructional support, 1:1 revised books, and teachers’ guides was the most expensive, but that the additional impact on learning made this the most cost-effective intervention”.

Kraft et al., [5] “reviewed the empirical literature on teacher coaching and conducted meta-analyses to estimate the mean effect of coaching programs on teachers’ instructional practice and students’ academic achievement. Although these findings affirm the potential of coaching as a development tool, further analyses illustrate the challenges of taking coaching programs to scale while maintaining effectiveness. Average effects from effectiveness trials of larger programs are only a fraction of the effects found in efficacy trials of smaller programs”.

Cornelius et al., [15], “examined the impact of PD and coaching on mentoring of novice special educators. The study investigated specialized PD and individualized coaching for general education teacher mentors. Results indicated a functional relationship between the intervention and mentor knowledge as well as the ability to identify components of specialized instruction. The novice special educators improved their instructional practices after being mentored by those who received the PD and specialized coaching”.

Pianta et al., [16], “explored teacher coaching to improve students’ school readiness skills: indirect effects of teacher–student interaction. Findings indicated teachers engaged in more feedback cycles, showed greater improvements in

instructional interactions and in turn predicting greater increases in students’ early literacy and working memory”.

Dewi, [17], “examined how to boost teacher pedagogic competence using a mentoring coaching approach. The collected data were analyzed qualitatively and quantitatively. The findings indicated that teacher pedagogic was able to rise using this combined technique”.

Gamage et al., [18], aimed to evaluate the “impact of coaching and mentoring on enhancing student engagement in the higher education sector. The findings of the study recommend that the higher educational institutes should administer a sound mentoring process that meets the ethical backgrounds to consistently support the continuous improvement of the students in an online learning environment to enhance their engagement in learning activities”.

Cilliers et al., [19] “looked at the prospects of replacing in person with virtual coaching. They concluded that while virtual communication holds the promise of enabling low-cost PD at scale, the benefits of in person interaction might be difficult to replicate. In an experimental study in South Africa comparing on site with virtual coaching of public primary school teachers, the study revealed that on site coaching improved students’ English oral language and reading proficiency (0.31 and 0.13 SD, respectively) while virtual coaching had a smaller impact on English oral language proficiency (0.12 SD), no impact on English reading proficiency, and negative effect on home language literacy. The top performing students consistently benefited most. Classroom observations show that on-site coaching improved teaching practices, while virtual coaching led to larger crowding-out of home language teaching time. Implementation and survey data suggest technology itself was not a barrier to implementation, but rather that in person contact enabled more accountability and support”.

Guedes [20] “looked at the effect the coaching model of PD has on the building of teacher capacity. The study examined the influence of the growing coaching model of PD on the capacity building of teachers in an educational context. These responses provide an important insight into what changes may occur in teacher pedagogy and teacher disposition, evidenced through changes in the classroom environment and the teachers’ thinking processes”.

Stuhlman et al., [21], “looked at integrating research supported coaching practices into secondary teachers’ team meetings: early indications of potential to impact collaborations, classroom interactions, and student engagement. The study showed that teaching partner secondary programs demonstrated improvements in classroom interactions and student outcomes in secondary schools using one-on-one coaching between study staff and teachers”.

Zimmer and Mathews [22] “focused on a virtual coaching model of PD to increase teachers’ digital learning competencies. Teacher hypothesized research highlights teaching digital literacy versus using it to learn. Furthermore, little research assesses the effectiveness of PD methods in providing digital literacy support to teachers. This mixed-methods experimental study addresses these concerns by creating a virtual coaching PD model to increase teachers’ digital learning identity, with teachers demonstrating concerns over staying current with changing technology, study results indicate coaching as one innovative approach to PD”.

Kwok, et al., [23] “investigated the pedagogical beliefs of novice teachers and their coaches throughout a two-year induction program and how those beliefs impact their induction experiences were explored. The study identified differences in how novice teachers and their coaches process induction and the need for greater connection across novice teacher learning environments. That is, there needs to be more-coordinated efforts to create vertical PD for novice teachers. Findings have implications for induction design and structures to help promote novice teacher development”.

Geletu, [24], “looked at the effect of pedagogical mentoring and coaching on primary school teachers’ PD practices and students’ learning engagements in classroom in Oromia regional state: Implications for professionalism. The results showed that mentoring practices improved teachers’ basic professional competencies; ($R^2 = .2437$ at $p < .05$). while coaching practices improved teachers’ specific competence development ($R^2 = .185$ at $p < .05$). The mentoring and coaching practices occurred against plan-do-study-act-evaluation paths. The practices particularly improved newly deployed teachers emotional safety, wellbeing and innovative pedagogical competencies of experienced teachers”.

Renes, [25], “investigated the concept of teacher coaching in a suburban Midwestern school district. The findings of the study allowed the researcher to share with the leaders of the focus district and other ideas for possible future study, as well as suggestions for things to embrace and possibly avoid when attempting to create an environment in which teacher coaching is utilized to professionally develop staff and improve their effectiveness, so that student performance ultimately improves”.

