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Hellen Joseph Njura, Isaac Kubai Kaberia & Simon Thurania Taaliu

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# Teaching secondary school agriculture at the psychomotor domain: a conceptual framework for enhanced skills development for food security

Hellen Joseph Njura<sup>a</sup>, Isaac Kubai Kaberia<sup>b</sup> and Simon Thurairia Taaliu<sup>a</sup>

<sup>a</sup>Department of Education, University of Embu, Embu, Kenya; <sup>b</sup>Department of Humanities, University of Embu, Embu, Kenya

## ABSTRACT

**Purpose:** To develop a conceptual framework that can be employed in secondary school agriculture classes on skills development for food security.

**Design/Methodology/Approach:** The conceptual framework was developed from the findings of an earlier study by the authors on the effect of agricultural teaching approaches on skills development for food security. Qualitative data were collected and analysed through descriptive statistics.

**Findings:** Skills development can be enhanced at the psychomotor domain of Bloom's taxonomy through integration of practical agricultural activities as guided by the conceptual framework. The skills developed at secondary school level can be timely applied for food security and nutrition which can ultimately reduce poverty and boost economic development in any country.

**Practical implications:** The conceptual framework can be used as a guide to developing agricultural skills which can be the drivers of economic development in any country. Such a transition can be an avenue for ultimate achievement in eradicating extreme poverty and hunger by the year 2030.

**Theoretical Implications:** The paper makes a contribution to the growing body of knowledge by highlighting practical learning opportunities that can be incorporated within the psychomotor domain. The hands-on-skills developed are applicable at meeting the four pillars of food security.

**Originality/value:** In the current studies on secondary school agriculture a conceptual framework that incorporates learning at the psychomotor domain of Bloom's taxonomy is hardly found. When incorporated into the theory, the framework can be a guide to skills development for enhanced food security and nutrition.

## ARTICLE HISTORY

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## KEYWORDS

Food security; nutrition; psychomotor domain; skills development; teaching agriculture

## 1 . Introduction

Eradication of poverty and extreme hunger by the year 2030 have been threatened by the projected rise in population, the soaring middle classes and changing diets such as food, feed, fibre and biofuels amidst decline in crop production in many developing countries

**CONTACT** Hellen Joseph Njura  [hellenanjurah@yahoo.com](mailto:hellenanjurah@yahoo.com)  Department of Education, University of Embu, P.O. Box 6-60100, Embu, Kenya

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(DFID (Department of International Development) 2015). As reported by the IFPRI (International Food Policy Research Institute 2019) the newly introduced second indicator for monitoring Sustainable Development Goal (SDG) of Moderate or Severe Food Insecurity (SFI) has raised the total to over 2 billion people worldwide not having regular access to safe, nutritious and enough food.

The increased pesticide use associated with a dietary transition has also led to increasingly unhealthy diets and obesity (DFID 2015). This is as a result of the rise in agricultural intensification in response to demand growth risking food safety. Urbanization and the supermarket and food company-driven changes in food value chains are also transforming food markets around the world creating both opportunities and challenges for small-scale farmers (DFID 2015).

As guided by the Food and Agricultural Organization (FAO 2019), both short-term and long-term policies can ultimately lower a country's economic vulnerability. The current study is aimed at developing a conceptual framework that can be incorporated into both the short-term and long-term policies on agricultural skills development in secondary schools. The skills so developed can ultimately reduce poverty, inequalities, food insecurity and malnutrition as these phenomena are not easily dissociated (FAO 2019). Such guidelines may include social protection programmes such as home-grown school feeding which has proved effects in preventing undesirable coping strategies. Schools and households can avoid negative coping mechanisms and in accelerating recovery after adverse economic episodes such as volatile food prices (FAO 2019).

Teaching agriculture at the psychomotor domain needs to focus on skills development within the multiple fronts such as technology development and adoption of the existing sustainable agriculture and climate smart practices and technologies such as agroforestry and conservation (DFID 2015). Skills aimed at improved prediction of future climate events, such as early warning systems and seasonal and daily weather forecasts, can also be developed at the secondary school level. Harnessing the innovation, energy and dynamism of the youth must, therefore, be a central element to overcoming challenges related to food security and nutrition (IFPRI 2006). Such challenges according to the authors include the rising demand for food, climate change and environmental degradation.

Agricultural transformations can also be promoted through the proposed framework to increase nutritional benefits. For instance, due to the risk of the growth of agricultural food sector leading to poor health outcomes (DFID 2015), knowledge interventions in the agricultural food sector can be practically disseminated through agriculture classes by taking the opportunity to build in nutritional benefit and monitor the impact on nutrition outcomes such as under-nutrition and over-nutrition. For example, school-based projects on production of indigenous vegetables and orphaned crops may shape and increase their potential to positively impact the underlying causes of hunger and malnutrition.

In their report (FAO 2019), in 2018, Africa and Asia had the greatest share of all forms of malnutrition by accounting for more than nine out of ten of all stunted children, over nine out of ten of all wasted children and nearly three-quarters of all overweight children worldwide. According to FAO (2019), the association of food insecurity with overweight and obesity across different age groups varies depending on the income level of the country. The report further indicates that food-insecure households from the low-income and lower-middle-income countries are less likely to experience overweight or obese or has a very weak or no association. On the contrary, in households from the

upper-middle and high-income countries, food insecurity is associated with increased overweight or obesity in some age groups (FAO 2019). The proposed conceptual framework draws attention to developing secondary school agricultural skills to reduce food insecurity on both extremes.

### **1.1. Statement of the problem**

The fundamental objective in learning agriculture is for learners to develop basic principles of agricultural production relevant to a nation and the surrounding environment [KNEC (Kenya National Examinations Council) 2017]. Practical teaching approaches result into the development of the required skills for food security. The skills developed encompass the aspects of food production, accessibility, food safety and nutrition as well as constancy in its supply leading to the achievement of the four pillars of food security namely: availability, accessibility, utilization and stability (FAO 2008). Despite the teaching of agriculture, the youth in and out of school are faced with the challenge of employing the skills developed to secure food for themselves and the future generation.

