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# Teacher qualification, experience, capability beliefs and professional development: Do they predict teacher adoption of 21st century pedagogies?

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**Abstract**

The primary objective of the study is to unravel the role played by selected teacher variables in adoption of 21st century pedagogies in Kisii County, Kenya. We hypothesized that there is no statistically significant relationship between the teacher characteristics and adoption of 21st century pedagogies. Convergent parallel mixed method design was employed in this research. A randomized sample of science teachers (n=184) was used to avail required data. Ordinal logistic regression was used to establish to what extent the teacher variables predicted teacher adoption of 21st century pedagogies. The final model statistically significantly predicted the dependent variable over and above the intercept-only model. We conclude that the teacher characteristics investigated do inform teacher adoption of 21st century pedagogies. Policy implications suggest that the Ministry of Education should strive to ensure quality pre-service teacher education, engender teacher motivation to better teacher beliefs/attitudes and also invest in teacher professional development-all which we consider fundamental determinants of teacher adoption of 21st century pedagogies.



***Keywords:*** Qualification, capability beliefs, 21st century pedagogies, teaching experience, professional development, innovation

## 1. Introduction

The dynamic nature of knowledge across all disciplines demands that education systems correspondingly transform their goals, course content, instructional approaches and curriculum evaluation to assist learners realize achievements which are vital for survival in the 21st Century (Lazarov, 2018). In education systems globally, meeting pedagogical innovation needs is accomplished through in-service teacher training. According to Donovan (2011), a huge investment of financial resources has occurred; however, this has invariably not translated into the anticipated tangible improvement in quality curriculum delivery in educational institutions. The explanation given for this eventuality is that teachers trained fail to harness the competencies acquired in the workplace. As a result of pressure from actors of education to get value for money (Allan, 2006), there is argent need for schools to be conversant with the teacher factors at play so as to remedy the situation precipitated by non-use of the 21st pedagogies hence engender more learners' academic outcomes.

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Teacher variables covered in research and literature in connection with adoption of pedagogical skills are many (Levin & Fullan, 2008; Orit & Eshet, 2011; Garcia, 2003; Baldwin et al., 2009; Garet et al., 2001 and Kimani et al., 2013); however, the role played by teacher qualification, teaching experience, capability beliefs and professional development as determinants of adoption of Strengthening of Mathematics and Science in Secondary Education (SMASSE) pedagogy herein referred to as 21st century pedagogy has not been researched in Kisii County. This scenario prompted the need for this study.

### 1.1 Statement of the problem

Professional development of science teachers in Kenya has been on-going for the last two decades. The fundamental intention of this strategy has been and continues to be equipping the teachers with Activity focused, Student centered Experiments and Improvisation (ASEI) through Plan Do See and Improve (PDSI) pedagogical abilities to apply to improve what had become a protracted poor showing in the science subjects' summative evaluation. Despite these efforts, learners' outcomes in science have remained horrendous. This scenario inevitably creates the impression that this training has failed to hit the objective for which it was commissioned to advance.

The persistent dismal subjects' performance is an issue of concern considering that a lot of resources have been invested in SMASSE INSET since its inception hence raising the issue of its cost-effectiveness. Furthermore, the realization of Kenya vision 2030 is anchored on high quality science curriculum delivery and therefore abysmal subjects' performance presents an insurmountable challenge in making real this national development blue print.

The present study borrowed heavily from the foregoing scholarly works, pieced together teacher variables with a quest to establish whether indeed they predict adoption of ASI-PDSI pedagogical skills or otherwise. The justification of this approach rested on the observation that the existing dialogue at the time of the study on whether SMASSE Project had succeeded or not was fragmented; the reason being that from extant research and literature by then, no scholar had studied teacher professional characteristics in their entirety vis-à-vis transfer of SMASSE pedagogical skills in secondary schools in Kenya. The essence of this research therefore was to answer the key question of the combined effect of four teacher professional characteristics in utilization of ASEI-PDSI pedagogy. This was the research void the study succeeded to fill.

### 1.2 Theoretical perspectives

Guzdial and Ni (2007) have come up with a model which attempts to illuminate on factors that might explain teacher readiness to accept pedagogical innovations in their practice. Having acknowledged that teachers' mandate is the most fundamental determinant of the learning process (see also Nundy et al., 2009). Guzdial et al. (2007) then proposes that teacher knowledge, attitudes and beliefs about curriculum, students, self and the quality of professional development endeavors will go a long way in informing the success in internalizing new teaching methods. The model points out that teachers are keen to establish the extent to which new instructional approaches mirror (align, fit) with what they desire to realize as they partake in the whole business of instruction, a perspective that is also shared by Errington (2004). The teachers' concerns are elaborated below:

*The Teacher Knowledge, Attitudes and Beliefs held about Subject Curriculum*

Teachers do get interested to want to know whether the new pedagogy takes care of their prior understanding of subject content (Burke, Schuck, Kearney & Aubusson, 2018). And, as Wacker & Olson (2019) submit, the new approach should at all times seek to maintain the status quo concerning teacher beliefs on what to teach and the methodology of delivery. In a nutshell, the areas of consideration by teachers are: learning goals, content coverage, preparation time and particular ideas contained in the new pedagogy (OECD, 2018; Crittenden & Wilson, 2005 and Mungure, 2016). All prescriptions of a new instructional method should never go counter to the foregoing concerns if teachers are to embrace a pedagogical innovation.