Menking, [26], “examined a wide range of research on how various coaching models at the primary and secondary levels affect teacher development and eventually impact on student achievement. The study findings showed that coaching models implemented as ongoing PD with established relationships and trust are effective in impacting development and learner achievement”.

Palacio and Digo [27] “Qualitative study identified the master teachers’ coaching and mentoring practices to be able to develop and evaluate the effectiveness of the instructional coaching and mentoring handbook along with the preparation of the proposed adoption guidelines. A guideline was developed to adopt and utilize the instructional coaching and mentoring handbook for master teachers and improve their instructional coaching and mentoring”.

2.1 Scope

The study was limited to teacher coaching and pedagogical competence in public secondary schools in Kenya where the Teachers Service Commission (TSC) has endeavored to implement Teacher Induction Mentorship and Coaching (TIMEC) policy on teacher mentorship practices. The study involved 72 public secondary schools from 36 counties in Kenya. School principals, head of departments; teacher mentors and novice; teacher mentees were respondents.

2.2 Justification of the Study

The study is useful to TSC as the institution reviews the mentorship and coaching policy for its effective implementation and improving teacher classroom practices/pedagogical competence. This study provides practical recommendations for improving long-term public secondary school teacher 21st century competencies. Moreover, Learners in the 21st

century are confronted with increasingly complex social, cultural, economic, technological, and global challenges; therefore well mentored teachers are needed to prepare learners who possess sophisticated, diversified, and complementary competencies that might enable them to navigate through these challenges. And lastly since public secondary schools are directly influenced by government policies: TSC, TIMEC and regulations, which play a crucial role in shaping the education system, therefore by conducting the study in public secondary schools, researchers can identify key issues and challenges that may require policy interventions and improvements According to Bold et al., (2017) teacher quality is a key determinant of student learning outcome and teachers play a key role in closing the gap between poor and good quality education by; maximizing the benefits of learning in every classroom for every child. This study focused on teacher coaching and pedagogical competence in public secondary schools in Kenya.

3. METHODOLOGY

3.1 Study Design

The study adopted mixed methods research design; the design combines elements of qualitative and quantitative research methods within a single study that was used in order to allow for triangulation of data that the researcher got from FGD. The study was grounded in the pragmatism research paradigm; qualitative data gave depth and context to quantitative data in this study, while quantitative data provided statistical support and generalization to qualitative findings of the study.

3.1.1 Target population

The target population was 105,234 teachers from 8,933 public secondary schools in 47 counties in Kenya.

3.1.2 Sampling techniques

Simple random sampling was used to select 36 counties from which 2 national schools (one boys school and one girls school) were selected, bringing the total to 72 national schools. The Principals in the selected schools took part in the study. Of these, however, only 12 principals were randomly selected to participate in the FGD. From the sampled schools, purposive sampling was further employed to recruit 184 HOD's /

teacher mentors while simple random sampling was used to recruit 184 novice/teacher mentees to take part in the study. Reliability was ensured by conducting a pilot study, Cronbach's alpha coefficient was used to measure reliability of the research instruments and factor analysis was conducted to test validity.

Data collection was done using FGD and questionnaires and analyzed using themes and descriptive statistics through'; frequencies, mean and standard deviations, while quantitative data using Pearson correlation, ANOVA and simple linear regression analysis. Mixed methods research was used in order to allow for triangulation of data from FGD; the results from quantitative data were validated and complemented from qualitative methods thus enhancing the credibility and reliability of the study. The methods enabled the researcher to enhance the validity of the study findings by addressing any potential biases and limitations of one method. The method provided flexibility in collecting and analyzing data for this study.

3.1.3 Sample size

To get the sample size, the study used Krejcie and Morgan table [28] to determine a sample of 384 with an oversampling of 56 to improve the statistical power. The study sample size therefore was 440 respondents that comprised 72 principals, 184 teacher mentors; HODs or heads of subjects with five or more years of teaching experience and 184 teacher mentees who were novice teachers with less than five years in teaching in five academic departments in sampled schools. The study was carried out in public national schools as they are known for their rigorous academic programs, well equipped and high educational standards. These schools also receive new teachers yearly and have a tradition of mentoring novice teachers.

Principals were purposely sampled, to represent their institutions in the study. Purposive sampling was used to recruit HODs as teacher mentors from specific departments in the schools that participated in the study while simple random sampling was used to recruit teacher mentees who were paired up with HODs in their respective departments and subject areas. Maintaining an equal number of teacher mentors and teacher mentees in the study, helped optimize the effectiveness of mentoring programs, promote fairness and equity, and enhanced the quality of mentorship relationships

that allowed for deeper and more meaningful connections, collaboration between the HODs, novice teachers and principal was key to this study. A Sample Frame of the individuals that participated in the study is shown in Table 1.

