Concepts in Context for Technical-Vocational and Livelihood Track Mathematics Curricular Enhancements

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Abstract With the ever widening jobs-skills mismatch, it is the role of every country's educational system to equip its students with the necessary skills to prepare them for the world of work. To determine what skills the industries expect from their workforce, this study explored the diversity of the applications of mathematics in the workplace as perceived by the skilled workers. This qualitative survey research purposively tapped 50 skilled workers from hairdressing, food and beverage, bread and pastry, call center and computer hardware sectors. After a three-level data analysis, the results showed how mathematics concepts like numbers and number sense, measurement, logic and technology integration were embedded in the context of production, services and sales in the different sectors. The researcher proposed curricular enhancements for Mathematics in the Senior High School Technical-Vocational and Livelihood Track and recommended that the study findings be used for a quantitative survey research.

Keywords*:* home economics, information and communication technology, mathematical literacy, technical-vocational and livelihood track, vocational education

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Introduction

Different countries have varied forms (Bakker, 2014) and diverse definitions (Dias, 2015) for vocational education. Despite these differences in perspective of vocational education, still the countries all over the world share the same goal of producing more globally competitive citizens who are equipped with skills and competencies necessary for job requirements today and in the future. This can be achieved through vocational education whose primary objective is on skills development. Yet, the link between the acquired skill sets in their vocational education and the job acquired by people in the workforce afterwards might not always be in congruence, which in turn would affect the quality of the manpower in the workforce. This time of pandemic would even demand the workforce to be more skillful to cope with the demands in the workplace in these challenging times. An appropriate system of education is believed to be instrumental in increasing the quality of a nation's human resources (Rusmar & Mustakim, 2017), and in reskilling the workforce to address the universal phenomenon of jobs-skills mismatch exacerbated by the COVID-19 pandemic (Cournoyer, 2020). Vocational education becomes relevant now more than ever as efforts to recover the economy are on their way to post COVID-19 (Pilcher & Hurley, 2020).

Because of the relevance of vocational education in upscaling the skills of the workforce to take initiatives in regaining the economy, the vocational education program would need a revisit to identify relationships among the program, the skills and most especially the students who will eventually be joining the workforce. There has been an increasing trend in vocational education programs to integrate students' experiences with practical applications in the workplace (Atkinson, 2016; Smith, 2012). This strategy called work integrated learning is deemed to promote employability of graduates (Rowe & Zegwaard, 2017). Studies have shown

how this strategy produced considerable beneficial results to the vocational education students (Armatas & Papadopoulos, 2014; Rowe & Zegwaard, 2017).

In the Philippines, the jobs-skills mismatch crisis was already growing continuously and thriving without or modest adjustment at the schools and learning institutions (Tacadena, 2016). The Senior High School (SHS) Program of the K to 12 Basic Education Curriculum commenced last 2016-2017. Among the four tracks in the Senior High School, the Technical-Vocational and Livelihood (TVL) Track corresponds to the formal vocational education offered in other countries. The TVL track was dubbed as a terminal course for high school since the economically challenged students perceive it as a venue where they can empower themselves for immediate employment after high school (Inocencio, 2014). This track gives some form of assurance for the senior high school graduate to be part of the labor force even without pursuing a college degree.

While there is no guarantee for the immediate hiring of the senior high school graduates, the two additional years in the program is foreseen to equip them with more tools for future employment and better prepare them particularly if they opt not to proceed to the next level of the educational ladder (Gamboa, 2016). But determining whether the senior high school program is equipping the students with the skills needed for them to be part of the workforce, this has to be looked into and to be studied further. In addition, the need for further studies was strengthened when Pajares and colleagues (2018) reported that there is an existing mismatch between the skills taught in the senior high school tracks particularly in the TVL track with the skills needed for what are considered the in-demand jobs. The academic subjects should be avenues where the skills in the students' chosen tracks will be honed and developed to mold the students better. Furthermore, Mathematics as one of the important subjects in

SHS continues to be a challenge for students. Mirabueno and Boyon (2020) found out that the SHS students were not able to transfer what they learned in mathematics to real world applications since the skills they are learning are not aligned with and applicable to their chosen tracks.