Various governments' efforts all over the world to address youth issues such as unemployment have remained a challenge until now. For instance in Kenya, the third National Development Plan (1974-1978), Sessional Paper number two of 1992 on small scale and cottage industry, the 1997–2001 Development Plan, the National Poverty Eradication Plan of 1999–2015 (MoALF 2017). The principal challenge is ensuring optimal utilization of the youth potential in contributing to the sector goals of achieving food and nutrition security, income generation, decent employment as well as wealth creation (MoALF 2017).

The inherent potential of the secondary school agriculture student can be energized through hands-on training so that the skills so developed can be applied at their own capacity for food security. The application of the psychomotor domain of Bloom's taxonomy (Bloom 1956; Simpson 1972) is such an avenue for skills development to meet the four pillars of food security, reduce poverty and reach the ultimate goal of economic development. The study, therefore, aimed at developing a conceptual framework that could be employed in secondary school agriculture classes at the psychomotor domain targeting enhanced skills development for food security.

### **1.2. Research objectives**

The development of the proposed conceptual framework was guided by the following research objectives.

- (a) To establish how the current practices of teaching secondary school agriculture are geared towards skills development for food security.
- (b) To find out whether the psychomotor domain is addressed to the components of instruction to develop skills for food security.
- (c) To identify the gaps in achieving the expected learning outcomes when teaching agriculture at the psychomotor domain.
- (d) To highlight the possible outcome of the suggested conceptual framework in applying the psychomotor domain in developing skills for food security.

### **1.3. Research questions**

The development of the proposed conceptual framework was further guided by the following research questions.

- (a) How are the current practices of teaching secondary school agriculture geared towards skills development for food security?
- (b) How is the psychomotor domain addressed to the components of instruction to develop skills for food security?
- (c) What gaps are identified in achieving the expected learning outcomes when teaching agriculture at the psychomotor domain?
- (d) What is the possible outcome of the suggested conceptual framework in applying the psychomotor domain in developing skills for food security?

### **1.4. Scope of the study**

The proposed conceptual framework focuses on teaching of secondary school agriculture at the psychomotor domain to developing skills for food security. The responses from an earlier research by Njura, Kaberia, and Taaliu (2020) informed the development of the framework.

### **1.5. Theoretical framework**

Practical-based approaches put the learner at the core of learning and through their active participation they gain hands-on experiences which develop on them skills that can be employed in the food industry. These experiences are what Kolb and Kolb (2005) describe as a key component in constructivist learning or basically experiential learning which forms the base for development of the proposed framework. The authors acknowledge that the primary goal of the use of this theory is students to learn how to learn by giving them the initiative for their own learning experiences.

### **1.6. Significance of the study**

The proposed conceptual framework can be used by agriculture teachers as a guide as well as a checklist as they teach secondary school agriculture. If adopted, the framework will necessitate skills development at each level of the psychomotor domain of Bloom's taxonomy and guide on their appropriate application so that the students can effectively participate in meeting the food security and nutrition agenda. These skills will be the drivers of reduced poverty and the ultimate economic development in any country. Such a transition can be an avenue for ultimate achievement in eradicating extreme poverty and hunger by the year 2030. This paper is, therefore, informing policy on areas that can be amended in secondary school agriculture syllabus so more time is dedicated to practical learning so that the hands-on-skills developed are applicable at meeting the four pillars of food security.

### **1.7. Emphasis of the conceptual framework**

- (a) It focuses on how practical agriculture at the psychomotor domain of Bloom's taxonomy can shape learning and achievement.
- (b) The role of the skilled learner in securing food and averting malnutrition challenges.
- (c) Social interactions necessary between practical learning and securing food and nutrition.
- (d) The relationship between the concept of practical agriculture and the aspects of food security and nutrition.

### **1.8. Basic assumptions of the conceptual frame work**

- (a) Only a few countries can sustainably progress on broad-based food insecurity and malnutrition reduction without secondary school agricultural education skills playing its role.
- (b) While agricultural education skills are important for food security and nutrition, it will depend, in the long run, on the change of attitude and in the engagement of the youth in the agricultural sector through job creation.

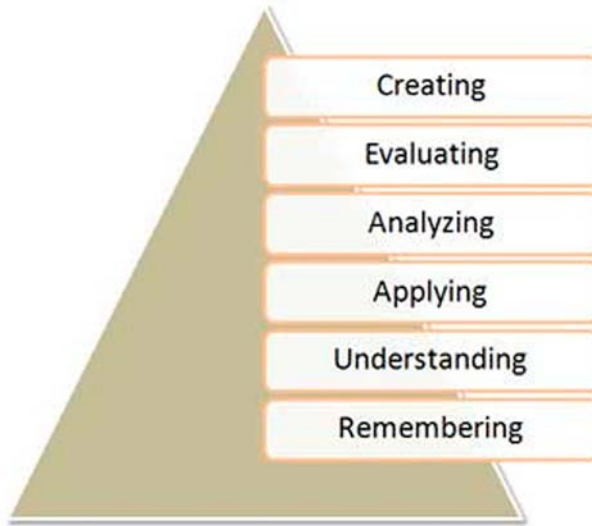
## **2. Literature review**

The taxonomy of learning behaviour is the goal of the learning process (Bloom 1956). Bloom's taxonomy comprises three categories of instruction, namely the cognitive, affective and the psychomotor domains. The cognitive domain involves knowledge and the development of intellectual skills (Bloom 1956; Anderson et al. 2001). This includes the recall or recognition of specific facts, procedural patterns and concepts that serve in the development of intellectual abilities and skills (Anderson et al. 2001). The six major levels of the cognitive domain are presented as Figure 1 from the simplest to the most complex level.

