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# The critical thinking skills of prospective teachers: Investigating their systematicity, self-confidence and scepticism

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ABSTRACT

Recently, researchers have shown an increased interest in studying about Critical Thinking Skills (CTSs). Indeed, the theme has become one of the most significant current discussions amongst many other international agendas. Given the perceived importance of CTSs in this 21st century, we investigated the CTSs of prospective teachers. The aim was to investigate the extent to which prospective teachers possess CTSs. Moreover, the study examined factors influencing CTSs of prospective teachers. The study sample (n = 965) was comprised of first, second and final-year students from one of the teacher education universities in Tanzania. The CTSs were measured using three dimensions—systematicity, self-confidence and scepticism. Overall, the results indicated that prospective teachers had higher mean scores in systematicity and scepticism, but significantly lower mean scores in self-confidence. Also, factors such as parents' education, parents' occupation and year of study were significantly related to at least one dimension of CTSs. For instance, father's education positively and significantly predicted prospective teachers' scores on scepticism. These results have far-reaching implications for policy and future research.

## 1. Introduction

Critical Thinking Skills (CTSs) constitute a major area of interest in the education field. The theme has received considerable attention among researchers in the 21st century. CTSs have become so fundamental that the extant literature treats the concept as a corner-stone of higher education (Carter, Creedy, & Sidebotham, 2018; Gelerstein, Nussbaum, Chiuminatto, & López, 2016; Ku, 2009; Ren & Tao, 2014; Wan Sulaiman, Rahman, & Dzulkifli, 2010). Also, policy-makers and researchers have underscored the value of developing CTSs in students primarily to nurture their critical attitudes and critical spirit (Ku, 2009; Sosu, 2012; Stapleton, 2010). Given such an emphasis, CTSs have become essential learning outcomes in higher education (Davies & Barnett, 2015; Malamitsa, Kasoutas, & Kokkotas, 2008; Rodzalan & Saat, 2015; Wood & Toronto, 2012).

Critical thinking scholars have argued that people with CTSs search for information to remain informed (Ennis, 2015); think open-mindedly, listen and communicate effectively with others (Paul & Elder, 2006); are inquisitive, self-confident in their own ability, are clear in formulating questions, and persistent when encounter difficulties (Facione, 2013). These attributes together help people with CTSs to make a value judgment of an idea based on the criteria (Brookhart, 2010); to evaluate the effects of all the decisions they make (Youens, Smethem, & Sullivan, 2014); and to critique situations around them instead of subscribing to every situation to the

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supernatural power (2013, Freire, 1974). As such, having people who can perform these functions requires them to possess and practise CTSs.

### 1.1. Factors affecting critical thinking skills

Depending on how CTSs are measured, research on the relationship between CTSs and other factors has produced mixed results. In this section, we reviewed the literature on some factors influencing CTSs. We reviewed these factors in relation to the dimensions of CTSs—systematicity, self-confidence and scepticism—used in this present study. To start with academic achievement, Derrick-Telemaque (2014) found that GPA positively and moderately correlated with systematicity and self-confidence. Also, CTSs have been linked to cognitive ability (Kettler, 2014) and academic achievement (Changwong, Sukkamart, & Sisan, 2018; Nold, 2017; Rodzalan & Saat, 2015; Wangensteen, Johansson, Björkström, & Nordström, 2010). Meanwhile, Carter et al. (2018) found that the students' GPA was positively related to reflective writing but not with the students' self-rating scores. Yuan, Liao, Wang, and Chou (2014) observed that there is a strong correlation between scepticism and systematicity.

Moreover, a relationship between a year of study and CTSs has been established. For instance, a study by Demrhan and Köklükaya (2006) found that seniors' CTSs in the dimension of open-mindedness and analyticity scores were higher than those of the freshmen. With regard to Critical Thinking dispositions (CTD), which are related to CTSs as they influence one another (Facione & Facione, 1992; Mwalongo, 2014; Thomas & Lok, 2015), Demrhan and Köklükaya (2006) observed that seniors' total CTD scores were also higher than the scores of those in lower years.

Additionally, Morley and Lugg (2009) have argued that gender and Socioeconomic Status (SES) are important variables to be included in any study as they affect many other variables. On gender, scholars have come up with mixed results regarding the relationship between gender and CTSs. Some scholars have found no significant relationship between gender and CTSs (French, Hand, Therrien, & Vazquez, 2012; Liu, Hsu, Hung, Wu, & Pai, 2019; Peerbolte & Collins, 2013). Others found that females outperformed males in CTSs (Mawaddah, Ahmad, & Duskri, 2018; Walsh & Hardy, 1999). There are also others who reported cases of males outperforming females (Ashraf, Garmabi, & Fayendari, 2017; Rodzalan & Saat, 2015). Given these mixed results, we thought of including gender in this study. Furthermore, we used parents' education and parents' occupation as indicators of SES. According to Gelerstein et al. (2016), SES has the possibility of influencing students' CTSs.

Likewise, professional experience has been linked with CTSs. According to OöNeill and Stephenson (2012), professional experience is associated with constructs such as self-confidence. Other scholars (Liu et al., 2019; Peerbolte & Collins, 2013) have also established a link between professional experience and CTSs. In addition to that, degree programme has also been connected with CTSs. In particular, studies have indicated that prospective teachers specializing in science subjects may differ with those who do not, because science content and processes involved, have been associated with the development of CTSs (Duran & Dökme, 2016; Forawi, 2016; Wagh, Cook-Whitt, & Wilensky, 2017; Wilmes & Siry, 2018).