Table 1. Summary of sample frame

Category	Target Population (N)	Sample Size (n) ±5
Principals	8,933	72
Teacher Mentors	48,145	184
Teacher Mentees	48,145	184
Total	105,234	440

Source: Researcher, 2024

3.1.4 Data collection, analysis and presentation

The study made use of FGD and online questionnaires to collect data. Nyumba et al., [29] asserts that FGD is frequently used as a qualitative approach to gain an in-depth understanding of social issues. Information gathered from the focus group, was used to understand the group’s perspective on teacher modeling practices and pedagogical competence in public secondary schools in Kenya. Thematic analysis was used to analyze qualitative data. According to Caulfield, (2023), a thematic analysis is a method of analyzing qualitative data. The responses from FGD were coded to generate themes, reviewing themes, defining and naming of themes and lastly writing up.

Online Survey Questionnaires targeted principals, teacher mentors, and teacher mentee. The questionnaire for teacher mentors had 30 items for mentors and 30 for lesson observation related to teacher mentorship practices and their pedagogical competencies. The questionnaires were presented in Google form and were distributed to participants after obtaining their consent through email and WhatsApp social media. The collected data from online responses was cleaned, converted into excel and analyzed using both descriptive and inferential statistics.

Data from online questionnaires was screened and cleaned to remove outliers and any biases then classified and tabulated for data analysis. Statistical Package for Social Sciences (SPSS) was used to analyze data. The study was based on a scale of 5-point Likert used by the respondents in data collection using the online questionnaire. The scale was interpreted using the ranges of 1– 5, where 1 = Not at all, 2=

slightly agree, 3 = moderately agree, 4 = Agree, and 5 = fully agree. In addition to the use of percentages and the mean values, the corresponding standard deviation of each item was reported to evaluate the level of variance

The inferential statistics; linear regression analysis and ANOVA were used to test the hypothesis at 0.05 level of significance. The study sought to determine the effect of teacher coaching on pedagogical competence in public secondary schools in Kenya.

In order to determine the effect, a linear regression analysis was done to make a prediction. The model was of the form; $Y_j = b_0 + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + \epsilon$

Where $X_1 \dots X_n$ are the independent variables.

Y = Pedagogical Competence

b_0 - Constant

$b_1 - b_5$ - Regression coefficient is the net change in Y for each unit change in X_2 holding X_2 . Teacher coaching.

X_1 - Teacher Modeling

X_3 - Teacher Role-Playing

X_4 - Collaborative Teaching

X_5 - Consultative Teaching

X_n Qualitative data was transcribed and reported thematically in line with the objectives

4. RESULTS AND DISCUSSION

4.1 Mentee Response on Teacher Coaching

Data from Table 2 shows that more than half (63.7 %) of the teacher mentee agreed or fully agreed that they have good understanding of teacher coaching. 48 (32.2 %) mentees fully agreed and 47 (31.5 %) mentees agreed, 28 (18.8%) mentees moderately agreed this is a strong indication that most had good understanding of teacher coaching. 26 (17.5 %) mentees slightly agreed or did not agree at all. The findings indicate that a significant majority of teacher mentees in public secondary schools in

Kenya feel well-informed and knowledgeable about teacher coaching. Teacher mentees are likely to be more receptive and engaged in teacher coaching practices and better equipped to actively participate in their own PD and apply the feedback and guidance provided teacher mentors to enhance their pedagogical competence. Teacher mentees who have knowledge about teacher coaching are more likely to be proactive in seeking support, feedback and guidance from their teacher mentors leading to a more collaborative and productive mentorship relationships and trust. Training sessions, resource provision, open line of communication, encouraging them to reflect on their classroom practices, set goals for improvement and allow for peer observation sharing best practices among teacher mentees can deepen their understanding of pedagogical competence and can also learn from the experience of their colleagues.

At the same time, more than half of the teachers mentee (51.0 %) slightly agreed or did not agree at all that their school has adequate teacher coaching programmes in place. 46 (30.9%) mentees fully agreed, 49 (32.9 %) mentees agreed and 29 (19.5%) mentees moderately agreed. The findings indicate that a significant portion of public secondary schools in Kenya have teacher coaching programmes in place. The scenario highlights a gap in teacher support and PD. The study suggests that there may be room for improvement in coaching programmes being offered to teachers in these schools.

A majority of the teachers' mentees (39.9 %) agreed or fully agreed that teacher coaching practices have enhanced the way I introduce and organize my lessons. 33 (22.1%) mentees fully agreed, 25 (16.8 %) mentees agreed, 34 (22.8%) mentees moderately agreed. The findings indicate that teacher coaching practices have a positive impact on novice teachers' ability to introduce and organize their lessons effectively. This implies that support and guidance is provided through teacher coaching which has improved their instructional skills or pedagogical competence.

The teacher mentees also agreed that they participated in teacher coaching practices to enhance their subject content delivery (53.0%). 37 (24.8 %) mentees fully agreed and 42 (28.2 %) mentees agreed, this implied teacher coaching practices enhances subject content delivery. 37 (24.8 %) mentees moderately

agreed while 33 (22.1 %) mentees slightly agreed or did not agree at all. The study findings indicate that a significant portion of teacher mentees recognize the value of teacher coaching in improving pedagogical competence in terms of subject content delivery. This suggests that teacher coaching in public secondary schools plays an important role in supporting and enhancing their ability to effectively teach subject –specific content.