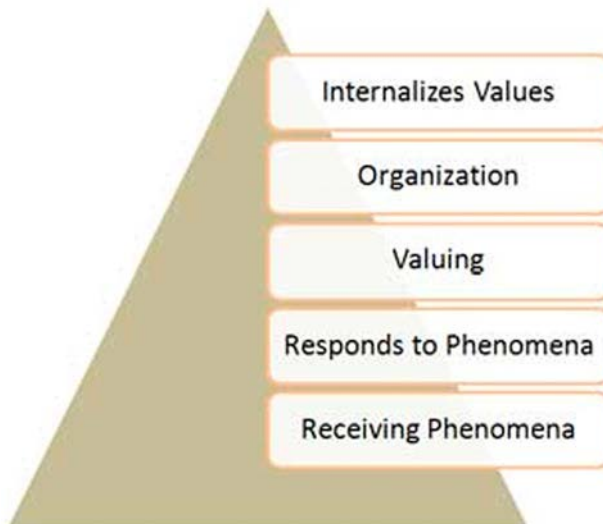
The affective domain deals with emotions such as feelings, values, appreciation, enthusiasm, motivations and attitudes (Bloom 1956; Krathwohl, Bloom, and Masia 1973). The five major categories are presented as Figure 2. from the simplest to the most complex level.

The psychomotor domain includes physical movement, coordination and the use of the motor-skill areas (Simpson 1972). According to Simpson (1972), development of these skills requires practice and is measured in terms of speed, precision, distance, procedures or techniques in execution. Thus, psychomotor skills range from manual tasks, such as digging a ditch or washing a car, to more complex tasks, such as operating a complex piece of machinery or dancing. The seven major categories are presented as Figure 3 from the simplest behaviour to the most complex level.

The three domains of learning are applied in all forms of instruction. In the context of the current study, the cognitive and the affective domains are the platform for skills

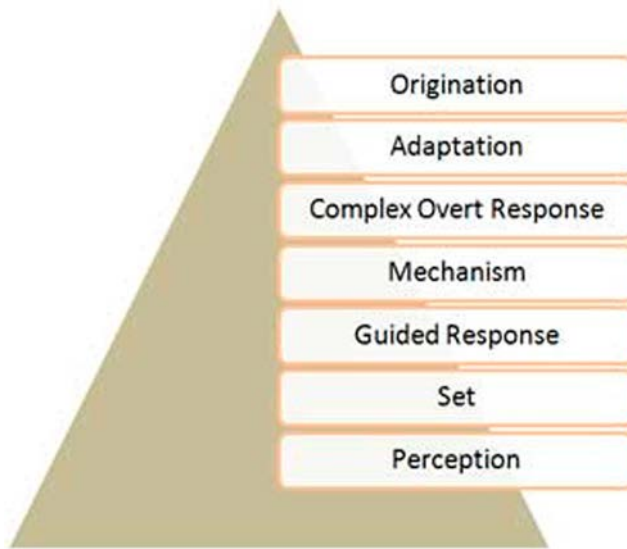


**Figure 1.** The cognitive domain of Bloom's taxonomy. Source: Anderson et al. (2001).



**Figure 2.** The affective domain of Bloom's taxonomy. Source: (Bloom 1956; Krathwohl, Bloom, and Masia 1973).

development at the psychomotor domain. The psychomotor domains of perception, set-up, response, controlled movement, mechanism, specific movement, settlement and originality can be applied in all teaching methods, teaching strategies and practical workshops (Alessi and Trollip 2001) and produce good results based on the learning objective. In agricultural education for example, preservice and inservice training for teachers are important ways of enhancing the ability of the agriculture teacher to effectively develop



**Figure 3.** The psychomotor domain of Bloom's taxonomy. Source: (Simpson 1972).

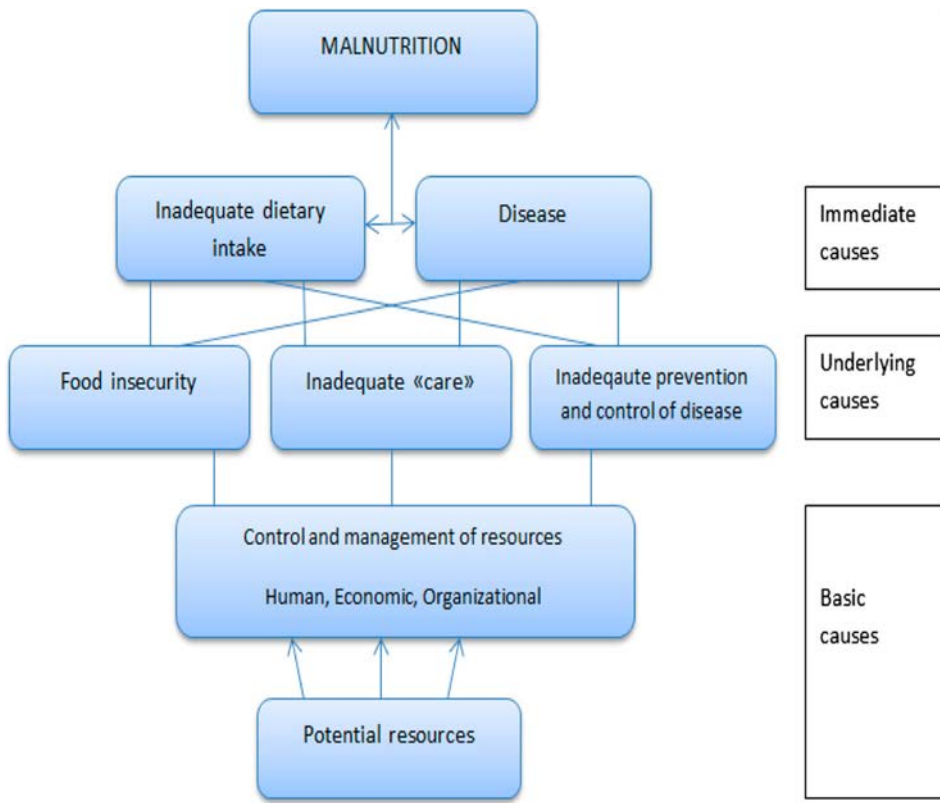
the required skills to their learners Harlin et al. (2007). Various learning settings that include classroom instruction, laboratory work, field trips and supervised agricultural experience programmes (Phipps et al. 2008) are avenues for hands-on experiences in agricultural education.

In the context of the current study, skills development in secondary school agriculture can be enhanced if learning at the psychomotor domain is emphasized in order to adapt to food security and nutrition. This has an ultimate goal of reduced poverty and economic development.

Various conceptual frameworks have been developed and applied in the learning process. However, an examination of the frameworks related to agricultural education has displayed a common research gap, which can be bridged through the integration of the psychomotor domain for enhanced skills development and their application to meeting the food security agenda.