*Teacher Knowledge, Attitudes and Beliefs about Learners*

Three aspects of learners are covered by the present model; what teachers know about their students' interests and academic abilities (Mayer & Marland, 2007), what teachers believe about students' interests and abilities and attitudes which teachers harbor about learners' interests and ability (Sadler, Sonnert, Coyle & Cook-smith, 2013). All these will weigh in to inform teacher extent of acceptance to utilize new teaching methods. This argument is congruent to Rocane (n. d) who notes that a tutor who believes that learners should discover by themselves will easily engage student-centered pedagogies while those who believe otherwise will embrace teacher-centered instructional approaches. Equally, Jullianne, Turner & Meyer (2009) observes that teachers may belief that students are of low entry behavior; this will see the teacher feel that the new teaching method will do little to transform their academic achievement. Contrary to the foregoing, Nundy et al. (2009) encountered teachers who were convinced that students were able to learn irrespective of their social-economic background; and, true to this mindset, all the students in class registered impressive change in behavior.

*Teacher Knowledge, Attitude and Beliefs about (Teacher) Self*

This aspect relates to teacher feelings on the need to change pedagogy, whether the teachers are keen to discern what the change is about and if they have confidence of enacting this in their instruction. True to what Nundy et al. (2009) believe, confident teachers are more likely to engage in more innovative pedagogical practices and mind their students learning more than tutors who lack this. Teachers who belief in themselves have also been found to be more open to new ideas and more willing to attempt new instructional techniques (Allinder, 1994; Guskey, 1998 and Tschannen-Moran, 2009).

*The Quality of professional Development Activities*

Guzdial et al. model suggests that a high quality teacher learning/ training is key to changing teacher knowledge, attitudes and beliefs about the intended curriculum reform. If discharged by strong trainers with adequate instructional media, the teacher participants may be convinced of the rationale of envisaged pedagogical innovations. In support of this point of view is Darling Hammond et al. (2017) who contend that fruitful professional development is called for so as assist educators learn and refine the pedagogies needed to guide students acquire the critical 21st century survival skills. Nundy et al. (2009) too noted that teacher training accorded them the confidence they required to offer learners more challenging activities within their subjects of specialization.

We attach much relevance of teacher Change Theory to the Current Study; first, teachers' espousal of 21st century pedagogies will be shaped by the extent to which they match their needs (Ryder & Banner, 2012) to cause realization of instructional objectives. Indeed, the 21st Century pedagogies for science education advocate for practical activities (experiments and projects) which are known to make science learning interesting and meaningful (Mwangi and Kibui, 2015; see also Ude & Ebuor, 2017) hence the educators should embrace them. Secondly, since 21st century teaching methods are in support of ideas like improvisation (Ndirangu et al., 2013), the tutors should have no problem welcoming the new pedagogies as the process of teaching is made more affordable in terms of procurement of teaching and learning resources. Lastly, one of the global learning goals at the moment is to equip students with critical and creative thinking and problem solving both which are embedded in 21st Century pedagogies (Aminata, 2015, p. 44); accordingly, there is a convergence of the need to harness the teaching approaches to help equip humanity with these requisite survival skills. As a consequence, science teachers are expected to embrace this noble instructional approach.

## 1.3 Review of literature

This section presents conceptual and empirical literature related to the current study. It starts with the concept of pedagogy and pertinent concerns of the 21st Century and then moves on to the impact of teacher beliefs, teaching experience, teacher qualification and professional development on adoption of 21st Century pedagogies.

### *1.3.1The concept of pedagogy and related concerns of the 21st Century*

In its elementary conceptualization, pedagogy refers to teaching methods or approaches. The pedagogy a teacher uses to convey content to learners (Maaji, 2003) will determine the effectiveness of teaching-learning process. This stand point is supported by Ukoha & Eneogue (1996) who aver that teaching approaches occupy a critical position in making sure that meaningful, captivating and quality learning occurs. On the contrary, they observe, methods of instruction may equally constrain successful learning. This point of view is echoed by Ogheneovo & Otaigbe (2015) who contend that the victory or letdown of any didactic effort hinge, in the end, on the pedagogical approach espoused by teachers.

The 21st century classrooms are characterized as being learner – centered, pervasive, digitally interacted and linked and novice-focused, where students are positioned on the steering and regulate their own scholarship in team-directed corporeal

and computer-generated education milieus (Saxena, 2013; Wierman, 2016; Zimmerman, 2016; Envision, 2017 and Kalaian, 2017). Furthermore, Scott (2015) weighs in and states that to aid acquire the 21stera abilities, the most appropriate pedagogy should be one that is defined by new focus on instruction quality, raise involvement, personalize and adapt learning, underscore practical and issue-based learning, involve and reinforce learners, embolden partnerships and communication and foster originality and novelty. The foregoing constitute basic elements of the 21st century pedagogy which in the words of Lai (2011) are the "ways of knowing" which all educators should embrace so that the entire human race affords to effectively tackle challenges of the 21st century.