The teacher mentees also agreed that they participated in teacher coaching practices to enhance their teaching strategies (63.7%). 44 (29.5%) mentees fully agreed and 51 (34.2 %) mentees agreed, this implied teacher coaching practices enhance teaching strategies. 37 (24.8 %) mentees moderately agreed while 34 (22.8 %) mentees slightly agreed or did not agree at all. The findings indicate that a significant majority of teachers recognize the value of teacher coaching in improving their classroom practices, approaches and strategies. This shows that teacher coaching may be seen as a beneficial tool for supporting novice teachers in developing and refining their teaching methods to be more effective in the classroom.

At the same time more than half (56.4 %) of the teacher mentee teachers agreed that they participated in teacher coaching practices to enhance their classroom management skills. 43 (28.9 %) mentees fully agreed and 41 (27.5 %) mentees agreed, this implied that most of the teachers participated in teacher coaching practices to enhance their classroom management skills. 25 (16.8 %) mentees moderately agreed and 40 (36.8 %) mentees slightly agreed or did not agree at all. These findings indicate that a significant portion of novice teachers recognize the importance of teacher coaching in improving their ability to effectively manage the classroom. This suggests that teacher coaching is valued for its role in supporting novice teachers in improving their classroom practices or developing pedagogical competence in public secondary schools.

The study further noted that 42.9 % of the mentees agreed that they participated in teacher coaching practices to enhance their communication skills. 33 (22.1 %) mentees fully agreed and 31 (20.8 %) mentees agreed, this implied that most teachers participated in teacher coaching practices to enhance their communication skills. 19 (12 %) mentees moderately agreed and 38 (25.5 %) mentees

slightly agreed. These findings indicate that a significant portion of novice teachers recognize the value of teacher coaching in improving their ability to effectively communicate with learners. Effective communication skills are essential for building positive relationships between novice teachers and learners.

On the other hand a majority of the teacher mentees (45.6 %) slightly agreed or did not agree that they participated in teacher coaching practices to enhance use ICT and digital skills. 26 (17.4%) mentees did not agree at all and 42 (28.2 %) teacher mentees slightly agreed, These findings indicate that most teachers participated in teacher coaching practices to enhance their use ICT and digital skills. However some novice teachers may not fully understand the importance of participating in teacher coaching practices to enhance ICT and digital skills. This can imply that teacher mentorship may lack necessary resources, such as training material, technology tools or dedicated time for teacher coaching which could hinder the effective enhancement of ICT and digital skills among novice or teacher mentees in public secondary schools.

4.2 Mentors Response on Teacher Coaching

The teacher mentors were requested to rate their views on teacher coaching. The findings are presented in Table 3.

Findings from Table 3 shows that more than half (57.0%) of the teacher mentors agreed or fully agreed that teacher coaching has enhanced the skills of lesson introduction and organization of novice/less experienced teachers in their department. 38 (25.5 %) mentors fully agreed and 47 (31.5 %) mentors agreed, 34 (22.8%) mentors moderately agreed this is a strong indication that teacher coaching has enhanced the skills of lesson introduction and organization of novice/less experienced teachers in their department. 30 (20.2 %) mentors slightly agreed or did not agree at all. The findings suggest that teacher coaching practices are perceived as beneficial in enhancing lesson introduction and organization of novice teachers in secondary school. Teacher coaching provides personalized support and guidance to novice teachers helping them improve their classroom practices or pedagogical competence. Novice teachers can benefit from experience and expertise of teacher mentors gaining valuable insights and strategies

to enhance their classroom practices eventually contributing to the overall quality of education and positive learner outcome in public secondary schools. Through ongoing Continuous Professional Development (CPD) opportunities both teacher mentor and mentee to ensure that teacher coaching practices are up-to-date and effective.

A majority of the teachers moderately agreed. These findings indicate that teacher coaching has improved novice/new teachers' teaching methods & techniques during their teaching in the department. There is a strong positive perception among teacher mentors regarding the impact of teacher coaching on novice teachers teaching methods and techniques in public secondary schools.

At the same time a majority of the teachers' mentors (44.3 %) slightly agreed or did not agree at all that teacher coaching has enhanced novice/less experienced teachers' learner involvement and communication skills in the department. 27 (18.1%) mentors did not agree at all and 39 (26.2 %) mentors slightly agreed. 24 (16.1%) mentors moderately agreed and 35 (23.5%) mentors agreed. This indicated that teacher coaching did not enhance novice/less experienced teachers' learner involvement and communication skills in the department in public secondary schools. The findings may suggest that there is room for improvement in the teacher coaching programs aimed at enhancing novice teachers' learning.

The teacher mentors also fully agreed or agreed that teacher coaching has enhanced classroom management skills of novice/less experienced teachers in my department (61.0%). 44 (29.5 %) mentors fully agreed and 47 (34.9 %) mentors agreed, 29 (19.5 %) mentors moderately agreed while 29 (19.5 %) mentors slightly agreed or did not agree at all. This indicates that teacher coaching has enhanced classroom management skills of novice/less experienced teachers' in public secondary schools. The study signals strong consensus among these teacher mentors regarding the effectiveness of teacher coaching in improving the classroom management skills of novice teachers.