The United Nations Children's Fund (UNICEF) conceptual framework, (Figure 4) on the causes of child malnutrition (UNICEF 1998), was developed in 1990 as part of the UNICEF nutrition strategy. The framework according to Von Grebmer et al. (2010) is the origin of the most prominent frameworks such as those currently used by the Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS) of the FAO and United Nations partners, the Food and Nutrition Technical Assistance Project (FANTA) supported by the United States Agency for International Development (USAID) and the International Food Policy Research Institute (IFPRI). The UNICEF's framework identifies different channels through which an individual's nutritional status might be affected and the related causes of malnutrition at different levels (Von Grebmer et al. 2010). The causes are structured into immediate, underlying and basic causes which relate to the individual, household and societal levels forming the independent variables, while the effect is on the individual's nutrition forming the dependent





**Figure 4.** UNICEF's conceptual framework for the cause of malnutrition. Adapted from UNICEF (1998)

variables. The UNICEF framework has mainly enhanced food security at the household level (Von Grebmer et al. 2010). The proposed conceptual framework looks at the enhanced skills development on the youth in school whose benefit will be felt at the individual, household as well as the societal level.

The new conceptual framework (Ecker and Breisinger 2012) is a development of the UNICEF's framework as it further incorporates the complex interactions of factors at the macro and micro levels. The framework also incorporates the manner in which external shocks, such as global food price spikes and natural disasters as well as interventions in the form of policies and programmes, affect the availability of food, people's access to it and the resulting nutritional status of individuals (Ecker and Breisinger 2012). The current framework borrows a lot from the new conceptual framework as it discusses how the various psychomotor skills can lead to the achievement of the four pillars of food security. However, the proposed framework is specific to secondary agricultural education as a member of producers of the needed skills, while anyone is entitled to benefit from the effects of the skills. This is unlike the new conceptual framework which is specific to the micro- and macro-dimension of food security and nutrition. The micro-dimension relates to issues of food and nutrition security at the household and individual levels, while the macro-dimension goes far beyond issues of agricultural production and international trade, given strong linkages with the rest of the economy through which

outputs in non-food sectors and macro and (non-agricultural) economic policies greatly influence food supply (Ecker and Breisinger 2012).

The (DFID 2015) conceptual frame work on agriculture (Figure 5) focuses on the contribution of the agrifood sector to achieving three interconnected goals of economic growth and poverty reduction by creating jobs and higher incomes for the rural poor, food security and improved nutrition and sustainable food systems. This has an emphasis of ensuring that the current production systems do not compromise future production and future supply is resilient in the face of climate change and resource scarcity (DFID 2015). The current research aims at improving on achievement of these goals by ensuring that secondary school agriculture that is not mentioned in the DFID frame work is an avenue for reduced poverty and economic development. In this regard, the interactive nature of the variables has an impact on meeting the four pillars of food security and nutrition, reducing poverty and finally economic development.

The 2018 Agrilink conceptual framework (Figure 6), on the other hand, is oriented towards connecting micro-level farmer decision-making processes to the governance and functioning of the farm advisory sector. Its success has been seen significantly reducing poverty and hunger and boosting the incomes and livelihoods of many people including in the poorest countries (AgriLink 2018). The Agrilink conceptual framework has also focused on the new challenges and opportunities as they present themselves. These include climate change, resilient and sustainable food systems, girls and women involvement in agriculture as well as migration to towns and cities where plot sizes and climatic conditions make it less and less likely that those future generations will be able to feed themselves and their families with their own agricultural production. The proposed framework advocates that the psychomotor skills developed to the youth in school can be a good avenue for adapting to food security and nutrition despite the aforementioned challenges. This group has also not been highlighted in the Agrilink conceptual frame work. Such skills include prediction of weather patterns, pest and flood pandemic making it possible to determine the appropriate agricultural practices to carry out.

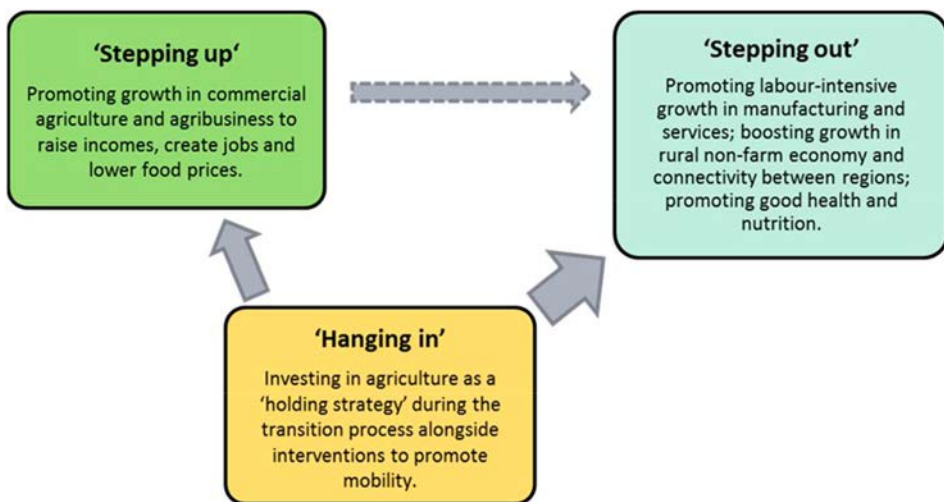
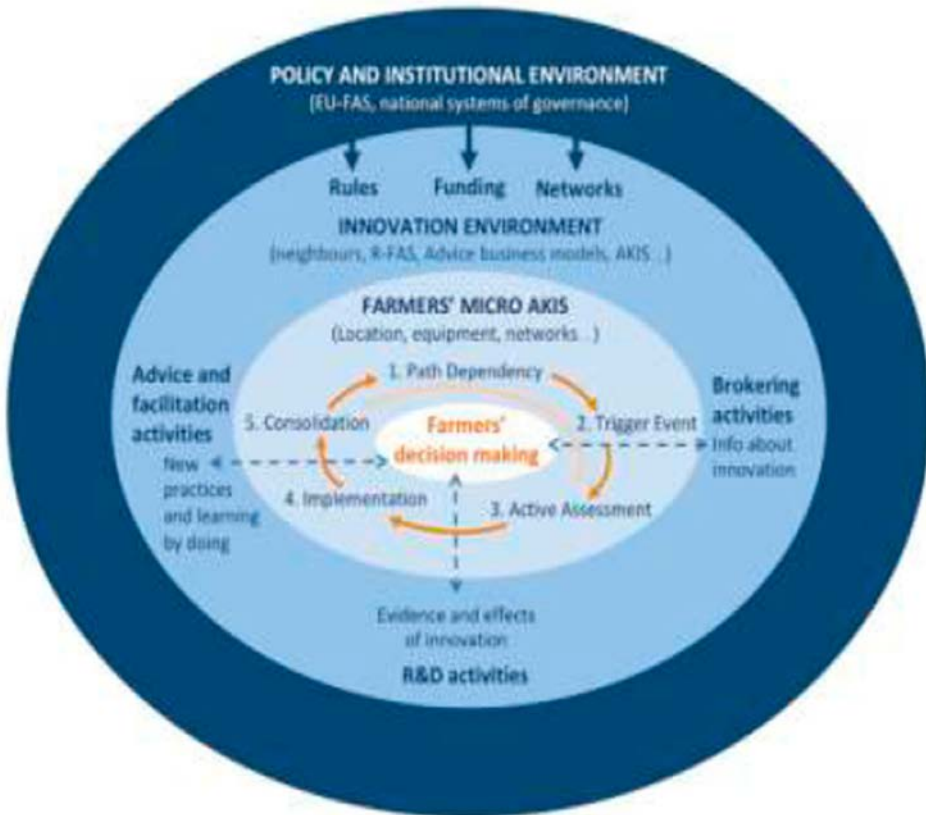