Mathematics in Vocational Education

Critical thinking and problem solving are essential skills that any nation's workforce must possess in this fast-changing world. These are also in fact the top two skills needed to thrive in the Fourth Industrial Revolution era (Gray, 2016). Hence, mathematics continues to be an important element in the educational systems across the globe.

In Iran, technical and vocational education students study the kind of mathematics that is also being taught in the ordinary high schools whose students want to proceed to the tertiary level (Zeynivandnezhad, Ismail & Yusof, 2012). For Sweden, before reforms were made in their vocational education program, the same mathematics course in upper secondary school was taken up by the vocational education students and the non-vocational education students alike (Lindberg & Grevholm, 2011). The numerous issues that persist on how students in mathematics are not able to transfer what they learned in the classroom to concrete situations outside the classroom could be attributed to this kind of set up in the teaching of mathematics. Lindberg and Grevholm (2013) further confirmed the lack of direct applicability of the mathematics learned in school in the workplace context through their studies which compared how workers and high school students respond to problems which are workplace mathematically based. Their studies revealed that the problems were solved by the workers while the high school students had difficulties solving those.

It is then imperative that vocational students should be able to incorporate the mathematics and statistics they

learn in the classroom to what are actually being practiced beyond the classroom, most especially in the different jobs in the workplaces (Bakker & Akkerman, 2014; Swanson & Williams, 2014). Hence, more meaningful and purposeful activity should be promoted in the schools by conveying the actual reality of the workplace as curriculum tools (Swanson & Williams, 2014). Even in England, mathematics (as a compulsory component of the program for vocational students) is learned based on a particular context and practical need (Dalby & Noyes, 2015). These practices from different countries show great emphases on the significance of the mathematical concepts in their vocational education programs.

Considering its importance in vocational education programs, the mathematics being taught in the schools should be able to address the skills needed in the different industries to propel the economy forward. Yet, there has been known skills shortages in certain sectors of the economy, and researches can potentially influence the formulation of policies for mathematics education (FitzSimons, 2014). Through improving educational policies, the shortage on skills for the economy will be addressed. To identify which factors work best for vocational education would need further studies. On the contrary, there has not been much mathematics education researches conducted along the lines of vocational education and workplace training (Bakker, 2014). A dialogue between schools and workplaces is then vital to address jobs-skills mismatch and to aid in curriculum designing.

Mathematics in the Technical-Vocational and Livelihood (TVL) Track

The Conceptual Framework for Mathematics, as stipulated in the Mathematics Curriculum Guide of the K to 12 Mathematics Curriculum, emphasized that "Mathematics is one subject that pervades life at any age and in any circumstance. Thus, its value goes beyond the classroom

and the school" (Department of Education, 2013). The Brief Course Description also stipulated that the K to 12 Mathematics Curriculum "…provides necessary concepts and life skills needed by Filipino learners as they proceed to the next stage in their life as learners and as citizens of the Philippines" (Department of Education, 2013, p. 5).

In the SHS curriculum, students regardless of their tracks study 80 hours of General Mathematics and 80 hours of Statistics and Probability. These are the only two mathematics subjects that the students in the TVL track will have in their two years in SHS, which are similar to the mathematics subjects being taught to students in the other three tracks. Research on math achievement among SHS students show that students in the TVL track are outperformed by students in the STEM track, but they perform at par with students from the other tracks (Cerbito, 2020; Mamolo, 2019). Mirabueno and Boyon (2020) in their study which tracked students' mathematics performance from junior to senior high school recommended that the mathematics subjects offered in senior high school be designed according to the skills applicable to the students' chosen tracks.