Since the basic function of learning institutions is to change learners' behavior (Mascolo, 2009), Goertz (2015) asserts that it is paramount for classroom practices to be enhanced so as to be appropriate for 21st century students. This is so because a country where curricular content and teaching method are unable to actively involve the students to meaningfully create new ideas is not worth its salt; this is basically working at cross purposes to the development good of such a nation (Randall & Cox, 2015). To be in tandem with the foregoing scenario prompts Tan, Choo, Kang, & Liem (2017) post that a pedagogical intervention is inevitably demanded; in other words, to achieve the 21stcentury expectations, teachers have to distance themselves from instructional approaches of the past and be gallant proponents of the kind of learning presumptions of students of the moment. This then implies that more time should be spent on hands-on activities where wide latitude is accorded to students to experiment with real life situations (Cheng, 2017).

The preceding perspective is accentuated by Freire (1970) who reminds us that learning must of necessity accommodate inquiry as the bottom-line in academic work. Freire further professes that teachers should, as a fundamental requirement allow learners to exercise their independent mind so as to come up with solutions to tasks at hand. As a sequel to the above point of view, Reeves (2004) has called upon educators to evaluate their instructional practices and transform from the old-fashioned less useful teacher-centered orientation to the more significant learner-centered approach that is now strongly recommended as the pedagogy of the moment. We believe that the aforementioned dialogue among scholars concur that classroom practical activities (like the one fronted by ASEI-PDSI instructional approach) match in many respects with the 21st century pedagogies which all science teachers should endeavor to assimilate into their repertoire of practice.

### *1.3.2 Teacher beliefs about pedagogical innovation*

Governments and educators have for a long time found teacher change an uphill task (Li & Lu, 2019); however, they argue, self-initiated change would be activated by teachers who are resilient, reflective and available to partake in learning opportunities which are provided by professional development ingenuities. Katie (2015) reasons that for teachers to transmute their instructional beliefs, knowledge and practices, they have to meditate on their individual goals and prior belief orientation as compared to what they are expected to alter; in particular, the extent to which the teachers accommodate change will be shaped by contextual variables that include time, instructional media and support from school leaders.

Gregoire (2003) has created a model that attempts to lay bare the mechanism through which educators may embrace change when called upon to do so. This model

observes that depending on a wide spectrum of considerations, envisaged teacher transformation would end up being either true, no change or a superficial one; as they conceptualize it, tutors' beliefs about themselves propel them to take charge of how they think and act in terms of individual organization, proactivity, reflection and regulation. The line of thought by Thieman (2000) is that teachers' previous learning, beliefs and attitudes are critical ingredients in the process of pedagogical change orientation. Thieman suggests that slow pace of change may reflect beliefs developed during teacher pre-service education as students themselves, compounded by their own experience as they continue to execute their mandate on daily basis.

Teachers' knowledge on subject content and pedagogy has a close association with their past encounter with practiced instructional methodology. Research (notably Cohen & Spillane, 1992) opined that pedagogical innovations anticipate teachers to discard past traditions of understanding and embrace learner–centered instructional approaches, where the role of tutors is confined to facilitation to mid-wife effective learning. OECD (n. d.) established that schools which reported highest teacher familiarity with new pedagogies also realize greatest change in utilization 21st century pedagogies.

A plethora of studies (for example Nisbet, 1978; Zimmerman, 2006;Terhart, 2013; Savina, 2019 and Alagul & Gursel, 2019) now show that teachers never oppose pedagogical innovations without a justified cause as may have been implied elsewhere; however, they clinch, craft, push ahead and rejoice change; what is different is that to them, change should be what is noble for the learners and this is what occupies the central concern going forward. In fact (Altinelken, 2013), teachers of all shades are relentlessly in search of ways to construct a curriculum that has relevance, engagement, purpose, challenge and accelerative focus. Furthermore, anecdotal evidence from scholarly works (Jorgenson, 2006; Somekh, 2008 and Howard, 2013) reveal that teacher opposition towards curriculum reform is seldom an insensitive response for it is often an honest standpoint. We are also for the view that policy formulators should desist from introducing instructional approaches which are devoid of teachers' input for this is bound to be confronted with teacher negative attitude. Consequently, teaching and learning processes which are worthwhile (practical and relevant) must have support from tutors. Clearly, this is what Ministries of Education should know if at all curriculum innovations are to be embraced by teachers (Errington, 2004).

The role played by teacher beliefs in shaping pedagogy used in curriculum implementation in developing countries has been investigated by Westbrook et al. (2013) where use of ineffective teaching strategies were reported in East Africa, India and Burma -here learning was found to take place under challenging conditions of large class sizes and few resources; teachers were found to possess entrenched beliefs about teachers role as the main source of knowledge hence working at cross-purposes with ideals of the 21stcentury pedagogies.

Cultural constructions of the teacher as authoritative master created resistance to more student–centered approaches. A similar finding has been registered by Kul & Celik (2017) who established that although teacher interviews portrayed tutors of constructivist orientation on teaching and learning of mathematics, lesson observation revealed a practice that was largely teacher-centered.