Figure 5. Economic and livelihood strategies. Source: DFID (2015).



**Figure 6.** AgriLink multi-level conceptual framework diagram. Source: AgriLink (2018).

### 3. Methodology

#### 3.1. Rationale of the proposed conceptual framework

The conceptual framework builds on a recent paper by Njura, Kaberia, and Taaliu (2020) on the Effect of Agricultural Teaching Approaches on Skills Development for Food Security published in the *Journal of Agricultural Education and Extension*. This is due to the fact that some of the responses found in the paper opened up room for further discussion on what more could be done to enhance the teaching of secondary school agriculture for skills development and their application to food security. The current paper responds to the global changes to food security issues as well as the challenges of teaching secondary school agriculture for food security providing an important evidence base for developing the conceptual framework. The framework is further pegged on the 2019 IFPRI's definition of food security which goes beyond hunger and malnutrition and also incorporates overweight and obesity. The proposed framework further builds on the new conceptual framework by Ecker and Breisinger (2012) that besides the individual, household and societal components, there is the complex interaction between the micro- and macro-dimensions of food and nutrition security. In the proposed framework, the interactive nature of the independent variables that are the levels of skills development at the

psychomotor domain have a direct impact on the achievement of the four pillars of food security, namely, availability, accessibility, utilization and stability. It is grounded in the recognition that food security and nutrition can sustainably be achieved through skilled manpower hence the need to focus on agricultural skills development in secondary schools. It summarizes the philosophical views of the role of the practical agriculture at the psychomotor domain and essential understanding of skills that can be developed for food security.

The initial research that led to the development of the proposed conceptual framework involved key participants who are agriculture teachers and their students. The two groups of respondents had a common response to a question on what more could be done to improve the teaching of secondary school agriculture (Table 2). The responses provided a foundation for in-depth literature review on the role of students' field attachments, school-community-linked projects as well as increased practical sessions in developing agricultural skills for food security. The constructs reported within the previous studies that led to the development of the proposed framework will be validated by conducting a research survey.

### **3.2. Validation and testing of the proposed conceptual frame work**

Besides the reviewed literature, which is the source of construct validity for the proposed conceptual framework, further validation and testing will be done. The authors target to select two counties in Kenya between January and May 2021 when normal school learning resumes after the Covid-19 lockdown. The targeted respondents for the survey will be the agriculture teachers who deliver the content, the agriculture students who are the direct consumers of knowledge and skills as well as the parents/guardians who represent the immediate community that benefit from the skills developed especially from projects done by their children at home.

Expert judgement from the field of agricultural education, agricultural extension as well as technicians in the agricultural firms where the students are likely to be attached over the April school holiday will further validate the framework. Case studies will further generate empirical evidence, while member check will provide participants' opinions providing further validation.

During the empirical study, survey data will be collected and analysed through Structural Equation Modelling (SEM) techniques. If need be, further research will be required to validate the revised framework with revised survey instruments. The revised version of the framework will be reported in future agricultural education and food security-related conference meetings.

**Table 2.** Agriculture students' opinions on the approaches that could help them develop more skills for food security.

Approach	N	%
Students should be attending field attachment for around two weeks in an agricultural based institutions	391	42.0
Greater commitment involving technical experts from agricultural institutions in school-community-based projects	318	34.2
Increased instructional sessions through creation of adequate time for practical aimed at food security	221	23.8
Total	930	100.0

Source: Njura et al. (2020).

The authors have established an agenda to foster the use of the conceptual framework as a common ground for teaching secondary school agriculture for skills development to tackle food security issues. However, due to its flexible nature, future research may be necessary to assess whether the framework guides on teaching secondary school agriculture for enhanced skills development to meet other roles of agriculture to the economy such as income generation and provision of raw materials for industries.

### **3.3. Location of study for the initial research**

The study (Njura, Kaberia, and Taaliu 2020) that informed the development of the proposed conceptual framework was carried out in Embu County representing the 47 counties in Kenya. The aspects of resource endowment, climatic conditions, rural versus urban areas, private versus public schools as well as diversity in population distribution have an influence on various ways in which the psychomotor skills can be developed and applied at secondary school education level for food security.

### **3.4. Research design**

The previous study that led to the development of this paper adopted descriptive survey design where qualitative data obtained guided the development of the conceptual framework.