While studies in the Philippines focused on identifying the level of mathematics performance of the SHS students including those in the TVL track, this research looked into what actual skills are demanded in the workplaces as an attempt to lessen the gap between what the industries need and what are being taught in the schools. Being able to identify the necessary mathematical concepts in the context of the workplace that the TVL students are expected to possess after finishing their chosen track may provide valuable insights on what can be done for the teaching and learning of mathematics. After all, the future workforce of the country are molded and honed in the schools.

Theoretically, this study grounds on Situated Learning Theory of Jean Lave and Etienne Wenger (1991).

This theory states that learning is dependent on the "activity, context and culture in which it occurs", that is, it is situated (Culatta & Kearsley, 2015). It is in contrast with what usually takes place in the classroom wherein knowledge seems theoretical and out of context.

In this study, how mathematics is applied in the context of the workplace was explored to be able to come up with suggestions for the present Mathematics curriculum of the TVL track. As to how aligned the competencies stipulated in the current curriculum guides for the core subjects (General Mathematics and Statistics and Probability) are to the actual competencies needed in the future workplaces of the students in the TVL track in the Philippines remain to be a question. Another critical point to be addressed is how these competencies are being taught and learned in the classroom.

Purposes of Research

This qualitative survey research aimed to explore the diversity of how mathematics is applied in the workplace as perceived in particular by the skilled workers of the Home Economics and ICT industries.

Specifically, this study sought to answer the following questions:

1. What are the applications of mathematics identified by the skilled workers belonging to the five sectors:
   a) Hairdressing;
   b) Food and Beverage Services;
   c) Bread and Pastry Production;
   d) Contact Center Services; and
   e) Computer Hardware Servicing?
2. What are the dimensions of the applications of mathematics in the workplace in the Home Economics and ICT industries?

3. What are the categories that emerged as combinations of the dimensions of the applications of mathematics in the workplace?
4. What curricular enhancements in Mathematics can be proposed for the Technical-Vocational and Livelihood Track in Senior High School?

Methodology

Research Design

This qualitative survey research was designed to establish the meaningful variation (Jansen, 2010) of how mathematics is applied in the workplace particularly in the Home Economics (HE) and Information and Communication Technology (ICT) industries. In this study, the diversity of the responses of the population being studied was described after conducting written interviews of a small, diverse sample.

Participants

Table 1.
Educational Profile of the Participants.

	College Graduate	College Level	TESDA Trained	High School Graduate	High School Level	Total
Hairdressing	2	4	1	3	0	10
Food and Beverage Services	1	8	0	0	1	10
Bread and Pastry Production	6	3	1	0	0	10
Contact Center Services	7	2	0	1	0	10
Computer Hardware Servicing	9	1	0	0	0	10
Total	25	18	2	4	1	50

Purposive sampling was utilized in this study to achieve a diverse sample. A total of 50 skilled workers of varied HE and ICT were purposively selected with 10 skilled workers from each of these five sectors: hairdressing, food and beverage services, bread and pastry production, contact/ call center services and computer hardware servicing. These skilled workers vary in terms of their educational profile with reference to their highest educational attainment. At the time of this study, they were currently working in various HE and ICT industries like parlors, fast food chains, pastry and bake shops, business process outsourcing (BPO) and ICT companies.

Study Locale

This study was conducted in the urban areas of Cebu such as Cebu City, Mandaue City, Lapulapu City and Consolacion where the HE and ICT industries thrive. Parlors, fast food chains, pastry and bake shops, and computer shops situated in the large malls were the sites of this study. Participants of the contact center services sector worked in multinational BPO companies also found in the greater Cebu metropolitan area.

Data Collection

The researcher first obtained permission to conduct the study then explained the study, its merits and the expected form of participation of the prospective participants to the supervisors or managers of the different companies. The researcher then solicited the participants' informed consent. The participants signed a written form that detailed the purpose of the study and how it will be conducted; the risks and benefits for the participants; and how their privacy, anonymity and confidentiality will be ensured in the conduct of the study.