Guskey's (2002) view on the impact of teacher beliefs takes another dimension of this discourse where it is reported that going forward; certain specific events have to occur before teachers can develop desired beliefs. According to Guskey's model, teachers will only embrace a given pedagogy after it has been proved to cause improvement in attainment of instructional objectives. We are of a strong view that Guskey's standpoint

is misleading because failure of a given pedagogical approach to better curriculum implementation could be due to other variables. As Orafi (2008) points out, wrong beliefs would be caused by incorrect conceptualization of curriculum goals.

*1.3.3 Effect of teaching experience on adaption of pedagogical innovations*

There is a claim by researchers (e.g. Johnson and Myrberg, 2019) that content knowledge and pedagogical knowledge are distinct, yet related constructs; additionally, content knowledge has been found to be a prerequisite for pedagogical content knowledge development. In other words, teachers require profound subject matter knowledge for making content comprehensible for students. Thieman (2000) has identified factors influencing teachers to change their classroom practices in response to education reform as (among other variables), present and previous teaching experience, pedagogical knowledge needed to implement curriculum reform and self –efficacy. Previous experience as a student and as a teacher creates a mentality about teaching and learning. While most teachers do not use the term epistemology, they, somehow do have a theory in use about learning and how students should be taught.

According to Webster, McNeish, Scott, Mary-hard & Haywood (2012), novice tutors may be slow to embrace instructional innovations because they consider themselves not accommodated nor appropriately inducted to confront the task; for this reason, situations of low teacher self- efficacies will be more common. Webster et al. (2012) further notes that although teachers of long serving experience may preserve optimistic proficient outlook as they advance in age, they, nevertheless face the challenge of coping with demands of teaching and shifting individual situations for example adjusting to variations due to added governance responsibility. Besides, the tutors have to embrace change of policy, practice, and respond to young students whose attitude, motivation and behavior might be at variance with those whom their professions were molded (Taylor, Spacco, Bunde & Zeume, 2018). Terhart (2013) has established that more experienced educators invariably go through a feeling of forfeiture as they prepare for exiting the teaching profession; in particular, rapidly forced policy transformation besides society vilification of them as mavens can provoke a profound nous of insecurity analogous to sorrow or grief.

Tumova (2012) subjected the effects of teachers' age and length of professional practice to readiness to adopt curriculum reform. The result demonstrated that tutors of professional experience longer than 15years tended to resist new instructional methods. This finding is similar to that of Areekkuzhiyil (2014) who established that teachers of medium professional experience possessed a significantly more positive attitude towards curriculum reform when compared with teachers of a higher professional experience.

*1.2.4 Teacher qualification and professional development in Kenya*

There are three options of Pre-service teacher education in Kenya for persons to teach in secondary schools as set out below by Kenya Institute of Curriculum Development, KICD, (2016)

i. Diploma teacher education offered by colleges for to- be secondary teachers;
ii. University teacher education at degree level and

iii. Kenya Technical Teachers' College offers diploma in teacher education for to- be secondary tutors.

Once any of the three options above is finalized, graduates are allowed (if they so wish) to advance from diploma or from bachelor degree to masters and still continue teaching in secondary albeit in a higher grade.

Acquisition of advanced degrees in education (whether masters or PhD) is considered professional development. Another type of professional development assumes the form of in-service teacher education and training. Since the year 2004, Centre for Mathematics, Science and Technology Education (CEMASTEA) in Kenya have discharged in-service training. This has been intended to endow science tutors with 21st Century pedagogies. The ultimate purpose of this effort is to improve science curriculum delivery. To succeed in this endeavor, it's imperative that teachers avail themselves for the training to acquire requisite skills as guided by the relevant curriculum. The teacher learning revolved around promotion of the understanding and internalization of ASEI-PDSI principles, enhance teachers knowledge, skills and attitude as INSET providers and in development and utilization of work planning tools (CEMASTEA, 2016). There have been numerous organized training workshops for science teachers in Kenya since course inception to date. Teacher response has invariably been above board except in the year 2015 where CEMASTEA (2015) notes that teacher attendance was low, and this was attributed to teachers' strike at the time of the training. All the same, most of the objectives of the professional development were achieved.

### 1.4 The present study

Our fundamental purpose was to examine the influence of selected teacher characteristics (qualification, capability beliefs, teaching experience and professional development) on adoption of 21st century pedagogies in Kisii County, Kenya. Borrowing from previous research (Thieman, 2000; Kul et al., 2017; Kamemia et al., 2017 and Johanson & Myrberg, 2019 ), we anticipated teachers of higher of these independent variables to more readily employ 21st century pedagogies in science curriculum implementation as opposed to tutors of lower level of the attributes. The following null hypothesis was tested:

$H_o1$: There is no significant relationship between selected teacher characteristics – qualifications, experience, capability belief and SMASSE training (professional development) and adoption 21st century pedagogies in Kisii County, Kenya.

## 2. Method

### 2.1 Setting and participants

We conducted this study in selected secondary schools in Kisii County. Prior to actual visits, we did reconnaissance to familiarize ourselves with schools' location and book appointments. It was during this time that consent to participate in the research was sought from biology and chemistry teachers. The science teachers signed consent forms as a commitment that they were willing to participate in the study. We employed

convergent parallel mixed method design using cross-sectional approach. We found this research design suitable because qualitative and quantitative data were amalgamated to produce a rich statistical analysis of the research problem (Creswell, 2014). The process of data collection lasted between the months of September of the year 2017 and August of the year 2018. The sampling unit in this study was a school and a chain of command was maintained throughout the entire period of data gathering. In every school visited, we spelt out the objectives of the study and assured participants of confidentiality of the information they volunteered. To safeguard against anonymity, respondents were advised not to write their names in the questionnaires.