On the other hand, a majority of the teacher mentors (44.3 %) slightly agreed or did not agree that their teacher coaching has enhanced the use of ICT and digital literacy skills of novice/less experienced teachers in my department.

29(19.5%) mentors did not agree at all and 37 (24.8 %) mentees slightly agreed, 28 (18.8 %) mentors moderately agreed while 27 (18.8 %) mentors agreed. This indicated that teacher coaching did not enhance the ICT and digital literacy skills of novice/less experienced teachers in departments. The relatively balanced distribution of responses may suggest varying opinions or experiences among teacher mentors on teacher coaching and use of ICT and digital literacy skills.

4.3 Correlation between Teacher Coaching and Pedagogical Competence

In order to establish the relationship between; Correlation between Teacher coaching and pedagogical competence, *Pearson* correlation analysis was used to find out if there existed a relationship. A correlation is a number between -1 and +1 that measures the degree of relationship between two variables. The correlation coefficient value (r) that ranges from 0.10 to 0.29 would be considered weak, from 0.30 to 0.49 would be considered medium and from 0.50 to 1.0 would be considered strong. Therefore a positive value for the correlation would imply a positive relationship and a negative value for the correlation would imply an inverse or negative association. The study findings are shown on Table 4.

Table 4 shows there exists a correlation between teacher coaching and pedagogical competence in Kenya. With correlations between .025 and .742; five factors of teacher coaching correlated with pedagogical competence; hence likely affected by teacher coaching practices. The Pearson correlation index obtained on the first variable “I have good understanding of teacher coaching” was $r=.742$, it is a strong positive correlation with $p = .0001$ which is less than $\alpha = .05$ which means teacher coaching likely affected pedagogical competence. The second variable, “This school has adequate teacher coaching programmes in place” moderately correlates with pedagogical competence. ($r = .624$, $p=.29$) at $\alpha=.05$). The fourth variable “I have participated in teacher coaching practices to enhance my subject content delivery.” moderately correlated with pedagogical competence. ($r = .458$, $p=.07$) at $\alpha=.05$). The fifth variable “I have participated in teacher coaching practices to enhance my teaching strategies” moderately correlated with

pedagogical competence. ($r = .523$, $p=.29$) at $\alpha = .05$).

The sixth variable “I have participated in teacher coaching practices to enhance my classroom management skills” strongly correlated with pedagogical competence. ($r = .562$, $p=.033$) at $\alpha = .05$). However, the correlation between the third seventh and eight variable and pedagogical competence was not statistically significant i.e. ($r = -.125$, $p=.335$) at $\alpha = .05$), ($r = -.25$, $p=.221$) at $\alpha = .05$) and ($r = -.205$, $p=.124$) respectively at $\alpha = .05$).

4.4 Regression Analysis and Hypothesis Testing

Diagnostic tests were done to ensure that the assumptions of the regression model were met and proceeded to test the formulated null hypothesis which stated that; **Ho₂: Teacher coaching has no statistically significant effect on pedagogical competence in public secondary schools in Kenya.** Simple linear regression analysis was used to test the hypothesis at 0.05 alpha levels. Tables 5, 6 and 7 showed the information from the analysis.

Table 5 shows the value in R , ($r = .423$), indicating a medium positive relationship between the two variables- teacher coaching and pedagogical competence. The coefficient of determination, R -Square, ($R^2 = .371$), reveals that 37.1 % variability in pedagogical competence can be explained by teacher coaching practices. The analysis indicates that 62.9 % unexplained variation can be attributed to other factors not included in this model. Further Table 6 presents the ANOVA results.

Table 5 discloses whether or not the model is a significant predictor of pedagogical competence. The analysis in Table 6 shows ANOVA results of $F=83.256$ with 1 and 147 degrees of freedom and F being significant at $p<.05$. Given this result, it can be presumed that the regression model significantly predicts the extent to which Teacher coaching practices affect pedagogical competence. The regression equation established from this output may be stated as $F(1,147) = 83.256$ $p = .0001$. Furthermore, Regression Coefficient (Table 7) reveals how (Teacher coaching practices) the predictor variables contribute to the model.

Table 2. Mentee response on teacher coaching

Statement	1	2	3	4	5	Mean	SD
I have good understanding of teacher coaching	7 4.7%	19 12.8%	28 18.8%	47 31.5%	48 32.2%	3.738	0.895
This school has adequate teacher coaching programmes in place	7 4.7%	18 12.1%	29 19.5%	49 32.9%	46 30.9%	3.732	1.256
Teacher coaching practices has enhanced the way I introduce and organize my lessons	23 15.4%	34 22.8%	34 22.8%	25 16.8%	33 22.1%	3.074	1.356
I have participated in teacher coaching practices to enhance my subject content delivery	10 6.7%	23 15.4%	37 24.8%	42 28.2%	37 24.8%	3.490	1.023
I have participated in teacher coaching practices to enhance my teaching strategies	2 1.3%	18 12.1%	34 22.8%	51 34.2%	44 29.5%	3.785	0.996
I have participated in teacher coaching practices to enhance my classroom management skills	16 10.7%	24 16.1%	25 16.8%	41 27.5%	43 28.9%	3.477	0.568
I have participated in teacher coaching practices to enhance my communication skills	28 18.8%	38 25.5%	19 12.8%	31 20.8%	33 22.1%	3.020	1.324
I have participated in teacher coaching practices to enhance use of Information Communication Technology and digital skills	26 17.4%	42 28.2%	20 13.4%	34 22.8%	27 18.1%	2.960	1.652
Total						3.410	1.134