For data collection, the researcher used an instrument consisting of two sections with the first section asking for the profile of the participants and the second section contained the open-ended question on how mathematics is concretely applied in their respective workplaces. The researcher chose to conduct a written interview to give the participants the time they need to compose their thoughts. In this way, the participants were able to answer the instrument during their most convenient time.

Data Analysis

Once the responses of the participants were retrieved, data were analyzed in three levels. The first level is unidimensional description, the second level is multidimensional description and the third level is explanation (Jansen, 2010). In the first level of analysis, the object of the study which is the application of mathematics was diversified into two dimensions: mathematical concepts and workplace context. These two dimensions also had their own categories under them. In the second level of analysis, concept-oriented synthesis was done by putting together dimensions and their categories into one abstract core concept (Jansen, 2010) which this study referred to as the learning competencies. Lastly, the explanation was made by analyzing relationships based on the multidimensional description that is stated in the conclusion of this study.

Findings

Applications of Mathematics in the Five Sectors

Table 2 shows the more specific and practical applications of mathematics that are unique and distinct in the context of each particular sector.

Table 2.
Applications of Mathematics in the Five Sectors.

Hairdressing sector
recognizing the shape of the face as oval, round or heart-shaped following the steps for haircutting 1) greeting the client in a proactive manner 2) analyzing the hair 3) asking what hairstyle 4) cutting and styling using clipper and scissors and with precision referring to the guide when using a machine
Food and beverage services sector
measuring ingredients before cooking measuring the cutting of vegetables measuring the amount of water used in making gravy measuring the amount of sugar syrup used in making an iced coffee mixture using the standard measurements of the shakes and meals determining how many scoops can be scooped from a liter of ice cream creating a list of items/materials to be stocked and estimating its quantity to avoid overstocking using calculator when counting money when in a rush calculating the given target calculating the Senior Citizen's and PWD's discount
Bread and pastry production sector
measuring ingredients and using formulas using measuring cups computing the amount of ingredients when doubling a mixture converting volume to weight using spreadsheet for costing and pricing measuring sizes and distances for particular cake designs calculating mentally in changing money
Contact center services sector
estimating total amount to be spent predicting spending pattern

preparing quotes for clients
calculating the delivery charge based on the total cost of furniture to be purchased by the customer
creating formulas using excel
calculating state tax in addition to product price (state tax differs in every state)
converting currency from international purchases to USD
using mathematics or calculator in pricing doctor's claims
counting the numbers or inquiries to be assigned to colleagues
using charts and graphs to check the trend of monthly sweeper accuracy
determining the scorecards
measuring the quality of work based on survey returns
calculating and estimating the minutes per call to the number of call per shift to follow the call metrics procedures
Computer hardware servicing sector
using addition, subtraction, multiplication and division
using IT skills (hardware and software)
estimating 5 mg of epoxy
measuring and checking exact voltage, current and resistance by multi-tester
calculating using formulas
using hot air apparatus in measuring exact hotness and air pressure
reading and understanding the printed circuit board in which integrated circuits and other components are attached
using Ohm's Law
estimating parts and components to respective price and charges
calculating and analyzing files for software solutions

Table 2 reveals the activities in the hairdressing sector which the skilled workers (hairdressers and hairstylists) consider to be practical applications of mathematics in their workplace. Some participants of the study mentioned mathematical concepts and competencies though their answers are stated differently. Such practical applications

include "*estimating the shape of face, like example oval/ round/heart shaped*" and "*ask first the customer before cutting the hair and start cutting in a proportional*".

Table 2 further shows that skilled workers in the food and beverage services and bread pastry production sectors identified measuring of ingredients as a major activity in their workplace that makes use of mathematics. It can be noted that the skilled workers were specific in providing examples of the ingredients that they are using and measuring. Such responses from the skilled workers include "*measuring the standard measurements of the shakes and meals*", *estimating the rice before cooked and also the water*", "*in scooping ice cream if how many can be scooped in one liter*", "*measuring the amount of hot water that is used in making gravy*" and "*measuring the amount of sugar syrup used in making an iced coffee mixture*". Other practical applications enumerated involve time, temperature, list of items, sales, discount, money and supplies. It can be noted that the participants were able to recognize mathematics being applied in their work but are not able to articulate it well. Responses such as these include "by double the mixture" and "ratio of the ingredients".

