INNOVATING AN ELECTRONIC BODY-MASS-INDEX CALCULATOR (E-BMIC) FOR THE TECHNO-CHALLENGED COMPUTER APPLICATION USERS

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Abstract

Existing Body-Mass-Index (BMI) calculators generate reports by data migration, or encoding analyzed nutritional data into the spreadsheet. Then, the user formats these reports according to the Organization’s specifications. In some cases, the user does manual computation and analysis, or the spreadsheets require additional coding and importation of growth standards. These knowledge and skills are beyond the capability of most end-users. This paper, therefore, aimed to innovate an electronic Body-Mass-Index Calculator (e-BMIC) for generating auto-formatted nutritional reports that are usable by even the techno-challenged end-user. The program was written in Visual Basic Application for Excel following the modified waterfall software design. Since it runs on personal computers and mobile devices, it is useful for health workers conducting field monitoring and reporting in rural communities. Its major distinct features are the following: (a) automatic calculation, generation, and formatting reports without data migration; (b) provision of management modules for data entry to allow users with limited Excel knowledge and skills; and (c) immediate display of an individual client’s nutritional status in the user-interface and worksheet. Based on accuracy and reliability, it generated error-free nutritional status reports for Eastern Samar Division of the Department of Education in the Philippines. It was assessed as excellent for usability and more likely to be recommended to users. However, the future of this application is intensifying its usability and capability while extending it for general purpose implementation.

Keywords: Spreadsheet; anthropometric indicators; Visual Basic Application for Excel; Health and Nutrition, e-BMIC

Introduction

Body-Mass-Index (BMI) is a tool for screening and monitoring the health conditions of school-age children and adolescents. This perceived usefulness generated interest in the creation of various desktop and mobile software applications. Among these applications is the WHO Anthro software for PC for assessing nutritional status that was introduced by the World Health Organization (WHO) (2010). WHO made the software as simple as possible but, it cannot cater to all range of users. Consequently, the manual and online help for debugging user problems require a good level of IT expertise.

The Anthro software and its macros are programmed for the standard data-entry and resulting table format of the WHO Global Database (2010). These program features are the reason it cannot generate the report consistent with the format required by a user. To do this, the user must export the file and create the spreadsheet file format according to the required specification. The same is true with online spreadsheet BMI calculators (Bejanishvili, 2014; Musadya, 2009; Centers for Disease Control and Prevention, 2011; Vertex42, 2009). In some cases, these spreadsheets are BMI calculator templates so that, it would require additional coding and importation of growth standards to effect analysis and generate the user-specified report format.

Other BMI applications cater to individual users rather than the generation of group reports (Diabetes Canada, 2003; Center for Disease Control and Prevention, 2011; Nigrin & Kohane, 1998; Lozy, 1978; Hasman, 2011; National Heart, Lung, and Blood Institute, 2016). Data-entry in these applications can be easier than WHO Anthro. However, when using these applications for group reporting, the process of file management like importing, exporting, conversion, formatting, or printing, requires at least average IT skills.
Software development considers user requirement and, system requirements which may be functional requirements or non-functional system requirements (Sommerville, 2004). Thus, these requirements were investigated to create the electronic BMI calculator as shown in Figure 1.

![Diagram showing project design flow of the electronic body-mass-index calculator (e-BMIC) showing the design requirements and the expected report outputs](image)

The user requirements provided the information in designing what the health workers expected the e-BMIC application to accomplish. This information was the basis of the system requirements such as what the user needed to do (functional) so that the application delivers the reports enumerated in the Figure. Likewise, the design considered other requisites (non-functional) like giving priority to the growth reference standards.

In 2006, WHO released the Child Growth Standards (CGS) for length/height, weight and age (WHO Multicentre Growth Reference Study Group, 2009). These reference standards were later adopted by the Department of Education (DepEd) of the Philippines through the issuance of Memorandum Order No. 165, series 2010, (2010). The policy resulted in the continuing quarterly evaluation of the body mass index (BMI) of children by the health workers of DepEd. The Department extended the same service to the health and well-being of the older persons, in coordination with the Department of Health (DOH) (2005).

Due to the above-stated events, a computerized tool was necessary for the generation of evaluation reports on nutritional status in a fast, efficient, and accurate manner. These reports are vital since the performance evaluation of the health and nutrition workers, and financial support of the government and non-government agencies is dependent on the quality and timeliness of the submission of the reports. Thus, the nutrition and health workers of Eastern Samar requested the researcher to study the existing computer-based calculators for body mass index (Inciso, personal communication, September 11, 2011). During the consultations that ensued, the User Requirement established the following: (a) using Excel to generate reports, (b) conformity of output with the WHO growth standards and existing display format of the Office, and (c) limited user interaction with the program for data input and report printing.

It can be noted that the Growth Reference Standards, which is a non-functional system requirement, was separately given focus in the diagram since it was critical in the analysis of the nutritional status. According to the World Health Organization (Onis M. d., et al., 2007), the BMI-for-age (5-19 years) classification based on the standard deviation are: Overweight: >+1.0 SD; Obesity: >+2.0 SD; Thinness: <-2.0 SD; Severe thinness: <-3.0 SD. Likewise, the z-scores (BMI in kg/m2) for the growth reference table for girls from 5-19 years old are: +3 SD = 21.3 - 36.2, +2 SD = 18.9 - 29.7, +1SD = 16.9 - 25.0, Median = 15.2 - 21.4, -1SD = 13.9 - 18.7, -2SD = 12.7 - 16.5, and -3SD = 11.8 - 14.7. For boys from 5-19 years old, the z-scores are: +3 SD = 35.5 - 20.2, +2 SD = 18.3 - 29.7, +1SD = 16.6 - 25.4, Median = 15.3 - 22.2, -1SD = 14.1 - 19.6, -2SD = 13.0 - 17.6, and -3SD = 12.1 - 15.9.