*The science teachers' questionnaire*

We developed this questionnaire bearing in mind the purpose of the study. Top on the list of teacher variables was data on teacher demographics starting with professional qualification (Master of education, Master of science with post graduate diploma in education, Bachelor of education science, Bachelor of science with post graduate diploma in education, diploma of approved teacher status), whereby each respondent was required to tick the option that applied to them. Teaching experience in years was also sought from the teachers. They were also required to state whether they had attended SMASSE training or not. Performance of students in the students in the subject being handled by individual teachers was also required. The teachers were also asked to give the mean score of their subjects in Kenya certificate of secondary education KCSE for the year 2016. Capability belief of the teachers was sought and here teachers were asked to give a general assessment of their feelings of capacity to use ASEI-PDSI pedagogy to enhance curriculum implementation in their respective subjects. Four options to choose from were given: very high, good, low and very low. To establish whether the questionnaire content would measure what it was intended to, we employed a panel made of three judges. Two of them were doctor of philosophy holders in curriculum studies while one was a teacher trainer working for CEMASTEA in Kenya. The three professionals assessed the relevance of the content in the questionnaire. We then made adjustments as recommended to arrive at the final copy that was used to collect data. Test-retest approach was applied to establish the reliability of the questionnaire, which was found to be 0.78. A reliability of this magnitude is acceptable (Glen, 2016; and Williams, 2020).

## 2.2 Analytic sample

Randomized sample made of 184 science teachers filled the questionnaires. Those who returned the questionnaires were 125 hence a response rate of 68.0% which is good

enough for descriptive studies (Kothari, 2004). Majority of science teachers in this study were males (64%).

Most of the science teachers (83%) had a teaching experience of less than five years. The study targeted effect of selected teacher variables on adoption of 21st century pedagogies in Kisii County which is located in western Kenya.

### 2.3 Data analytic plan

The data we collected using questionnaires was validated, edited and then coded. We then computed questionnaire return rate to find out the acceptability of sample size. Quantitative data was analyzed using statistical package for social sciences (SPSS) version 21. Descriptive statistics (frequency distribution and percentages, mean and standard deviation) were utilized to analyze and present data. Ordinal logistic regression was used to test the hypothesis. We did hypothesis testing at 5% level of significance.

We found Ordinal logistic regression appropriate because (Kleinbaum & Klein, 2010 and Agresti, 2013) it is used to predict an ordinal dependent variable (which for us was adoption of 21st Century pedagogies that we operationalized using students' scores), given one or more independent variables (in our situation these were selected teacher characteristics: professional qualifications, experience, capability beliefs and professional development). More explicitly, Hosmer et al. (2013) states that ordinal logistic regression enables a scholar to decide:

(a) Which independent variables (if at all) yield a statistically significant relationship with the dependent variable and

(b) The accuracy with which an ordinal logistic regression model explains the dependent variable. Ordinal logistic regression equally enables usage of collaborations between -+

independent variables to forecast the dependent variable.

Agresti (2010) has spelt out four assumptions that have to be made before subjecting a given data to ordinal logistic regression analysis. The first and the second assumption relates to the choice of research design and the measurements which have been carried out, while the next two assumptions are about the attributes of the data truly gathered (i.e., how the data fits the model).

These assumptions are given below:

- Assumption 1: A single dependent variable measured at an ordinal level.

In our study the dependent variable was measured using students' examination scores which were ranked into three levels thus poor performance, average performance represented good performance.

- Assumption 2: Existence of single or multiple independent variables that are either ordinal, categorical or continuous. Still, ordinal independent variables have to be taken as being either continuous or categorical.

All the independent variables in this study: teacher qualification, experience, capability belief and SMASSE training (professional development) met this requirement.

- Assumptions 3: There ought to be no multicollinearity, which happens when at least two independent variables are greatly correlated with one another.
- Assumptions 4: There are proportional odds. This proposition infers that every independent variable has an indistinguishable impact at each total split of the ordinal dependent variable.

## 3. Results

### *3.1 Academic performance*

We transformed students' mean scores into ordinal levels, where scores ranging 0 - 4.99 represented poor performance, scores between 5 - 8.99 represented average performance, while scores ranging 9 - 12 represented good performance. This transformation enabled us to perform ordinal logistic regression.

**Table 1**

*Frequencies on Academic Performance*

| Level of Performance | Frequency | Percent |
|---|---|---|
| Poor performance | 66 | 52.8 |
| Average performance | 53 | 42.4 |
| Good performance | 6 | 4.8 |
| **Total** | **125** | **100.0** |

As displayed in Table 1, more than half of the participants (52.8%) had poor performance, 42.4% had average performance, while 4.8% had a good performance.