### 1.2. Critical thinking skills in Tanzanian government documents

Since the Tanzania government does not operate as an island, in its vision—the development vision 2025—Tanzania emphasises on CTSs among students at all education levels. The United Republic of Tanzania [URT] (2000) reported that the government has realised that the 21st century is an era of changes due to globalisation influences. In consequence, it impresses on and supports all the levels of education to cultivate graduates who are self-confident, creative and able to solve problems around them. Similarly, the then Ministry of Education and Vocational Training [MoEVT] (2014) (now the Ministry of Education, Science and Technology) stressed on the need to churn out graduates with skills and competences necessary for survival in this knowledge economy era. Despite CTSs being one of the key features in the Tanzanian development vision 2015 and the Education and Training Policy of 2014 (MoEVT, 2014), the same MoEVT (2014) acknowledges that many Tanzanian graduates still lack necessary CTSs such as self-confidence, inquisitive mind as well as exploiting possibilities and alternatives to problems. This reality exposes the limitation of the training in force at the moment on CTSs.

### 1.3. Critical thinking skills in Tanzania's higher education

In the 1960s, when the University College, Dar es Salaam (now the University of Dar es Salaam) was established, Julius Nyerere, the founding Father of the Nation, wanted the institution to train graduates with clear thinking and a high analytical ability (Nyerere, 1973). Notably, students who attended the courses at that time were regularly involved in critical intellectual discussions and debates (Maghimbi, Lokina, & Senga, 2010; Shivji, 2009). Implicitly, the university was a place where intellectuals could critically discuss issues for the betterment of the country (Kavenuke, 2018). This alone indicates that CTSs were important elements for all students at the university. Furthermore, given the importance of CTSs, the University of Dar es Salaam UDSM (2018) offers CTSs as a standalone course. In such a course, students engage in dialogue and are taught how to make critical arguments. In the process, they develop many critical thinking related skills such as self-confidence, systematicity and scepticism. This is because, through argumentation, students become curious and inquisitive, organise their ideas systematically before they share with others and as they share with others they develop their self-confidence. Additionally, the website of one of the teacher education universities in the country where the study was undertaken states clearly that its focus is to prepare graduates equipped with CTSs (DUCE, 2019). The assumption is that upon graduation, these graduates become a preferred choice for employers within and beyond the teaching industry.

In addition, similar to the observation made by MoEVT (2014), other studies conducted in Tanzania have noted that higher

education students lack the necessary CTSs. For instance, Kavenuke (2018) observed that many students lack self-confidence that emanates from their inherent fear. Such fear comes from the socio-cultural grounded factors that have traditionally kept a vertical relationship between children and parents, students and teachers or anyone with authority. This vertical relationship limits prospective teachers' ability to dialogue confidently with their lecturers. The belief is that lecturers are regarded as knowledgeable, making prospective teachers passive in the entire teaching and learning process. This practice has tended to limit prospective teachers' self-confidence since Freire (1974, 2010, 2013) argued that it is when there is a horizontal relationship, when the interlocutors can confidently engage in a dialogue.

Although Tanzania government documents stress on fostering CTSs among its people, so far, too little attention has been paid to measuring CTSs among prospective teachers in Tanzania. Considering the dearth of research on this topic in low and middle-income countries such as Tanzania, it is our expectations that this study will be a refreshing contribution to the ongoing discourse on the matter. Since trainee-teachers are expected to cultivate students with CTSs upon their graduation, this study that focused on them as units of analysis was imperative. As such, the thrust of this study was to investigate the CTSs of prospective teachers. In this attempt, the study was guided by the following specific research questions and hypotheses:

i To what extent do prospective teachers possess critical thinking skills?

**H1.** There will be no difference among prospective teachers' self-confidence; scepticism and systematicity.

ii What factors influence critical thinking skills among prospective teachers?

**H2.** There will be no significant difference between men and women with regard to their CTSs.

**H3.** There will be a significant relationship between working experience and CTSs.

**H4.** There will be a significant relationship between a year of study and CTSs

**H5.** Prospective teachers from different degree programmes will differ with regard to their CTSs

**H6.** Parents' education will have a significant effect on prospective teachers' CTSs

**H7.** Parents' occupations will have a significant effect on prospective teachers' CTSs

**H8.** Prospective teachers' GPA will have a significant effect on their CTSs

## 2. Theoretical framework

Based on the literature review, in particular the study by Shin, Park, and Kim (2015) from which our instrument was adopted, we constructed our theoretical framework using three important dimensions of CTSs: systematicity, self-confidence and scepticism. Consistently, several other scholars (See, for example, Aktam & Yenice, 2010; Facione & Facione, 1992; Gul et al., 2010; Kavenuke, 2018; Kirmizi, Saygi, & Halil, 2015) have recognised at least one of these as an important dimension of CTSs. These dimensions are briefly described hereunder:

### *2.1. Systematicity*

Systematicity refers to the habit of striving to approach problems in a disciplined, organised, focused and systematic manner (Derrick-Telemaque, 2014; Shin et al., 2015). Similarly, Mwalongo (2014) asserted that systematicity has to do with the skill and disposition of being organised and focused on thinking. As a result, this organised way of thinking enables a student to make well thought out ideas and reach logical conclusions. Just like any other skill, systematicity develops through actively performing a particular task. Systematicity is mainly promoted when students are involved actively in interacting with teachers and with fellow students (Mwalongo, 2014). Studies indicate that there is a correlation between systematicity and prospective teachers' GPA. For instance, Derrick-Telemaque (2014) found that the GPA was positive but moderately correlated with systematicity.