Responses of the skilled workers in the contact center services sector are as diverse as spending pattern, delivery charges, state taxes and currency conversion. This is attributable to the fact that handling customers' queries and grievances, and providing technical support for various products and services are the basic functions of call/contact centers. The use of Excel as a practical application of math in the workplace has also been mentioned. The responses of the call center agents also include "*predict spending patterns*" and "*use charts and graphs to "check the trend of monthly sweeper accuracy*" which are considered higher cognitive tasks.

Table 2 also reveals that the skilled workers in the computer hardware servicing sector were able to specifically identify applications such as "*measuring voltage, current and resistance*", "*using Ohm's Law*" and even "*estimating 5 mg of epoxy*". A participant also cited *"estimate parts and components to respective price and charges"* as a mathematical literacy skill in his line of work. *"Software solutions"* had also been mentioned even if the sector was computer hardware servicing.

Applications of Mathematics: Mathematical Concepts and Workplace Context

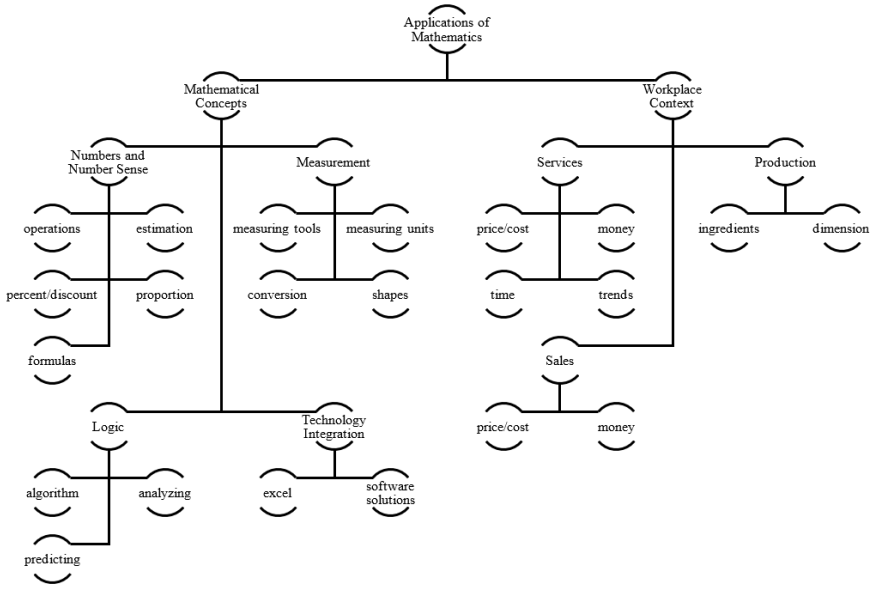

Figure 1. Unidimensional Description of the Applications of Mathematics.

Figure 1 depicts the applications of mathematics, the two dimensions and the categories under them. Key words mentioned by the participants correspond to mathematical concepts that fall under a particular content strand in

mathematics. The mathematics that they apply in their workplaces are mathematical concepts such as numbers and number sense and measurement that schools are introducing early on in the basic education level. Logic is a content strand though in senior high school while technology integration is evident across the different levels in the educational ladder. This goes to show how mathematics concepts utilized in the workplaces are being taught in schools from elementary up to senior high school.

On the other hand, work context includes services, production and sales. This work context pertains to the specific nature of the tasks and activities which the skilled workers do on a daily basis. Services refer to work done to address a customer's need and these are intangible like the services offered by a hair dresser. Production is the process of coming up with an output or a tangible good such as the baking of bread and pastry products. And sales pertain to the manner of selling tangible (products) or intangible (services) goods.