Table 3. Mentors response on teacher coaching

Statement	1	2	3	4	5	Mean	SD
Teacher coaching has made novice/new teachers in my department perfect lesson introduction and organization skills during teaching.	5 3.4%	25 16.8%	34 22.8%	47 31.5%	38 25.5%	3.591	1.582
Teacher coaching has improved novice/new teachers' mastery of subject content delivery skills in my department.	23 15.4%	45 30.2%	25 16.8%	31 20.8%	25 16.8%	2.933	1.235
Teacher coaching has improved novice/new teachers' teaching methods & techniques during their teaching in my department.	12 8.1%	16 10.7%	22 14.8%	57 38.3%	42 28.2%	3.678	1.635
Teacher coaching has enhanced novice/less experienced teachers' learner involvement and communication skills in the	27 18.1%	39 26.2%	24 16.1%	35 23.5%	24 16.1%	2.933	1.221

Statement	1	2	3	4	5	Mean	SD
department.							
Teacher coaching has improved novice/less experienced teachers' classroom management skills in my department.	5 3.4%	24 16.1%	29 19.5%	47 31.5%	44 29.5%	3.678	1.336
Teacher coaching has enhanced ICT and digital literacy skills of novice/less experienced teachers that have been mentored	29 19.5%	37 24.8%	28 18.8%	27 18.1%	28 18.8%	2.919	1.235
Total						3.289	1.374

Table 4. Pearson correlation of teacher coaching and pedagogical competence

	Pearson's Correlation	1	2	3	4	5	6	7	8	9
1 Pedagogical competence	Correlation Sig.	1								
2 I have good understanding of teacher coaching	Correlation Sig.	.742** .000	1							
3 This school has adequate teacher coaching programmes in place	Correlation Sig.	.624** .029	.685** .002	1						
4 Teacher coaching practices has enhanced the way I introduce and organize my lessons	Correlation Sig.	.125 .335	.201 .351	.204 .356	1					
5 I have participated in teacher coaching practices to enhance my subject content delivery	Correlation Sig.	.458** .007	.458** .021	.723** .000	.389** .043	1				
6 I have participated in teacher coaching practices to enhance my teaching strategies	Correlation Sig.	.523** .029	.201 .428	.592** .041	.021 .952	.458** .035	1			
7 I have participated in teacher coaching practices to enhance my	Correlation Sig	.562** .033	.396** .042	-.130 .756	-.117 .782	.189 .862	.059 .852	1		

	Pearson's Correlation	1	2	3	4	5	6	7	8	9
classroom management skills										
8 I have participated in teacher coaching practices to enhance my communication skills	Correlation	.025	.385**	.035	.053	.453**	.389**	.532**	1	
	Sig.	.221	.534	.712	.486	.042	.043	.033		
9 I have participated in teacher coaching practices to enhance use my of Information Communication Technology and digital skills	Correlation	.205	.359**	.102	.023	.125	.538**	.110	.113	1
	Sig.	.124	.965	.862	.475	.563	.037	.352	.235	

** Correlation is significant at the 0.05 level (2-tailed)

Source: Author 2024

Table 5. The Regression Model Summary for Effects of Teacher Coaching on Pedagogical Competence

Model Summary						
Model	R	R- Square	Adjusted R- Square	Std. Error of the Estimate	p-value	
1	.423 ^a	.402	.371	.42862	.000	

a. Predictors: (Constant), Teacher coaching

b. Dependent Variable: pedagogical competence

Table 6. ANOVA Test for the effects of Teacher Coaching on Pedagogical Competence

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	36.325	1	26.321	83.256	.000 ^a
	Residual	78.325	147	3.256		
Total		114.65	148			

a. Predictors: (Constant), Teacher coaching

b. Dependent Variable: pedagogical competence

Table 7. Regression Coefficient for the effects of Teacher Coaching on Pedagogical Competence

Coefficients						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	Constant	3.256	1.325		24.236	.000
	Teacher coaching	.095	.006	.068	7.325	.000

a. Predictors: (Constant), Teacher coaching

b. Dependent Variable: pedagogical competence

Table 7 shows the results of the regression coefficient analysis. It provides information about the change in the value of the dependent variable (*pedagogical competence*) corresponding to one unit change in the independent variable (Teacher coaching practices). The data in Table 7 indicates the model; Y (*pedagogical competence*) = $3.256 + .095 X_1 + \varepsilon$ (X_1 = Teacher coaching practices), where Y is the estimated value of the dependent variable, and X , the value of the independent variable. From the regression coefficient, an increase of 1 unit in effects of Teacher coaching leads to an increase in pedagogical competence by 0.095 units. This indicates the effects of teacher coaching practices that explained the significant proportion of variation in pedagogical competence, ($t= 7.325$, $B = .000$) $p = .0001$). Based on this, the study rejected the null hypothesis, H_02 that; “Teacher coaching has no statistically significant effect on pedagogical competence in public secondary schools in Kenya...” This suggests that teacher coaching practices have a positive significant effect on pedagogical competence. This is in line with a study by Zimmer and Mathews (2022) whose

results indicate teacher coaching as one innovative approach to teacher professional development.