### *2.2. Self-confidence*

Self-confidence refers to the level of trust one places in one's own reasoning processes (Wangensteen et al., 2010). In other words, self-confidence means the ability of a student to trust the use of his/her reason and reflective thinking. Correspondingly, Shin et al. (2015) treat self-confidence as the tendency to trust one's reflective thinking to solve problems and make rational decisions. Moreover, Mwalongo (2014) contends that self-confidence helps teachers perform their roles better, including their mastery of the subject matter. Just like with systematicity, studies indicate that there is a correlation between self-confidence and prospective teachers' GPA. For instance, Derrick-Telemaque (2014) found that GPA positively, but weakly correlated with self-confidence.

### *2.3. Scepticism*

Shin et al. (2015) defined scepticism as the habit of continually seeking the best possible understanding of any given situation. It is a skill that requires students to be doubtful and, thus, requiring a reliable reason of the information on which one is reflecting in order

to make rational decisions. Usually, people who are sceptical tend to perform their tasks systematically. In fact, studies, for instance, Yuan et al. (2014) have found a correlation between scepticism and systematicity. In addition, Shin et al. (2015) found that scepticism positively correlated with other aspects of CTSs such as systematicity, self-confidence, eagerness and objectivity.

## 3. Materials and methods

### 3.1. Participants

The study was carried out in one of the teacher education university colleges in Tanzania. This university college is specifically for the purpose of training prospective teachers. A sample of 965 students, including first, second and final-year students was selected from a population of (3072 males and 2082 females) prospective teachers to participate in the study. Sample selection was in two phases. Firstly, in accordance with degree programmes, students attend at least one course that brings all of them in one lecture theatre. We treated these four degree programmes as clusters. Secondly, inside each cluster, we used systematic sampling (Gray & Kinnear, 2012) where every $1/n^{th}$ student was randomly selected and given a questionnaire depending on the total number of students attending the lecture. We planned to collect data from 1200 students, distributed according to the proportion of a total number of students from each cluster. Thus, we expected to have a sample of 501, 283, 235 and 177 from B.A. Ed., B.Sc.Ed., B.Ed. (Arts) and B.Ed. (Science) respectively. Nonetheless, 401, 228, 190, and 142 prospective teachers from B.A. Ed., B.Sc.Ed., B.Ed. (Arts) and B.Ed. (Science) respectively, responded to the questionnaire yielding a response rate of 80.4 %.

Out of the 965 participants, 580 (60.5 %) were men and 379 (39.5 %) were women. Also, 170 (18.4 %) participants had worked before as teachers and 752 (81.4 %) were pre-service teachers. Moreover, 543 (56.8 %) participants were first-year students, 144 (15.1 %) were second-years and 269 (28.1 %) finalists in their third year students. Before data collection, we obtained an institutional research permit. We prepared a consent form of which participants filled to affirm their willingness to partake in the study. The form included research ethical issues such as participants' rights, responsibilities and risks involved. For instance, participants were assured that their responses would be kept confidential. The purpose of including prospective teachers from all the years was to determine whether or not there are changes in CTSs across years of study.

When it comes to the education of the prospective teachers' parents, the majority of the parents had lower education levels. For instance, only 24 (2.5 %) prospective teachers' mothers and 64 (6.8 %) prospective teachers' fathers had a bachelor's degree and above. In addition, for occupation of the prospective teachers' parents, the majority of the parents were small-holder farmers. For instance, 589 (62.5 %) prospective teachers' mothers were small-holder or subsistence farmers and 510 (56.4 %) prospective teachers' fathers were also small-holder farmers. Overall, the average of the Grade Point Average (GPA) of these prospective teachers was 3.197. Table 1 summarises the demographic data of the study participants:

### 3.2. Instruments

#### 3.2.1. Dependent variables

*3.2.1.1. Systematicity*. Systematicity was measured using a 7-point scale (1 = strongly disagree, 7 = strongly agree). The dimension was measured using nine items (e.g. "When I solve a problem, I usually organise systematically the sources of data to solve that problem"). These items were modified from Shin et al. (2015) who carried out a study to validate Yoon's Critical Thinking Disposition Instrument. The reliability coefficient in terms of Cronbach's alpha (∝) was .84. However, some of the items were modified to make them congruent with the study context. For instance, items which had a difficult language for our participants as second English language users were rephrased. In the present study, the reliability coefficient in terms of Cronbach's alpha (∝) for this dimension was .71.

*3.2.1.2. Self-confidence*. We measured self-confidence using nine items (7-point scale, 1 = strongly disagree, 7 = strongly agree). One of the items used was "I think I can get through any complicated problem". Similar to the items for systematicity, the items for this dimension were customised from Shin et al. (2015). In their study, the reliability on this dimension, in terms of Cronbach's alpha (∝) was .84. Like in systematicity, the items in self-confidence were modified by rewording to reduce the level of language difficulties. In the present study, the reliability in terms of Cronbach's alpha (∝) was .64.