While the mathematical concepts are stated in general terms like numbers and number sense and measurement, workplace context provides the specific numbers and the actual objects that the skilled workers measure. The participants identified price, money and time as the numbers they operate on, estimate and make sense of. They also enumerated actual ingredients and dimensions of objects that they measure. Further they mentioned trends which they analyze and use to predict assisted with software programs and applications.

Categories of Learning Competencies: Merging Concepts and Context

Table 3.
Multidimensional Description of the Applications of Mathematics.

Learning Competencies	**Dimensions**	
In	Mathematical Concepts	Workplace Context
ICT	Numbers and Number Sense	Services
HE	Numbers and Number Sense	Production
HE ICT	Numbers and Number Sense	Sales
ICT	Measurement	Services
HE	Measurement	Production
ICT	Logic	Services
ICT	Technology Integration	Services

Table 3 shows that in the second-level of analysis, learning competencies for the two strands, Home Economics (HE) and Information and Communication Technology (ICT), are based on the matching of types under the two dimensions: mathematical concepts and workplace context. It can be noted that service-oriented jobs have the greatest number of mathematical concepts applied namely numbers and number sense, measurement, logic and technology integration. Providing services is an element common to all the five sectors of hairdressing, food and beverage services, bread and pastry production, contact center services and computer hardware servicing.

Likewise, sales is a common context for the learning competencies for both HE and ICT strands. Industries exist and flourish with the primary motive of raising sales to generate more profit. The prevalence of the words price, cost, cash and money among the responses of the participants

evidently show what the lifeblood is of all the industries for them to continue to thrive and provide a dependable source of income to its skilled workers.

Proposed Curricular Enhancements in Mathematics

From analysis of the different categories of learning competencies, curricular enhancements are proposed for the core curriculum subject, Statistics and Probability, in the Home Economics and ICT strands of the TVL track of the SHS program. The existing curriculum of Statistics and Probability has an allocation during the 7th-10th week for an Enrichment Content of Correlation and Regression Analysis. In lieu of this enrichment content, the researcher suggests the proposed contents and competencies instead for the TVL track. The proposed K to 12 Basic Education Curriculum Enhancement in Statistics and Probability for the Senior High School TVL track Home Economics and Information and Communications Technology Strands are found in Appendix A and B respectively.

The mathematical concepts in the context of the workplace achieved through data analysis in this study and the K to 12 Mathematics Curriculum Guides were referred to in the identification of learning competencies that are necessary and essential in the Home Economics and ICT Industries. These competencies may be used when designing classroom activities that promote work integrated learning. After all, the teacher's role of recontextualizing mathematics is essential in the mathematics education of the future workforce (FitzSimons & Björklund , 2017).

Discussion

The study intended to explore the diversity of workplace mathematics through the lens of the skilled workers. The dimensions of the applications of mathematics as well as the

different emerging categories were determined. From the results, learning competencies for the Mathematics curricular enhancements were put forth for the Technical-Vocational and Livelihood Track in senior high school.

There were numerous and more diverse mathematical applications identified by the skilled workers from the contact center services and computer hardware servicing sectors under the Information and Communication Technology industries as compared to the sectors under the Home Economics industries. Mathematics is tied up with factors particular to workplaces and tasks that are considered as all part of the job, thus, it becomes difficult to identify mathematics in the different professions (Bakker, 2014). With technology and automation, mathematical processes become hardly noticeable too (Hoyles, Noss, Kent & Bakker, 2013).

In the home economics industries, the hairdressing sector participants straightforwardly associated concepts of shapes and proportion and the skill of being able to follow a set of steps or a particular procedure as being of relevance to mathematics. Measurement is also another basic mathematical concept predominantly identified by the participants from the food and beverage services, and bread and pastry production sectors. An in-depth understanding of the fundamental operations, fractions, measurements and conversions are considered important for routine cooking and meal planning even though knowledge of the basics in math may get one by in the kitchen (Hill, 2017). Also, Chester (2017) cited that a little knowledge in measurement, fractions and geometry is needed even with helpful measuring tools readily available for food preparation.