### **3.5. Sampling procedures and sample size**

During the initial study, mixed sampling methods, in which both random and non-random sampling designs, were used. Embu County was purposively selected. Stratified random sampling was administered to obtain the number of schools required in the public and private school categories. Systematic random sampling was further applied to get the specific schools and the agriculture teachers. Simple random sampling was carried out on the students in the selected schools. The researcher achieved this by obtaining the number of students specializing in agriculture in Form Three and Four from their subject teachers. However, the class registers from the class teachers in Form One and Two were used to determine the students present. This was with the assumption that they would not have selected their subject options by the end of Form Two. The researcher then assigned random numbers to all the students to sample those who would take part in the study. The population sample is presented as [Table 1](#).

**Table 1.** Population sample.

Subject category	Target population	Expected sample	Actual sample	Percentage sample
Public schools	186	132	60	41.67
Private schools	12	12	8	0.06
Agriculture teachers	235	148	111	75.00
Students	46,340	381	490	128.61

Source: Njura et al. (2020).

### **3.6. Research instruments**

In the initial research, an Agriculture Teachers' Interview Schedule (ATIS) containing 18 questions was developed. These were distributed into seven open-ended questions, six closed-ended questions and five in likert scales. A Students' Focus Group Discussion Guide (SFGDG) was also prepared with a set of fourteen open-ended questions which allowed students to speak freely and provide as much information as they knew. It is from these items that responses from an open-ended question on what more could be done to enhance the teaching of secondary school agriculture for skills development led to the development of the conceptual frame work.

### **3.7. Pre-testing the research instruments**

The interview schedule and the focus group discussion guide were subjected to pre-testing. A pre-test sample of 1% and 10% depends on the sample size, which is 1% for a large sample and 10% for a small sample (Mugenda and Mugenda 2003). The researcher used 10% of the research participants to give a total of fourteen schools, two focus group discussion and fourteen interview schedules in the selected schools to participate in the pilot study. The randomly selected schools for piloting were not included in the actual study. The pilot data were used to compute the reliability coefficient of the instruments using the internal consistency approach.

### **3.8. Data collection procedures**

During the initial study, a letter of introduction from the University of Embu helped the researcher obtain a research permit from the National Commission for Science, Technology and Innovation (NACOSTI). The researcher also obtained a consent letter from the County Director of Education before contacting the school principals to prepare for data collection. The research instruments were administered over a span of three months where the interviews with the agriculture teachers were conducted. Within these months, the researcher also met the students in their focus group discussions. Two field assistants were involved recording the interviews and the discussions.

### **3.9. Data analysis**

The edited data were coded and fed into the computer for analysis using the Statistical Package for Social Sciences (SPSS) version twenty four for windows. The researcher transcribed the audio data from face-to-face interviews and the focus group discussions that had been obtained from the initial research. The students' and the agriculture teachers' responses were read and re-read for proper interpretation. Content analysis was used to explain the qualitative data.

## **4. Results and discussion**

The research findings obtained from the earlier study by Njura, Kaberia, and Taaliu (2020) established that more could be done to enhance the teaching of secondary school

agriculture for skills development. The agriculture students' opinions are presented as [Table 2](#), while the agriculture teachers' opinions are as described evoking the development of the proposed conceptual frame work.

From the descriptive statistics shown on [Table 2](#), attendance of field attachment is the most critical approach to skills development due to the exposure and experience of the real world. This would not only prepare them for jobs in future but also help them continually develop skills for food security while in school. Greater commitment in involving technical experts from agricultural institutions would add more and new skills to the students. Finally, increased instructional sessions through creation of adequate time for practical agriculture would give room for more skills development aimed at enhanced food security.

In agreement with the students' views, the agriculture teachers had the opinion that more time was needed for practical sessions and in-depth learning. Majority of the work, covered theoretically in lectures and giving notes, would translate into problem solving and class projects paving way for more skills development for food security at secondary school level. Notably, both the agriculture students and their teachers have a common aim of enhancing skills development through practical agriculture.

The research findings are in agreement with those of Konyango and Asienyo (2015) in that practicals are an absolutely essential component of teaching most agriculture topics. However, the lack of appropriate facilities and high cost of setting up practical training have affected the quality and frequency of practical classes offered (Phipps et al. 2008; Konyango and Asienyo 2015) and the poor management, maintenance and upkeep of the facilities and insufficient budget to provide necessary supplies for each facility to allow students ample opportunities to learn and practise skill development (Engler and Kretzer 2014). A common complaint among agriculture students is that practicals are lacking or inadequate (Konyango and Asienyo 2015). Practical instruction, using hands-on approaches, is a great way to reach higher levels of Bloom's Taxonomy, giving students more relevant skills to enter the workforce in the food industry (Adom 2016). Related literature cited in this study has little linkage of the approaches to teaching agriculture and food security. This study hence adds to the existing body of knowledge by highlighting the need for school community linkages through class projects and students' agricultural field attachments to enhance hands-on experiences for food security at secondary school level.

In agreement with the students' views, the agriculture teachers had the opinion that more time was needed for practical sessions and in-depth learning. Majority of the work covered theoretically in lectures and giving notes would translate into problem solving and class projects paving way for more skills development for food security at secondary school level. Notably, both the agriculture students and their teachers have a common aim of enhancing skills development through practical agriculture.

In the context of the current study, the three approaches suggested by the agriculture students and the agriculture teachers' opinions can be integrated at the psychomotor domain giving room for enhanced skills development for food security. The researcher, therefore, found it appropriate to develop a conceptual framework that could accommodate such views by emphasizing on teaching agriculture with hands-on-skills development in mind.

### 4.1. The structure of the proposed conceptual frame work

The proposed conceptual framework (Figure 7) indicates the interactive nature between the independent variables, which are the various levels of skills development at the psychomotor domain of Bloom’s taxonomy in teaching secondary school agriculture, and their resultative impact on enhanced food security and nutrition. The authors have given relevant examples of skills that can be developed at each level of the domain. If appropriately developed, the skills at each level have their inherent ability to positively contribute to enhanced food security and nutrition. This can be done by achieving one or more of the aspects of food security that form the four pillars, namely, availability, accessibility, utilization and stability. The output of this interaction is the reduced poverty and the ultimate economic development. The frame work also includes external factors which may intervene with either skills development or their application in achieving the food security agenda. These can be home based, community based, political factors or even environmental factors such as pest and disease pandemics. The integration of the framework in the learning process should, therefore, be done bearing in mind that even disaster management in agriculture is part of skills development which can be done at the psychomotor domain.