Respondent 2 remarked that;

“Teacher coaching is a vital mentorship practice that sharpens mentee teachers’ pedagogical competence, and a good teacher should love to be coached and to coach other teachers, you cannot reinvent the wheel”

Respondent 3 had this to say;

“Teacher coaching has improved the pedagogical competence of novice teachers however, coaching depends on the attitude of the one being coached, a teachers who is negative cannot apply the teaching skills learnt”

The results in Table 7 are also in line with Albert Bandura’s social cognitive theory of 1986 which guided this study. It postulated that learning occurs through observation; in a social context with a dynamic and reciprocal interaction of the

person, environment and behavior. It emphasizes on the importance of social influence, the external and internal social reinforcement. Using the theory as a theoretical foundation, the reciprocal influences between teacher mentors and mentees, social interactions, and learning experiences which occur through the teacher coaching process is explained. This mentorship practice shapes mentees' pedagogical skills and beliefs about effective instructions, making them competent in delivering effective classroom instructions [30,31].

5. CONCLUSION AND IMPLICATIONS

The results suggest that teacher coaching has a significant effect on pedagogical competence. An increase of 1 unit in effects of Teacher coaching leads to an increase in pedagogical competence by 0.095 units. Further it was found most teachers had a good understanding of teacher coaching and had participated in teacher coaching practices which influenced their strong pedagogical competence. It was also found that some schools had adequate teacher coaching programmes in place.

The findings as presented in this article recognize that coaching plays a pivotal role and should complement existing knowledge and experience rather than being the sole source of pedagogical competence. Policy makers in continuous teacher professional development and instructional leaders find evidence in this article to prioritize teacher coaching practices in improving pedagogical competence. However the study provides data on the general applicability of teacher coaching and not specific learning areas. Future researchers may advance the study in this area by undertaking a longitudinal study to unveil more evidence on the impact of teacher coaching in specific learning areas.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

ETHICAL APPROVAL

The authors obtained all necessary ethical approval from suitable Institutions and informed

consent was obtained from all individual participants included in the study.

ACKNOWLEDGEMENTS

I am grateful to the International Development Research Centre (IDRC-CRDI) for their generous support through the Strengthening In-Service Teacher Training (SITT) project; Kibabii University Kenya. It made my doctoral research possible. The funding has been instrumental in enabling me to pursue my academic goals and contribution to the field of Education.

This work was carried out with the aid of a grant from the International Development Research Centre, Ottawa, Canada. The views expressed herein do not necessarily represent those of IDRC or its Board of Governors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. World Economic Forum, Catalyzing education 4.0: investing in the future of learning For a. Human-centric recovery. Insight Report; 2022.
2. Schleicher A. Teaching Excellence through Professional Learning and Policy Reform: Lessons from Around the World. Paris: International Summit on the Teaching Profession; OECD Publishing; 2016 Available: <https://doi.org/10.1787/9789264252059-en>
3. Bainton D, Barrett AM, Tikly L. Improving secondary school teacher quality in Sub-Saharan Africa framing the issues. Bristol Working Paper in Education Series. Master Card Foundation and University of Bristol; 2016
4. Okumu JB, Ogwang TH, Opio G. An Exploration of Issues That Affect Mentoring and Teacher Effectiveness in Government Aided Secondary Schools in the Acholi Sub-Region. Creative Education. 2023; 14(7):1496-1508. DOI: 10.4236/ce.2023.147095
5. Kraft MA, Blazar D, Hogan D. The Effect of Teacher Coaching on Instruction and Achievement: A Meta-Analysis of the Causal Evidence. Review of Educational Research, 2018;88(4):547-588.