**Table 2**

*Academic Performance Descriptive Statistics*

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Mean score | 125 | 1.00 | 10.18 | 5.1725 | 2.06140 |
| Valid N (list wise) | 125 | | | | |

As presented in Table 2, results indicate that the minimum score attained was 1, while the maximum score was 10.18. The average means score was 5.1725 (SD=2.06140), which indicates that the students scored averagely in academic performance.

**Table 3**

*Assumption of Multicollinearity Test Coefficients*[a]

| | | Collinearity Statistics | |
|---|---|---|---|
| Model | | Tolerance | VIF |
| 1 | Highest professional qualification | .959 | 1.043 |
| | Teachers experience | .948 | 1.055 |
| | SMASSE Training | .710 | 1.409 |
| | Capability Belief | .720 | 1.389 |

a. Dependent Variable: Mean Score

As depicted in Table 3, all the tolerance values were less than 1, while all the VIF values were less than 10, indicating that collinearity problem and therefore the assumption was met.

**Table 4**

*Goodness-of-Fit*

| | Chi-Square | df | Sig. |
|---|---|---|---|
| Pearson | 41.420 | 43 | .540 |
| Deviance | 45.962 | 43 | .351 |

Link function: Logit

Both the Pearson goodness of fit and the deviance goodness-of-fit tests indicated that the model was a good fit to the observed data, $\chi^2$ (43) = 41.420, p = .540 and $\chi^2$(43) = 45.962, p = .351 respectively.

**Table 5**

*Model Fitting Information*

C

| Model | -2Log Likelihood Model | Chi-Square | df | Sig. |
|---|---|---|---|---|
| Intercept Only | 106.635 | | | |
| Final | | | | |
| Final | .000 | 106.635 | 15 | .000 |

Link function: Logit.

The final model statistically significantly predicted the dependent variable over and above the intercept-only model, $\chi^2(15) = 106{,}635$ $p < .05$.

**Table 6**

*Tests of Model Effects*

| | Type III | | |
|---|---|---|---|
| Source | Wald Chi-Square | df | Sig. |
| Qualification | 3.082 | 6 | .799 |
| Experience | 14.165 | 5 | .015 |
| SMASSE Training | .167 | 1 | .683 |
| Capability belief | 7.871 | 3 | .049 |

Dependent Variable: Mean score

Model: (Threshold), Qualification, Experience, SMASSE Training, Capability belief

Teacher's experience and capability belief had a statistically significant effect on adoption of pedagogical skills (Mean Score), Wald $\chi 2(5) = 14.165$, $p = .015$, and Wald $\chi 2(3) = 7.871$, $p = .049$ respectively; however, teachers' professional qualification and SMASSE training a statistically an insignificant influence on adoption of pedagogical skills.

Table 7

*Parameter Estimates*

| Parameter | B | Error | 95% Wald Confidence Interval | Hypothesis Test | Exp(B) |
|---|---|---|---|---|---|

| | | | | | | Wald Chi-Square | df | Sig. | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Lower | Upper | | | | |
| Threshold | [Mean=Poor/ Average] | 1.371 | 1.9804 | -2.511 | 5.252 | .479 | 1 | .489 | 3.938 |
| | [Mean= Good] | 4.803 | 2.0456 | .794 | 8.812 | 5.513 | 1 | .019 | 121.869 |
| [Qualification=M.ED] | | .485 | 1.6827 | -2.813 | 3.783 | .083 | 1 | .773 | 1.625 |
| [Qualification=MSC+PGDE] | | -1.436 | 1.8030 | -4.970 | 2.098 | .635 | 1 | .426 | .238 |
| [Qualification=BED(SC)] | | .053 | 1.4339 | -2.758 | 2.863 | .001 | 1 | .971 | 1.054 |
| [Qualification=BSC+PGDE] | | -4.612E-15 | 1.9752 | -3.871 | 3.871 | .000 | 1 | 1.000 | 1.000 |
| [Qualification=Diploma] | | -.813 | 1.6667 | -4.080 | 2.454 | .238 | 1 | .626 | .443 |
| [Qualification=A.T.S] | | 0[b] | . | . | . | . | . | . | 1 |
| [Experience=1-5 years] | | -.980 | 1.0717 | -3.080 | 1.121 | .835 | 1 | .361 | .375 |
| [Experience=6-10 years] | | .437 | 1.1536 | -1.824 | 2.698 | .143 | 1 | .705 | 1.548 |
| [Experience=11-15 years] | | -2.165 | 1.3873 | -4.884 | .554 | 2.436 | 1 | .119 | .115 |
| [Experience=16-20 years] | | 1.632 | 1.5242 | -1.355 | 4.620 | 1.147 | 1 | .284 | 5.116 |
| [Experience=Over 20 years] | | 0[b] | . | . | . | . | . | . | 1 . |
| [SMASSE Training=Yes] | | .253 | .6187 | -.960 | 1.465 | .167 | 1 | .683 | 1.288 |
| [SMASSE Training=No] | | 0[b] | . | . | . | . | . | . | 1 |
| [Capability belief=Very high] | | 2.746 | 1.1416 | .508 | 4.983 | 5.786 | 1 | .016 | 15.579 |
| [Capability belief=Good] | | -18.230 | 38963.4086 | .108 | 76348.647 | .000 | 1 | 1.000 | 1.210E-8 |
| [Capability belief=Low] | | 2.038 | .7692 | .531 | 3.546 | 7.023 | 1 | .008 | 7.678 |
| [Capability belief=very low] | | 0[b] | . | . | . | . | . | . | 1 |
| (Scale)(Scale) | | 1[c] | | | | | | | |

Dependent Variable: Mean Score

Thr Model: (Threshold), Qualifications, Experience, SMASSE Training attendance, Capability belief

a. Set to a. Set to system missing due to overflow

b. Set tb b. Set to zero because this parameter is redundant.

c. Fixed c. fixed at the displayed value.