In the information and communication technology industries, the skilled workers mentioned "Excel" and "software solutions" as applications of math in the workplace. Tu and colleagues (2016), in the discussion of the prevalence

of poor basic literacy and numeracy, stated that the use of software such as Excel supports the employees whenever they are required to use numeracy. Employers also resort to lessening the extent to which the numeracy skills are necessary to accomplish several processes through the use of technology. In call centers, software packages and templates are already in place to address the need for mathematical literacy skills.

Even with software programs and various computer applications, the ability of skilled workers to deal with massive data and information is imperative. Interpreting computer-generated data or making sense of outputs is also a cognitive task that is required of employees since routine calculations are no longer expected from them apart from being able to input the correct data (Kyffin & Paneels, 2011). Calculations are performed by the computers but how to interpret and make meaning out of these calculations is still the task of the employees. A study also revealed that it was essential to do a thorough calculation to identify the cost to resolve the situation and its appropriate allocation when something did not go according to plan (Kyffin & Paneels, 2011). Thus, it is vital that skilled workers and employees also know how to accurately apportion costs since it is not just about efficiency in doing the task at hand but more so being able to do it in a cost-efficient manner since business is all about making profit in the end.

The results of this study then were utilized to draft learning competencies to enrich the existing mathematics curriculum, not to replace it, for the TVL track students in Senior High School. According to Kyffin and Paneels (2011), students in the pre-employment stage should be able to attain a mathematics proficiency level that is higher than what is required for their job. Such proficiency level will give them confidence and security in applying the mathematics that they needed in the workplace. The core subjects of General

Mathematics and Probability and Statistics in senior high school provide the higher level of mathematics for the future skilled workers in the Home Economics and ICT Industries. Hence, curricular enhancements were proposed instead of a curricular reform. As the Philippine educational system had just undergone a major reform with the two more years in senior high school directly impacting mathematics education, what is crucial is the provision of continual and practical guidance for its implementation vis a vis constraints management (Verzosa & Vistro-Yu, 2019).

Implication

This study sought to discover the meaningful variety of the applications of mathematics in the Home Economics and Information and Communication Technology Industries based on the perspective of the skilled workers and then the proposal of curricular enhancements in the existing Mathematics curriculum for the Senior High School Technical-Vocational and Livelihood Track followed. The study revealed that the mathematical concepts of shapes, proportion and algorithm are recognized in the hairdressing sector. Measurement and calculation of money are prevailing mathematical skills that are being utilized in the food and beverage services and bread and pastry production sectors. The same with mathematical calculations or computations and the use of computer hardware and/or software are the most identified skills among the contact center services and computer hardware servicing sectors.

The applications of mathematics in the workplace are actually mathematical concepts identified by the skilled workers that are in context with and distinctly embedded in their tasks and activities in the Home Economics and Information and Communication Technology industries. The skilled workers may have not been able to articulate these concepts well, but they were able to recognize the

"mathematics" used in their daily workplace chores and responsibilities. The merging of concepts and context paved the way for the formulation of the learning competencies proposed in this study since knowledge when presented in authentic contexts will make the learning of mathematics in the Technical-Vocational and Livelihood Track of the Senior High School more enduring as the Situated Learning theory posits.

The findings of the study show that the mathematical concepts and skills predominantly identified by the skilled workers are very basic. These are concepts and skills learned first in elementary, enriched in junior high school, but not that evident anymore in senior high school. This goes to show the importance for basic education schools and teachers to find ways and mechanisms to ensure students' mastery and retention of these mathematical concepts and skills such as measurement and computations. Moreover, the learning of these basic concepts and skills must be coupled with the appropriate context in which these are applied in real life to make the learning of mathematics more meaningful for the learners as embodied in work integrated learning.