*3.2.1.3. Scepticism*. Scepticism was measured on a 7-point scale (1 = strongly disagree, 7 = strongly agree). Nine items were used to measure the dimension (e.g. "When I am asked a question, I think twice before I give an answer"). Also, the items were customised from Shin et al. (2015). The reliability in terms of Cronbach's alpha (∝) in Shin et al. (2015)'s study was .84. In this present study, the reliability scores in terms of Cronbach's alpha (∝) for this dimension was .65.

#### 3.2.2. Independent variables

Based on the literature review, several independent variables were included to establish their relationship with the dependent variables. As such, we included the GPA as an independent variable. In this regard, we asked prospective teachers to include their GPA for the academic year at the time of conducting this study. In the context of Tanzania's universities, GPA ranges from 2.0 to 5.0, where 4.4–5.0 is a first class; 3.5–4.3 is an upper second class; 2.7–3.4 is a lower second class; and 2.0–2.6 is a pass. Furthermore, we included the years of study as an independent measure to determine whether CTSs in prospective teachers change with years of study. In this regard, prospective teachers were asked to indicate whether their year of study.

**Table 1**
Demographic characteristics of the sample.

| Characteristics (n = 965) | N | % |
|---|---|---|
| **Sex** | | |
| Male | 580 | 60.5 |
| Female | 379 | 39.5 |
| **Level of education (Mother)** | | |
| Never went to school | 98 | 10.3 |
| Primary education | 522 | 54.6 |
| Secondary education | 169 | 17.7 |
| Certificate | 96 | 10.0 |
| Diploma | 43 | 4.5 |
| Bachelor and above | 24 | 2.5 |
| **Level of education (Father)** | | |
| Never went to school | 73 | 7.7 |
| Primary education | 440 | 46.6 |
| Secondary education | 166 | 17.6 |
| Certificate | 108 | 11.4 |
| Diploma | 93 | 9.8 |
| Bachelor and above | 64 | 6.8 |
| **Mother's occupation** | | |
| Civil servant | 146 | 15.5 |
| Small entrepreneur | 207 | 22 |
| Small-holder farmer | 589 | 62.5 |
| **Father's occupation** | | |
| Civil servant | 197 | 21.8 |
| Small entrepreneur | 196 | 21.7 |
| Small-holder farmer | 510 | 56.4 |
| **Worked as a teacher before?** | | |
| Yes | 170 | 18.4 |
| No | 752 | 81.6 |
| **Year of study** | | |
| First | 543 | 56.8 |
| Second | 14 | 15.1 |
| Third | 269 | 28.1 |
| **Degree programme** | | |
| B.A.Ed. | 401 | 41.7 |
| B.Sc. Ed. | 228 | 23.7 |
| B.Ed. (Arts) | 190 | 19.8 |
| B.Ed. (Science) | 142 | 14.8 |

In addition, we included gender, parents' education and parents' occupation as other important independent variables. The inclusion of many independent variables adds to the exploratory nature of this study, given that little research has been done. Thus, we asked prospective teachers to indicate their parents' education using a 6-point scale (1 = Never, 6 = Bachelor and above). For parents' occupation, we asked prospective teachers to indicate their parents' occupation (1 = Small-holder farmer, 2 = small entrepreneur, 3 = Civil servant).

Further, we asked prospective teachers to indicate whether or not they had worked as teachers before joining university education programmes. In Tanzania context, some teachers, in particular, primary and lower secondary teachers are formally employed as teachers after attending two-years programme in teacher education. To qualify to teach up to high school, these teachers are obliged to enrol in a pre-service programme leading to a bachelor degree. Thus, these teachers joined the pre-service programme with some years of work experience. Since different degree programmes have different course content, we also treated degree programmes as an important independent variable. In the university where the study was undertaken, there are four degree programmes (See Table 1). In that regard, we used cluster sampling to ensure a representative sample from all the four degree programmes offered at the college.

## 4. Data analysis

We used the Statistical Package for the Social Sciences (SPSS) version 22 to analyse the data. To respond to the two research questions, we computed several analyses. Firstly, we conducted the reliability tests and exploratory factor analysis using the principal component analysis (Oblimin). The reliability scores reported in this study represent the consistency among the three items for each dimension. Given that the sub-scales were correlated, we used an Oblimin rotation as it permits correlated rotations (Gray & Kinnear, 2012). A cut off point of .40 was established to suppress items which did not load well. Secondly, to address the first research question, we computed mean and standard deviation for different dimensions. Also, we computed correlation and multiple regression analysis to respond to the second research question. To reduce the categorical effect, all categorical variables were recoded into dummy variables before they were included in the regression model. The purpose was to ensure that the variables take the value of 0 or 1 only. Furthermore, we used unstandardised regression coefficients (β) to estimate the effect size (Gray & Kinnear, 2012) for each