As depicted in Table 7, the odds of participants with very high capability belief relating to a good mean score was 7.901 times that of participants with low capability belief, 15.579, 95% CI [1.663, 145.977], Wald $\chi^2(1) = 5.786$, $p = .016$ and 7.678, 95% CI [1.700, 34.670], Wald $\chi^2(1) = 7.023$, $p = .008$ respectively; effects that were statistically significant.

*3.3 Overall findings*

An ordinal logistic regression was run to determine the effect of selected teacher characteristics (highest professional qualification, teachers experience, SMASSE Training attendance and capability belief) on the transfer of pedagogical skills (Mean score). There were proportional odds, as assessed by observing the parameter estimates from the dichotomized cumulative categories of the dependent variable. The assumption of Multicollinearity was met by the assessment of the Collinearity statistics (Tolerance and VIF). The Pearson and deviance goodness of fit, both showed that the regression model was a good fit to the data observed, $\chi^2(43) = 41.420$, $p = .540$ and $\chi^2(43) = 45.962$, $p = .351$ respectively. The dependent variable was statistically significantly predicted by the final model over and above the intercept-only model, $\chi^2(15) = 106.635$, $p < .05$. Teacher's experience and capability belief had a statistically significant effect on the transfer of pedagogical skills (as measured using students' mean score), Wald $\chi2(5) = 14.165$, $p = .015$, and Wald $\chi2(3) = 7.871$, $p = .049$ respectively. The odds of participants with very high capability belief relating to a good mean score was 7.901 times that of participants with low capability belief, 15.579, 95% CI [1.663, 145.977], Wald $\chi^2(1) = 5.786$, $p = .016$ and 7.678, 95% CI [1.700, 34.670], Wald $\chi^2(1) = 7.023$, $p = .008$ respectively; effects that were statistically significant.

## 4. Discussion

The aim of this research is to illuminate the extent to which selected teacher traits (academic qualification, teaching experience, capability beliefs and professional development) predict teacher adoption of 21st century pedagogies. It is observed that

while teaching experience and capability beliefs predict adoption of 21st century pedagogies, teacher academic qualification and SMASSE training (professional development) do not. We note with great interest the outcome that teacher academic qualification has no bearing on adoption of 21st century pedagogies. Perhaps to get an insight into the criticality of academic qualification, we borrow from Savina (2019) who professes that possession of relevant knowledge is the foundation of advent of new ideas on which all innovative activities are grounded; consequently, teachers who are academically highly qualified stand a better chance of being more inventive. By extension, such teachers are likely to embrace novel ways of confronting instructional practices. In view of Savina's perspective, we could infer that the teachers under study have not benefitted from their supposedly high level of academic qualification possibly due to factors beyond the scope of this study. Contrary to the findings of this research is Owusu, & Yiboe (2013) study that geared to establish how three teacher traits (academic qualification, teaching experience and perceptions) predicted adoption of a French curriculum. It came to pass that only teacher academic qualification had a statistically significant relationship with the innovation, with a regression model that yielded a B value of 0.857, p= 0.044.

The role of teacher professional development to catalyze teacher's innovative competencies cannot be gainsaid; indeed, fast changing societies, economies and technologies (TALIS, 2018a), have engendered several calls for innovation in education systems worldwide. All these efforts are geared towards meeting the demands of the 21st century. As Oloruntegbe (2011) also correctly points out, in-service avails the teachers with a singular opportunity to acquire 21st century pedagogical skills' competencies to apply in curriculum implementation.

In the current study, teacher attendance of professional development initiatives was found not to predict adoption of pedagogical innovations (herein referred to as 21st century pedagogies).

According to Gombe (2019), this would be explained by poor or failure by teachers to take an active role in the learning process when they subject themselves to the training; as a consequence, desired skills are not acquired. Put differently, lack of effective professional development of teachers would be caused by lack of teacher commitment and negative teacher attitude. In particular, Yariv (2011) argues that teachers who are nearing exit of the teaching service through retirement have been found to be slow to attend capacity building hence do not benefit at all. Another issue worth pointing out is that even when teachers avail themselves for in-service courses, they are offered insufficient programs characterized by inadequate and inappropriate content taught by incompetent trainers (Park & Sung , 2011). In the same breadth, Shabibi &

silvennoinen (2018) reports that teachers lack the opportunity to exploit best practices associated with collaborations with school leaders and collegiality with their peers.