The framework targets the skills development on the secondary school agriculture student to enhance sustainability on food security among the youth in school that form a cohort of future farmers. In this regard, future farmers are baked at the school level.

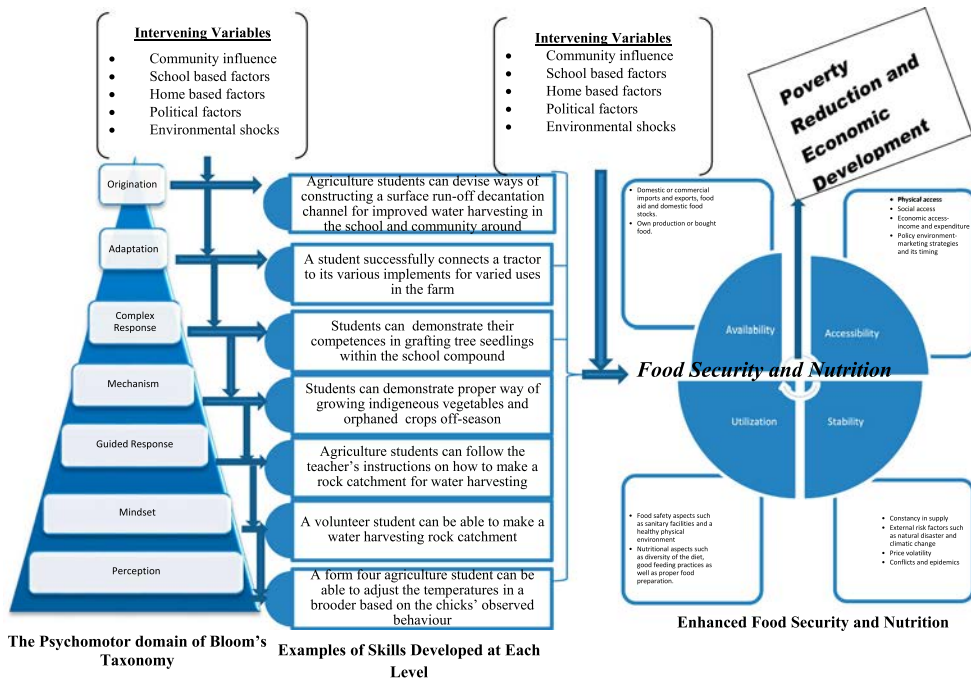


Figure 7. The proposed conceptual framework on teaching secondary school agriculture at the psychomotor domain for enhanced skills development for food security. Source: (Authors’ own inputs).



## 4.2. Application of the conceptual framework

Besides the cognitive and affective domains of education (Bloom 1956), agricultural knowledge and skills can be developed to students from the simplest to the most complex level of the psychomotor domain and later transferred to the real world for food security (Njura, Kaberia, and Taaliu 2020). According to Simpson (1972) development of the psychomotor skills requires practice which is measured in terms of speed, precision, distance, procedures or techniques which are all attributes of agricultural education. The proposed framework entails practical learning within the five main branches of agriculture, namely, crop production, livestock production, soil science, agricultural economics and agricultural engineering (KNEC 2017). In this regard, the skills developed at the psychomotor domain cut across all the five main branches of agriculture.

The development, implementation and evaluation of the food security and nutrition programme in any country can be achieved by linking the seven levels of the psychomotor domain to skills development. Some of the relevant examples are reflected on the conceptual framework, while others are discussed in the text. All these are geared towards the achievement of the four pillars of food security and nutrition with the aim of poverty reduction and the ultimate economic development of a country.

The availability of food can be achieved through skills in production which include infrastructure development such as water harvesting and soil and water conservation measures. The use of class projects, such as rock catchments, may, therefore, develop hands-on experiences in such activities geared towards food security. The kitchen garden technology and gutter vegetable production are innovative ways of availing food in a timely and economical manner. Skills in technology advancement such as the prediction of changes in weather patterns as well as value addition of the agricultural produce not only improve on production but also on access to food and its utilization. For instance, the processing of fruits at the peak period of harvest and the preservation of excess harvest improve on both form and time utility and ensure that there are minimal losses as those associated with bumper harvest. At the same time, skills in preservation and rehabilitation of the ecosystem can result in improved food accessibility both physically and economically. The teaching activities, such as safe food production, preparation and food combination at consumption level, can improve both food safety and nutrition which form the utilization pillar of food security (FAO 2008). Skills in insurance against crop failure can reduce vulnerability of individuals to temporal food supply (FAO 2008). These can be well articulated in areas of farm planning and budgeting through discussions and demonstration of diversification of risks and uncertainties through mixed farming methods.

Accessibility and proper utilization of food can also be enhanced through developing the skills needed to recognize fresh food, their preparation and eating behaviour. In a research (Fordyce-Voorham 2010) the agriculture teacher can design a programme that can improve on the students' ability to recognize fresh food by taking them to the market and develop consumer confidence as they consult with the sellers. At the same time, a programme to address behavioural capabilities to improve young people's food preparation and eating behaviour can also be incorporated enhancing the achievement of the utilization pillar through healthy eating habits. This can also be an avenue of controlling food insecurity related to overweight and obesity as articulated by IFPRI (2019).

The use of the mobile technology to develop skills in gathering and managing agricultural information is hardly found in secondary schools. If well incorporated and managed for use by the youth, it would be easy to control unfamiliar pests and diseases even in their small farms, gather market information such as pricing as well as access to microfinance. This would adequately prepare them for investing in agriculture as they complete secondary school. The mobile phones are cheaper, accessible and flexible due to their portability compared to other information technology gadgets such as laptops and personal computers making them favourable to the youth.