Furthermore, the results of this study revealed the need to be able to integrate technology in the teaching and learning of mathematics. The schools must be equipped with the necessary tools, gadgets and equipment to engage the learners in computer hardware and software as they learn mathematics. In this data-rich and data-driven society, it is essential for schools to develop among the students the ability to work with these data in meaningful ways. Teachers, therefore, must possess knowledge of digital pedagogies apart from being adept in various technologies as they teach mathematics to their students in this Fourth Industrial Revolution era, in this time of the COVID-19 pandemic and even beyond.

Recommendations

This study is only limited to the qualitative responses from the skilled workers which was also based on their capacity to recall the concepts and skills in mathematics that they perceive to be applied in their day to day tasks. Further researches may be done which will include actual observation of the skilled workers as they perform their duties in the workplace on a regular basis.

The findings of this qualitative survey research may be used as basis for a quantitative survey instrument or an inventory checklist of the mathematical concepts in the context of the Philippine workplaces. Such instrument may also be used to assess how equipped the Senior High School TVL Track graduates are with the mathematical literacy skills after finishing their high school studies. Or the companies may make use of the instrument to help them in the selection of skilled workers to be employed in the various HE and ICT industries.

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Appendix A

Proposed K to 12 Basic Education Curriculum Enhancement in Statistics and Probability for the Senior High School TVL Track Home Economics Strand

CONTENT	CONTENT STANDARDS	PERFORMANCE STANDARDS	LEARNING COMPETENCIES	CODE
ENHANCEMENT				
Numbers and Number Sense	The learner demonstrates understanding of the fundamental operations, percentages and proportions.	The learner is able to apply the fundamental operations, percentages and proportions in real-life tasks in the Home Economics industries.	1. performs the fundamental operations on money, sales and supplies mentally or with the use of a calculator.	**M11/12SP-IVg-2**
			2. estimates quantities like money, sales and supplies.	**M11/12SP-IVg-3**
			3. solves percent problems (discounts, original price, sale price, sales tax).	**M11/12SP-IVh-1**
			4. solves problems involving proportions in mixing and preparing ingredients.	**M11/12SP-IVh-2**
Measurement	The learner demonstrates understanding of key concepts on measurement.	The learner is able to solve real-life problems on measurements in the Home Economics industries using a variety of strategies.	5. identifies the appropriate measuring tools to use when measuring ingredients.	**M11/12SP-IVi-1**
			6. measures ingredients using appropriate measuring tools and measuring units.	**M11/12SP-IVi-2**
			7. reads time and temperature settings in machineries.	**M11/12SP-IVj-1**
			8. solves problems involving conversion of units of measurement.	**M11/12SP-IVj-2**

Appendix B

Proposed K to 12 Basic Education Curriculum Enhancement in Statistics and Probability for the Senior High School TVL Track Information and Communications Technology Strand

CONTENT	CONTENT STANDARDS	PERFORMANCE STANDARDS	LEARNING COMPETENCIES	CODE
ENHANCEMENT **Numbers and Number Sense**	The learner demonstrates understanding of the fundamental operations and percentages.	The learner is able to apply the fundamental operations and percentages in real-life tasks in the ICT industries.	1. performs the fundamental operations on money, sales and other product- and service-related quantities mentally or with the use of a calculator	**M11/12SP-IVg-2**
			2. estimates quantities like money, sales and other product- and service-related quantities.	**M11/12SP-IVg-3**
			3. solves percent problems (discounts, original price, sale price, states tax).	**M11/12SP-IVh-1**
Measurement	The learner demonstrates understanding of key concepts on measurement.	The learner is able to solve real-life problems on measurements in the ICT industries using a variety of strategies.	4. identifies the correct units of measurements for product- and service-related quantities.	**M11/12SP-IVh-2**
			5. solves problems involving conversion of units of measurement.	**M11/12SP-IVi-1**
Logic in ICT	The learner demonstrates understanding of logical reasoning.	The learner is able to apply logical reasoning in real-life tasks in the ICT industries.	6. interprets technology-generated data.	**M11/12SP-IVi-2**
			7. applies created and existing formulas.	**M11/12SP-IVj-1**
			8. performs troubleshooting using system tools.	**M11/12SP-IVj-2**