**Table 2**
Factor analysis.

| | Factor | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| When I solve a problem, I usually organise systematically the sources of data to solve that problem | .747 | | |
| I believe in my reasoning involved in drawing a conclusion to solve the problem | .683 | | |
| I evaluate fairly either my opinion or opinions of others. | .667 | | |
| I easily accept a critical evaluation of other people on my opinion | .626 | | |
| When I face a problem, I try hard to find an answer until I solve it | .620 | | |
| I try to understand how things which are not known to many people do work | .565 | | |
| Everything I see, hear and do in this world, I do it with a questioning mind | .464 | | |
| I tend to act carelessly when I face a difficulty | .420 | | |
| I constantly look for pieces of information related to solving a problem | .413 | | |
| I don't decide depending on others' opinion | | | |
| I don't rush to judgment | | | |
| When I am asked a question, I think twice before I give an answer | | .770 | |
| I normally give explained reasons, if I don't agree with others | | .776 | |
| I think any opinion needs to have a reliable reason to insist | | .606 | |
| I usually have a reasonable proof, in whatever decision I make | | .573 | |
| I turn my mistake into an opportunity to learn | | .401 | |
| I continually evaluate whether my thought is right or not | | | |
| I willingly solve a complicated problem | | | .706 |
| I think I can get through any complicated problem | | | .631 |
| I willingly accept the proved truth, although I may have a different opinion on it | | | .610 |
| I usually deal with complicated problems by using criteria set by myself | | | .547 |
| I tend to make a decision quickly without considering a matter carefully | | | .541 |
| When I judge a matter, I judge objectively | | | .476 |
| I prefer to think differently from others | | | .468 |
| I have a status of being a rational person | | | .467 |
| Although something is already known, I normally have questions about it | | | |
| When I have a question, I try to get the answer | | | |

independent variable. We used Gray and Kinnear (2012) guideline for estimating the values of effect size (β), where $\beta < 0.2$ is regarded as weak, $0.2 \leq \beta < 0.5$ is considered as medium and $\beta \geq 0.5$ is viewed as large effect size.

## 5. Results

The study aimed to investigate prospective teachers' CTSs using three dimensions—systematicity, self-confidence and scepticism. The study was guided by two research questions. The results were presented in accordance with the research questions. Nevertheless, we start this section by presenting the findings of factor analysis. Results from factor analysis indicated that some items did not load quite well within their respective dimensions. To avoid having items in the same dimension that contradict with the literature definition of each dimension, we decided to drop some of them. Hence, we regard this as one of the limitations of the study. In that respect, for each dimension, only three items which loaded well and were consistent with the literature definition were retained. The retained items are 1, 2 and 3 for systematicity, 18, 19 and 21 for self-confidence and 12, 14 and 15 for scepticism (See Table 2).

As noted, a good number of items did not load well as in the original scale. Thus, we did not treat these items as a waste. Instead, we computed the descriptive statistics for the items in order to provide an overview of how prospective teachers scored on these items (See Table 4). In the next sub-section, we present the results in accordance with the research questions and the subsequent research hypotheses.

### *5.1. To what extent do prospective teachers possess critical thinking skills?*

To address this research question, we compared the mean scores for the three dimensions as Table 3 illustrates. Results indicated that prospective teachers had higher mean scores ($M = 5.7396$, $SD = 1.05214$) in scepticism, followed by systematicity ($M = 5.7047$, $SD = 1.09228$). However, results indicated that prospective teachers had low mean scores ($M = 5.2591$, $SD = 1.09380$) on self-confidence as compared to other two dimensions.

As noted earlier in this section, to have a clear understanding of how prospective teachers scored on individual items, we also computed the means and standard deviations for individual items. Overall, we found that, prospective teachers had comparatively lower mean scores on items constituting the dimension of self-confidence as indicated in Table 3.

Additionally, prospective teachers had higher mean scores on individual items that did not load well within their respective dimensions (See Table 4). As an exception, the lowest mean scores were observed for items 2 and 11, all of which were reversed items measuring the dimension of systematicity. These two items were also among the five items (2, 7, 11, 13, 14) which had the highest standard deviations (i.e. *SD* of above 2) which indicates lack of consistency among the scorers. Partly, this explains why these items did not load well within their respective dimensions.

**Table 3**
Mean scores of dimensions and their respective individual items.

| | Min | Max | *M* | *SD* |
|---|---|---|---|---|
| **Systematicity** | **1** | **7** | **5.70** | **1.092** |
| I evaluate fairly either my opinion or opinions of others | 1 | 7 | 5.64 | 1.397 |
| When I solve a problem, I usually organise systematically the sources of data to solve that problem | 1 | 7 | 5.74 | 1.326 |
| I believe in my reasoning involved in drawing a conclusion to solve the problem | 1 | 7 | 5.73 | 1.386 |
| **Self-confidence** | **1** | **7** | **5.26** | **1.098** |
| I think I can get through any complicated problem | 1 | 7 | 5.31 | 1.499 |
| I willingly solve a complicated problem | 1 | 7 | 5.42 | 1.480 |
| I usually deal with complicated problems by using criteria set by myself | 1 | 7 | 5.01 | 1.620 |
| **Scepticism** | **1** | **7** | **5.74** | **1.052** |
| When I am asked a question, I think twice before I give an answer | 1 | 7 | 5.99 | 1.285 |
| I usually have a reasonable proof in whatever decision I make | 1 | 7 | 5.60 | 1.446 |
| I think any opinion needs to have a reliable reason to insist | 1 | 7 | 5.62 | 1.400 |