The benefits and opportunities of linking young agriculture students to farmers through school community projects can create a closer relationship between the two (International Fund for Agricultural Development-United Nations Educational, Scientific and Cultural Organization [IFAD-UNESCO] 2014). This is a way of taking the knowledge learnt in class to the field from where the farmer and the student can use such knowledge in food production subsequently combating food insecurity. The produce grown by schools can be utilized by the same learners incorporating it into the school feeding programme in an effort to tackle hypertension, diabetes and obesity (IFPRI 2006).

Skills on food safety can help in safeguarding against food safety hazards like consumption of pesticide residual on vegetables and foreign bodies such as heavy metals and detergents in waste water. Such skills can be developed on students as guided by the CODEX food safety standards (CODEX 2019). The practical approaches can also develop on students food safety standard skills to safeguard harvested grains like maize that form the hub of staple food in many countries. This is as guided by the East African Community (EAC) food safety standards (EAC 2015). For instance, skills on moisture control, vermin control in grain stores, proper aeration and regular inspection during storage can greatly improve on safety and reduce post-harvest losses. Additionally skills in agricultural planning and budgeting can result in the production of enough staple crops for households' own consumption as well as having enough disposable income to meet their food needs for the market (Saina et al. 2012).

#### ***4.3. Implication of adopting the proposed conceptual framework***

The proposed framework considers the four pillars, namely: availability, accessibility, utilization and stability as the core elements of food security. If adopted, the proposed framework will provide a complete means of guiding on how secondary school agriculture can be taught at the psychomotor domain of Bloom's taxonomy for enhanced skills development in achieving the aforementioned pillars. This achievement will eventually reduce poverty within households and states fostering economic development. The conceptual framework will also help stakeholders, namely, agriculture teachers, agriculture students and the parents/guardians as well as education policy makers to engage in structured coherent debate about enhancing skills development for food security.

Once approved for adoption by the ministry of education, the final validated conceptual framework will be used as a guide during practical agriculture lessons inside and outside school as well as an assessment tool for evaluating whether these practical are targeting skills development at the psychomotor domain of Bloom's Taxonomy. The authors have tasked themselves to include practical guidelines, suggest teaching and learning materials as well as interactive tools that can be used for each practical session. These

will be attached to the final framework and will be in tandem with the specific objectives for each topic of the approved agriculture syllabus. These guidelines will be organized from the lowest level (Form one) to the highest level (Form four) of secondary school education system in Kenya. This will provide a smooth flow of knowledge and skills development from known to unknown learning concepts. It is, therefore, worth noting that the proposed model in the current study has only highlighted examples of the skills that can be developed in different classes and, therefore, flexibility is needed based on the content being covered.

## 5. Conclusion

The recent food crises of food security and nutrition in developing countries and the slow progress in reducing nutritional deficiencies experienced in these countries call for effective strategies to address hunger and malnutrition as well as overweight and obesity. The study aimed at developing a conceptual framework that can guide on the teaching of secondary school agriculture at the psychomotor domain of Bloom's taxonomy for enhanced skills development for food security. The research findings that informed the development of the proposed conceptual framework and the reviewed literature for this study were all in agreement that investment on skills development in agricultural education remains important if countries have to remain food secure. However, skills development on the youth in school has been underestimated as an avenue for sustainably achieving the food security agenda. Related literature has mainly focused on the out of school youth in involvement in agriculture amidst the challenges of a rapidly growing population, youth unemployment and the rural-urban migration. At the same time, emphasis on the application of the psychomotor domain in teaching secondary school agriculture to develop, implement and evaluate the food security and nutrition programme was hardly found. To harness the youth potential and the ultimate motivation to be attracted to agriculture whether in rural or urban setting, a conceptual framework that could link the psychomotor domain of Bloom's taxonomy to skills development for food security was found necessary.

The authors suggest that the independent variables in the framework, which are the skills developed in agriculture to a great extent, trigger food security and nutrition in the society. Youths in school have a lot of inherent ability and energy to gain skills which can be applied to meet the food security agenda. Intervening variables may, however, influence the effect of the independent variables to the dependent variables. In this regard, a careful examination of the education policies is needed in order to be able to curb the effect of such shocks during the teaching process. The choice of the priority teaching methods to be used as interventions to skills development should be based on careful diagnostic assessment of the potential role of the skills in promoting food security and nutrition in specific countries and their geographical areas. The agriculture teacher should, therefore, target to develop skills with examples drawn from the surrounding environment. For example, skills in construction of a rock water harvesting catchment may play a very critical role in rural settings but of low relevance to the urban areas. This observation is in tandem with those of DFID (2015) which indicated that it is important to recognize the different potential and opportunity within the different geographical areas or zones when making decisions to prioritize agriculture and its intervention

priorities. The authors suggest that agricultural education cannot be treated as stand-alone programme in schools hence education policy and investment need to be aligned with the skills market demands.

This paper intends to inform policy by synthesizing the pertinent food security and nutrition literature and providing a conceptual frame work that may help to guide the discussion on promising pathways for achieving food security and improved nutrition through the secondary school youth. The paper also recognizes that external shocks or stressors may influence the intended learning outcome. Therefore, the authors recommend the recognition of interventional measures such as the economic policies, social policies as well as nutritional and health programmes for effective achievement of the food and nutritional security agenda.

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## Disclosure statement

No potential conflict of interest was reported by the author(s).

## Notes on contributors

*Dr Hellen Joseph Njura* (corresponding author) has an earned Ph.D. in Education Planning and Administration from the University of Embu, Kenya. She is a scholar and an academic researcher in the field of Education and in particular to Agricultural Education and Extension. Njura is a professionally trained Agriculture/Biology secondary school teacher. Outside her professional work, Njura engages in farming and reading scientific journals.

*Dr Isaac Kubai Kaberia* is a lecturer, a scholar and a researcher in the department of humanities, school of education and social sciences, University of Embu. He is a co- author for RAEE 1816479 and a Ph.D. supervisor to Njura. Dr. Kaberia has earned Ph.D. in Theology and Religious studies having specialized in ethics, peace and conflict management.

*Professor Simon Thurania Taaliu* is a lecturer, a researcher and an educational administrator at the university level. He is a co-author for RAEE 1816479 and a Ph.D. supervisor to Njura. Professor Taaliu has earned Ph.D. in International Education Policy, University of Maryland, College Park, MD, USA (2010).

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