We consider it common knowledge nowadays that teachers are invariably convinced that their voice and full participation during initial stages of curriculum innovation should never be under estimated; in line with this teachers' mindset, studies have encountered situations that put teachers on collision course with their seniors in the Ministry of Education. To underscore the preceding standpoint we leverage revelation by two studies from extant literature, both whose findings are at variance with the present study. In their study to find out teachers' role in the development of English as a Foreign Language (EFL) in Saudi Arabia, Alnefaie and Gritter (2016) established that virtually all teacher respondents believed that their ministry of education considered them (teachers) as mere tools used to pass an already developed content over to learners. The afore-stated research funding closely mirrors the works of Troudi, & Alwan (2009) whose result demonstrated that teachers had mixed feelings towards innovation in that, while a few aspects of curriculum change were accepted, a large majority was rejected; further, tutors in this study reported low work morale citing their not being fully involved in curriculum development process; in other words, the educators were of the view that the curriculum change was imposed on them, hence felt that they had little to do with it.

In agreement with the findings of the present study is Areljung (2019) where teacher positive beliefs triggered adoption of pedagogical innovation. In the foregoing study, the tutors embraced new instructional approach because they conceptualized it to enable them to build on science content in their everyday participation in curriculum implementation, which they found more fulfilling when compared with hitherto teaching methods. In congruent with the above stated study is the research by Konig, Bremerich-Vos, Buchholtz & Glutsch (2020) which established that teachers accepted to adopt novel pedagogy because it was found to resonate with their self-serving beliefs.

A critical aspect of teacher beliefs is that of tutor self-belief or amount of confidence that teachers possess. According to TALIS (2013), researchers, policy makers and practitioners are ideally in agreement that teacher self-efficacy is a critical teacher attribute and it is highly related to the type and quality teachers' instructional practices, which in turn strongly correlate with learners' academic achievement. The findings of the present study on age and adoption of pedagogical innovation agrees with Tunova (2012) and Areekkuzhiyil (2014) whose study revealed that teachers of professional experience longer than 15 years to resist curriculum reforms, but supported it during their early years as teachers. This study reported that majority of the science teachers had a teaching experience of less than five years, hence they tended to adopt pedagogical innovations.

### 4.1 Conclusions and policy implications

Based on the findings, the null hypothesis was rejected; accordingly, it is concluded that the selected teacher characteristics do influence adoption of 21st Century pedagogies. Based on the findings, we recommend that the Ministry of Education in Kenya should put in place a mechanism to engender closer supervision and monitoring of all education inputs which impacts on education quality, right from pre-service teacher education though in-service teacher education and training to secondary science curriculum implementation, if they hope to harness SMASSE pedagogical skills profitably. In particular, more financial resources should be invested to cause mounting of more vigorous capacity development of secondary science teachers on 21st Century pedagogical skills to boost their pedagogical content knowledge, attitude change and teacher motivation.

### 4.2 Recommendations

Based on the findings of the study, we have proposed the following recommendations:

- Actors in education should ensure that prospective teachers are highly qualified before they embark on pre-service teacher education.
- High quality professional development should be discharged. This would accord the teachers the relevant skills which they could leverage to realize high quality pedagogy to use to engender effective curriculum implementation.
- Appropriate teacher motivation is key to cause teachers to settle for the business of executing their mandate of curriculum delivery. Many a times teachers in Kenya have absconded work and resorted to industrial action citing poor remuneration; going forward, the ministry of education has to confront this challenge if the situation is to be tackled once and for all.
- Professional development efforts need to inculcate in teachers a sense of positive attitude and confidence both which are critical ingredients in adoption of pedagogical innovations.

### 4.3 Limitations and implications for future research

We do appreciate that our methodology was limited to one data collection instruments-science teachers' questionnaires. Although the questionnaires facilitated collection of substantial amount of both qualitative and quantitative data for assessment of the role of selected teacher characteristics on adoption 21st Century pedagogies, more data collection tool should have been used for the purpose of triangulation. In this regard

document analysis, focused group discussion, additional questionnaires (for principals and students) and lesson observation schedules should have been in order. Content analysis needs to zero in on schemes of work, laboratory bookings, record of work and progressive records so as to generate a clue on extent of teacher adoption of 21st Century pedagogies. To correct this anomaly, future research of similar purpose should bring on board all the aforementioned data collection instruments. As Orodho (2005) aptly opines, probing questionnaires which are invariably inherent in interviews enhance collection of more in-depth data.

We used students' scores as an indicator of adoption of 21st century pedagogies. The implicit of this thinking is that employing 21st Century pedagogies should automatically translate to improvement in learners' achievement; however, in retrospect, this approach is clearly of limited practicality because of complexities associated with adoption innovation. For example, cultural mindset and school context will more often than not work at cross purposes to the intended out-comes (Ndirangu, 2013). To mitigate this adversity, future research should mind actual implementation of these pedagogies in the classroom using lesson observations to avail a complete picture of aspects like pronunciation and definition of technical terms in chemistry and biology.

The present study was limited to selected teacher characteristics as determinants of adoption of 21stCentury pedagogy. While this research generated useful insights into this situation in Kisii County, incorporating of more variables or controlling for them would have given more complete and therefore more useful outcome. To be more specific, the role played by student characteristics (e.g. entry behavior, socio-economical background and attitude towards science and the 21st century pedagogies cannot be under estimated (Ogunkola, 2000 and Simiyu, 2015); Consequently, upcoming studies should consider the preceding concerns.

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