**Table 4**
Mean scores for individual items excluded from the dimensions.

| | Min | Max | *M* | *SD* |
|---|---|---|---|---|
| 1. I turn my mistake into an opportunity to learn | 1 | 7 | 5.50 | 1.817 |
| 2. I tend to make a decision quickly without considering a matter carefully | 1 | 7 | 3.24 | 2.176 |
| 3. I willingly accept the proved truth, although I may have a different opinion on it | 1 | 7 | 5.03 | 1.779 |
| 4. I prefer to think differently from others | 1 | 7 | 5.26 | 1.633 |
| 5. I normally give explained reasons if I don't agree with others | 1 | 7 | 5.72 | 1.410 |
| 6. When I judge a matter, I judge objectively | 1 | 7 | 5.39 | 1.409 |
| 7. Although something is already known, I normally have questions about it | 1 | 7 | 5.09 | 3.381 |
| 8. I have a status of being a rational person | 1 | 7 | 5.50 | 1.413 |
| 9. I continually evaluate whether my thought is right or not | 1 | 7 | 5.57 | 1.555 |
| 10. I constantly look for pieces of information related to solving a problem | 1 | 7 | 5.49 | 1.506 |
| 11. I tend to act carelessly when I face a difficulty | 1 | 7 | 3.66 | 2.298 |
| 12. Everything I see, hear and do in this world, I do it with a questioning mind | 1 | 7 | 5.49 | 1.476 |
| 13. I don't rush to judgment | 1 | 7 | 5.32 | 2.803 |
| 14. When I have a question, I try to find the answer | 1 | 7 | 5.84 | 2.046 |
| 15. I try to understand how things which are not known to many people do work | 1 | 7 | 5.42 | 1.364 |
| 16. When I face a problem, I try hard to find an answer until I solve it | 1 | 7 | 5.77 | 1.308 |
| 17. I don't decide depending on others' opinion | 1 | 7 | 4.99 | 1.826 |
| 18. I easily accept a critical evaluation of other people on my opinion | 1 | 7 | 5.36 | 1.490 |

### *5.2. What factors influence critical thinking skills among prospective teachers?*

To respond to this research questions, we computed correlation and multiple regression analysis. Running regression analysis presupposes that correlation among variables exists. Thus, we carried out the Pearson correlation as the first step of analysis (See Table 5).

Study findings revealed that there was no significant correlation between GPA and the CTSs dimensions. On the other end, the results indicated that there was a positive and a moderate significant correlation between systematicity and self-confidence ($r$ = .431), systematicity and scepticism ($r$ = .414) and self-confidence and scepticism ($r$ = .302). Contrary to the expectation that there would be a strong correlation among the dimensions of CTSs, the correlation was moderate. Additionally, there was a significant correlation between CTSs and several independent variables as well as among the independent variables. For instance, the year of

**Table 5**
Correlation among dimensions of CTSs and GPA.

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| Systematicity | — | | | | | | | | |
| Self-confidence | .431** | — | | | | | | | |
| Scepticism | .414** | .302** | — | | | | | | |
| GPA | .065 | .022 | .021 | — | | | | | |
| Mother's education | −.045 | −.039 | −.065 | .167** | — | | | | |
| Father's education | −.018 | −.022 | −.015 | .137** | .662** | — | | | |
| Mother's occupation | .060 | −.003 | .060 | −.181** | −.610** | −.539** | — | | |
| Father's occupation | .086* | .014 | .058 | −.126** | −.503** | −.648** | .712** | — | |
| Year of study | −.116** | .019 | −.124** | .082* | .111** | .119** | −.218** | −.217** | — |

** Correlation is significant at the level of 0.01 level (2-tailed).

**Table 6**
Regression results coefficients (Systematicity).

| | | Unstandardised Coefficients | | Standardised Coefficients | | |
|---|---|---|---|---|---|---|
| | Model | B | Std. Error | Beta | t | Sig. |
| 1 | (Constant) | 5.228 | .449 | | 11.651 | .000 |
| | Mother's Education | −.025 | .056 | −.027 | −.452 | .652 |
| | Father's education | .106 | .049 | .135 | 2.162 | .031 |
| | Mother's occupation | −.065 | .089 | −.045 | −.725 | .468 |
| | Father's occupation | .199 | .087 | .147 | 2.285 | .023 |
| | Year of study | −.131 | .053 | −.104 | −2.473 | .014 |
| | Degree programme | −.063 | .042 | −.063 | −1.492 | .136 |
| | Gender | −.041 | .094 | −.018 | −.438 | .661 |
| | Work experience | −.075 | .115 | −.026 | −.655 | .513 |
| | GPA | .109 | .081 | .055 | 1.353 | .177 |

Dependent Variable: Systematicity.

study and prospective teachers' systematicity ($r$ = -.116, $p < .01$) were negatively and significantly correlated.

Being certain of the correlation among dimensions of CTSs and several other variables, we computed regression analysis to determine the extent to which the independent variables predict CTSs. In this present study, these independent variables were considered as the factors influencing CTSs. Therefore, three independent regression analyses were carried out, whereby one dimension of CTSs acted as a dependent variable. Tables 6–8 illustrate the findings:

Overall findings indicated that the independent variables included in the regression models were significant predictors of prospective teachers' systematicity ($R^2$ = .021, F = 2.469, $p < .01$) and scepticism ($R^2$ = .020, F = 2.395, $p < .05$). On the contrary, the independent variables included in the regression models were not significant predictors of prospective teachers' self-confidence ($R^2$ = .011, F = .312, $p > .05$). With regard to how each independent variable influence CTSs, findings indicated that, there was no significant observable difference between gender and all the three dimensions of CTSs ($p > .05$) (see Tables 6–8). Therefore, we accepted our hypothesis (H2).