- Available:<https://doi.org/10.3102/0034654318759268>
6. Will M. Mentors for new teachers found to boost student achievement-by a lot. Education Week; 2017.
Available:https://blogs.edweek.org/teachers/teaching_now/2017/06/
 7. Molla D, Zhan H, He X, Xu Q. Overview of the 2023 ALTA Shared Task: Discriminate between Human-Written and Machine-Generated Text. In Proceedings of the 21st Annual Workshop of the Australasian Language Technology Association, Melbourne, Australia. Association for Computational Linguistics. 2023:148–152.
 8. Wetene, D., Choge, J. R. Kodak, B. Influence of Teachers' Professional Development on Performance in Kenya Certificate of Secondary Education in Public Secondary Schools. in Nyandarua County, The International Journal of Humanities & Social Studies. 2020;8(5).
DOI: 10.24940/theijhss/2020/v8/i5/HS2005-101Kenya
 9. UNESCO, UNESCO's ICT competency framework for teachers, UNESCO; 2021
 10. Thurlings M, den-Brok P. Learning outcomes of teacher professional development activities: a meta-study. Educational Review, 2017;69(5):554–576
Available:<https://doi.org/10.1080/00131911.2017.1281226>
 11. Couto SM, Jaureji K. The role of coaching in teacher competence development for tele-collaboration, Open Edition Journal, 2020;20(1)
<https://doi.org/10.4000/alsic.3149>
 12. Zhang S, Liu Q, Wang Q. A study of peer coaching in teachers' online professional learning communities. Univ Access Inf Soc. 2017;(16):37–34.
<https://doi.org/10.1007/s10209-016-0461-4>
 13. Ben-Peretz M, Gottlieb E, Gideon I. Coaching between experts – opportunities for teachers' professional development. Teacher Development, 2018;22(3):303–313.
Available:<https://doi.org/10.1080/13664530.2018.1438310>
 14. Ma, Ning, et al. A Peer coaching-based professional development approach to improving the learning participation and learning design skills of in-service teachers. Journal of Educational Technology & Society. 2018;21(2):291–304.
Available:<http://www.jstor.org/stable/26388408>
 15. Cornelius KE, Rosenberg MS, Sandmel KN. Examining the impact of professional development and coaching on mentoring of novice special educators. Action in Teacher Education. 2020;42(3)
<https://doi.org/10.1080/01626620.2019.1638847>
 16. Pianta RC, Lipscomb D, Ruzek E. Coaching teachers to improve students' school readiness skills: Indirect effects of teacher–student interaction. Child Development. 2021;92(6)
Available:<https://doi.org/10.1111/cdev.13600>
 17. Dewi I. A mentoring-coaching to improve teacher pedagogic competence: An action research. Journal of Education, Teaching and Learning. 2021;6(1):1-6.
Available:<https://www.learntechlib.org/p/219429/>.
 18. Gamage KAA, Perera DAS, Wijewardena MAD. Mentoring and Coaching as a Learning Technique in Higher Education: The Impact of Learning Context on Student Engagement in Online Learning. Educ. Sci. 2021;11(10):574
Available:<https://doi.org/10.3390/educsci11100574>
 19. Cilliers J, Fleisch B, Kotze, J, Moholwane N, Taylor S, Thulare T. Can virtual replace in-person coaching? Experimental evidence on teacher professional development and student learning. Journal of Development Economics. 2022;155 (102815),
Available:<https://doi.org/10.1016/j.jdeveco.2021.102815>
 20. Guedes .What effect does the coaching model of professional development have on the building of teacher capacity? A dissertation. The University of Melbourne; 2022
 21. Stuhlman M, Mikami AY, Hofkens T, Allen J, Pianta R, Smit S. Integrating Research-Supported Coaching Practices into Secondary Teachers' Team Meetings: Early Indications of Potential to Impact Collaborations, 2022;7; 883226.)
DOI: 10.3389/feduc.2022.883226
 22. Zimmers WK., and Mathews, SD. A virtual coaching model of professional

- development to increase teachers' digital learning competencies.2022:
23. Kwok A, Keese J, Suárez MI, Mitchell D, Huston D. Novice teacher vertical professional development? Exploring teachers' and coaches' beliefs throughout a two-year induction program. *Learning Environ Res*, 2022;5:255–270 Available:<https://doi.org/10.1007/s10984-021-09360-3>
 24. Geletu GM. The effect of pedagogical mentoring and coaching on primary school teacher's professional development practices and student 's learning engagements in classrooms in Oromia regional state: Implications for professionalism. *International Journal of Primary Elementary and Early Years Education*. 2023;3(12): 1-17 <https://10.1080/03004279.2023.2293209>
 25. Rene RA. Teacher coaching: What is it and what are the conditions necessary for greater engagement? A dissertation submitted to the faculty of the University of Michigan-Flint in partial fulfillment of the requirements of the degree of doctor of Education. University of Michigan 2023
 26. Menking K. Coaching model's impact on teacher development and student achievement. Thesis, Concordia University, St. Paul; 2024.
 27. Palacio HG. and Digo GS. Development of handbooks on instructional coaching and mentoring for master teachers. *International Journal of Social and Education Research Studies*. 2024;04(04):326-337.
 28. Krejcie RV, Morgan DW. Determining sample size for research activities. *Educational and Psychological Measurement*; 1970
 29. Nyumba T, Wilson K, Derrick C, Mukherjee N. The use of focus group discussion methodology: Insights from two decades of application in conservation. *Methods in Ecology and Evaluation*. 2018;9(9):2032
 30. Piper B, Zuilkowski SS, Dubeck M, Jepkemei E, King SJ. Teacher professional development and coaching, student textbooks, and structured teachers' guides. *World Development*. 2018;106:324-336 Available:<https://doi.org/10.1016/j.worlddev.2018.01.018>
 31. TSC, Policy on Mentorship and Coaching in Teaching Service. Kenya; 2020.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of the publisher and/or the editor(s). This publisher and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.

© Copyright (2024): Author(s). The licensee is the journal publisher. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

The peer review history for this paper can be accessed here:
<https://www.sdiarticle5.com/review-history/122608>