Whether or not one had worked before joining a teacher education programme was not a significant predictor of CTSs. As such, the null hypothesis could not be rejected, thus, it is inconclusive whether or not work experience affects CTSs. With respect to the years of study, results indicated that, there was a significant relationship between years of study and prospective teachers' systematicity ($p < .05$, β = .131) and scepticism ($p < .05$, β = .116) only. In both cases, the effect size was weak (β < .2). Thus, we retained our hypothesis (H4) for the two dimensions. In addition, as the negative signs of β values implies (Tables 6 and 8), prospective teachers' scores on these dimensions decreased with the years of study. Thus, the highest mean scores for systematicity and scepticism were observed among first-year students ($M$ = 5.81, $SD$ = 1.074 and $M$ = 5.86, $SD$ = 1.010), followed by second-year students ($M$ = 5.70, $SD$ = 1.143 and $M$ = 5.64, $SD$ = 1.166) and third-year students ($M$ = 5.52, $SD$ = 1.056 and $M$ = 5.57, $SD$ = 1.043), respectively.

With regard to prospective teachers' degree programme, results indicated that there was no significant relationship between degree programme and all dimensions of CTSs ($p > .05$) (Table 6–8). Therefore, we rejected our hypothesis (H5).

Furthermore, an analysis of the relationship between parents' education and CTSs produced mixed results. While the results showed that mother's education had no significant effect on CTSs, father's education was significantly related to the dimensions of systematicity ($p < .05$, β = .106) and scepticism ($p < .05$, β = .149). Nonetheless, the β values imply that the effect size for the two dimensions are weak. In contrast, parents' education was not significantly related to the dimension of self-confidence. Hence, we accepted the hypothesis (H6) on the two dimensions for fathers' education only. Additionally, as the positive signs of β values implies

**Table 7**
Regression results coefficients (Self-confidence).

| | | Unstandardised Coefficients | | Standardised Coefficients | | |
|---|---|---|---|---|---|---|
| | Model | B | Std. Error | Beta | t | Sig. |
| 1 | (Constant) | 5.443 | .443 | | 12.277 | .000 |
| | Mother's Education | −.019 | .056 | −.021 | −.340 | .734 |
| | Father's education | .011 | .049 | .015 | .227 | .821 |
| | Mother's occupation | −.065 | .088 | −.046 | −.734 | .463 |
| | Father's occupation | .018 | .087 | .014 | .212 | .832 |
| | Year of study | .042 | .053 | .034 | .791 | .429 |
| | Degree programme | −.027 | .042 | −.027 | −.636 | .525 |
| | Gender | −.069 | .095 | −.032 | −.734 | .463 |
| | Work experience | −.076 | .116 | −.027 | −.658 | .511 |
| | GPA | .007 | .082 | .004 | .087 | .931 |

Dependent Variable: Self-confidence.

**Table 8**
Regression results coefficients (Scepticism).

| | | Unstandardised Coefficients | | Standardised Coefficients | | |
|---|---|---|---|---|---|---|
| | Model | B | Std. Error | Beta | t | Sig. |
| 1 | (Constant) | 5.518 | .436 | | 12.648 | .000 |
| | Mother's Education | −.125 | .054 | −.138 | −2.306 | .021 |
| | Father's education | .149 | .047 | .198 | 3.138 | .002 |
| | Mother's occupation | −.055 | .086 | −.040 | −.641 | .522 |
| | Father's occupation | .157 | .085 | .121 | 1.862 | .063 |
| | Year of study | −.116 | .051 | −.097 | −2.297 | .022 |
| | Degree programme | −.020 | .040 | −.020 | −.487 | .627 |
| | Gender | −.111 | .090 | −.051 | −1.230 | .219 |
| | Work experience | .015 | .111 | .006 | .139 | .889 |
| | GPA | .042 | .078 | .022 | .542 | .588 |

Dependent Variable: Scepticism.

(Table 6 and 8), prospective teachers' scores on these dimensions increased with father's level of education. On parents' occupation, as shown in Table 6, the results indicated a significant and positive relationship between fathers' occupation and the dimension of systematicity only ($p < .05$, $\beta = .199$). Despite the reported relationship, the β value was weak. Therefore, the hypothesis (H7) was retained for systematicity only. Finally, the findings indicated that prospective teachers' GPA did not have a significant effect on their CTSs. Thus, we rejected the hypothesis (H8).

## 6. Discussion and conclusion

The study investigated prospective teachers' CTSs using three dimensions—systematicity, self-confidence and scepticism. Descriptive statistics showed that overall, in our sample, prospective teachers' parents had low levels of education. For instance, only 2.5 % and 6.8 % of mothers and fathers, respectively, had a bachelor degree and above. These findings reflect the Tanzanian social stratification, whereby students from low SES join teacher education programmes. In fact, the results showed that many parents (fathers 56.4 %, mothers 62.5 %) are small-holder farmers—an occupation which in the Tanzania context is associated with low SES. Similar findings were reported by Morley and Lugg (2009) who found that students from less priveledged families tended to enrol into teacher education programmes as opposed to highly socially accepted professions such as medicine and law. Also, prospective teachers' mothers ($M = 2.53$, $SD = 1.130$) had relatively lower levels of education compared to the education of prospective teachers' fathers ($M = 2.90$, $SD = 1.380$). These findings may have implications of how gender is constructed in the society.

Further, although, we found that prospective teachers had low mean score on self-confidence compared to the other two dimensions of CTSs, overall, prospective teachers reported moderate levels of CTSs. While, this study did not establish the reasons behind this discrepancy, Kavenuke (2018) in his study noted that many students lacked self-confidence. Such lack of self-confidence stems from students' fear associated with the vertical relationship existing between children and parents, students and teachers or anyone with authority (Kavenuke, 2018). With respect to gender and CTSs, our findings support earlier studies (French et al., 2012; Liu et al., 2019; Peerbolte & Collins, 2013) which found no significant differences between males and females with regard to their CTSs.

In contradiction with our hypothesis and the literature (Demrhan & Köklükaya, 2006), we found that there was no significant relationship between years of study and the dimension of self-confidence. Nevertheless, a significant relationship was observed between years of study and the other two dimensions of CTSs—sytematicity and scepticism. Surprisingly, prospective teachers' systematicity and scepticism decreased with years of study, contrary to what Demrhan and Köklükaya (2006) found. Demrhan and Köklükaya (2006) established that CTSs increased with years of study, with the final-year students' mean scores on the dimensions of CTSs being significantly higher than those of first-year students. Furthermore, we found that there was no significant relationship between work experience and prospective teachers' CTSs. This finding is contrary to OöNeill and Stephenson (2012) who noted that constructs such as self-confidence improve with professional experience.

Additionally, science education content has been consistently linked with CTSs (Duran & Dökme, 2016; Forawi, 2016; Wagh et al., 2017; Wilmes & Siry, 2018). Contrary to this assertion, we found no significant relationship between degree programmes and the dimensions of CTSs. In other words, whether or not prospective teachers majored in science teacher education was not significantly related to their CTSs. Given these mixed results, future research is needed to investigate CTSs in relation to these subjects of specialty.

With regard to parents' education—one of the indicators of SES, overall, parents' education was not significantly related to prospective teachers' CTSs. Nonetheless, a few exceptions were noted where father's education significantly predicted prospective teachers' systematicity and scepticism. Similarly, only father's occupation, another indicator of SES, was significanly related to prospective teachers' systematicity. As researchers, we were not able to establish why only father's education and occupation were significant predictors of some of the dimensions of CTSs. Hence, it is important that future research is conducted to investigate this gendered pattern. Moreover, the observed significant relationship between some of the indicators of SES and the dimensions of systematicity and scepticism is consistent with the observation by Gelerstein et al. (2016) who established that SES has significant effect on CTSs. While we used parents' education and occupation, Gelerstein et al. (2016) used the type of school (public, public

subsidised and private) students enrol. Given that our findings replicate the study by Gelerstein et al. (2016) which was conducted in the Chilean context, it implies that SES remains an important variable across contexts. This truism adds to the complex nature of the intersection between social class and CTSs.

With respect to the relationship between the dimensions of CTSs and GPA, we found that GPA was neither significantly correlated nor a significant predictor of any of the dimensions of CTSs. Our findings appear to contradict with Derrick-Telemaque (2014) who observed a positive correlation between GPA and systematicity ($r = .35$) as well as GPA and self-confidence ($r = .23$). Further, while a study by Yuan et al. (2014) established a strong correlation ranging from $r = .60$ to $r = .71$ between systematicity and scepticism, in this study, we only found positive but moderate correlations among the dimension of CTSs ranging from $r = .302$ to $r = .431$. These correlations imply that developing CTSs requires prospective teachers to be conversant in all dimensions. Regarding the predictors of CTSs, we were not able to establish why year of study negatively predicted prospective teachers' CTSs on the dimensions of systematicity and scepticism. That is to say, further research, preferably a longitudinal study, is needed to account for that observation.

## 7. Study limitations and suggestions for future research

One of the limitations of this study is that most of the items did not load to their respective dimensions, resulting in weak internal consistency of the sub-scales. To some extent, this implies that the reliability of the adopted instruments could not be replicated in the Tanzanian context. Thus, more qualitative studies are needed to explore the conceptions of CTSs among university students, in particular, prospective teachers in Tanzania. In fact, one of the qualitative study conducted by Kavenuke (2018) indicated that even university lecturers had different conceptions of what constitutes CTSs. More significantly, there is a need to establish and validate instruments for measuring CTSs among university students in Tanzania. Based on our findings, we also recommend that future research in Tanzania must consider social class as an important variable. For instance, future studies may be conducted to establish the intersection between SES and other forms of social division such as gender as well as how such intersection is related to CTSs. With insufficient data available on SES in Tanzania, many studies will continue to face the challenge of measuring SES in Tanzania. Our measure of SES, in this study had several limitations. Firstly, there is a high possibility that some parents belonged to all the three occupations. Secondly, parents in the same occupation might differ significantly in terms of their income. Furthermore, the level of education as a measure of SES might be challenging in the context of Tanzania where part of the educated mass remain unemployed. Finally, we limited our measure of CTSs to only three dimensions—systematicity, self-confidence and scepticism. Thus, given the lack of studies on CTSs in the context of Tanzania, future studies may be extended to include other dimensions of CTSs such as analyticity and open-mindness.

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## Declaration of Competing Interest

None.

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