However, the Division of Eastern Samar uses the following modified classification of the nutritional standard for the BMI-for-age (5-19 years): Extremely Obese >+3SD; Obese: >+2.0 SD; Overweight: >+1.0 SD; Normal: >-1.0 SD <=+1.0 SD; Wasted: <=-2.0 SD; Severely Wasted: <=-3.0 SD (Inciso, personal communication, September 11, 2011). Nonetheless, the realignment of the reference standards among countries like the Philippines is not a unique occurrence. In the study conducted on the worldwide implementation of the WHO child growth standards, Onis et al. (2013) found out that the main reason for the deviations in the implementation standards was the preference for local references. For the South-East
Asia Region, the top two major reasons were financial and other resource constraints, and, procedural impediments, and then followed by coordination challenges.

On the other hand, this research adopted the BMI interpretations for men and women adults who are 20 years old and older based on the WHO standard weight status categories (Pt-Sunyer, et al., 1998). These are the categories: below 18.5 = underweight, 18.5-24.9 = normal, 25.0-29.9 = overweight, 30.0-34.9 = Obesity I, 35.0-39.9 = Obesity II, and Equal and Above 40 = Extreme Obesity (1998). According to Babiarczyk and Turbiarz (2012), the BMI is still a more effective alternative for determining the nutritional status of the elderly, despite the controversies. This conclusion is due to the need for more researches that will better define the specific cut-off points for older people thereby setting the international standards applicable to the Asian population.

Given the user requirements previously mentioned, the design proposed the spreadsheet simulation as the input-output platform for the analysis, organization, and storage of the nutritional status of clients. Furthermore, spreadsheets offer an easily-used platform and contain functions that are powerful for complex computations and graphing (Seila, 2006). Thus, the spreadsheet can limit the following privileges of the user: (a) view of displayed value, (b) full-access for cells with text or numeric data (c) display-access on cells with formula, and (d) storage of cell values (Grossman, 2008). Protecting the source codes through cell protection, hiding and protecting worksheets, protecting workbooks, and installing passwords set up the user-limitations (2008).

Spreadsheets simplify user interactions by automating the tasks by employing one of the simplest yet effective platforms such as Visual Basics for Excel (Smedley, Cox, & Byrne, 1996). This platform is advantageous to the user since no special software is needed to use the program (Price, 2003). Compared with Java and Python which hides the data, Visual Basic allows a direct view of the data during programming (Chang, 2016). Thus, despite dissenting opinions on the relevancy of Visual Basic, current development in Office has not diminished the power of VBA as a programming tool (Zang & Ashala, 2016).

Based on the deductions from the research reviews and project consultations, there is a need to create a body-mass-index calculator that caters to reporting the nutritional status of a single client and a group of clients using the document format specified by the user. Thus, the objective of the research was to innovate an electronic body-mass-index (BMI) calculator useable for even the techno-challenged computer application users. Its specific objectives included the following:

1. Develop a user-friendly and effective electronic simulation program for the calculation and analysis of the Body-Mass-Index (BMI); and
2. Allow for the electronic generation of auto-formatted BMI analysis reports consistent with the specification of the end-users.

**Methods**

Vaughan (Vaughan, 2013) defined technological innovations through the following areas: (a) invention – conception and production of a new solution, (b) realization – product development, and (c) implementation – the successful introduction of the product to its end-users. The succeeding sections describe the innovation phases.

**Software Conception and Design**

The development of a computer program follows a software development cycle that may be represented by any of the different development models. However, comparing the waterfall, iteration, V-shaped, spiral, and extreme programming models, Munassar and Govardhan (2010) revealed that the commonly used model in developing systems is the waterfall and the spiral model.

The spiral model does not work well with small projects (Lewallen, 2005). Thus, since the requirements conveyed by the end-users limited the development of the e-BMIC application, the researcher integrated the design strategy through the waterfall model. Among the activities proposed by Shneiderman (2000), this software innovation focused mostly on digital libraries surfing; peer- and mentor-consultation, data visualization, and processing; free associations thinking; exploring what-if solutions; and, disseminating results.
However, to ensure the early completion of the Calculator, it was convenient to follow the modified waterfall approach in Figure 2. Requirement definition, program design, and testing phase overlapped as coding errors and gaps in the requirements unfolded.

![Diagram of software development paradigm]

*Figure 2. The software development paradigm following a modified waterfall approach.*

The requirement definition in Figure 2 covered the user requirement and system requirement (functional and non-functional) specifications. Using this information, the e-BMIC program design model provided a general description of the methodology to accomplish the objective of the program. However, the major requirement gaps that resulted in the modified waterfall approach were the need to cater to the end-users with no Excel knowledge, produce auto-formatted reports, and running the program in mobile devices. These requirements translated to an e-BMIC program that saves time in encoding the data, processes the data and, generates reports according to the Organization’s format for the techno-challenged users. For this purpose, the design redefined the user requirements. The Excel knowledge and skills of the users were surveyed using the list of basic proficiency level in Microsoft Excel (Grant, Malloy, & Murphy, 2009; Baugh, 2004; Concordia University, 2011).

The e-BMIC was also designed to run on mobile devices considering the advent of the use of these gadgets in many workplaces. Ventola (2014) made a conclusive statement on this regard: “Medical devices and apps are already invaluable tools for HCPs, and as their features and uses expand, they are expected to become even more widely incorporated into nearly every aspect of clinical practice.”

**User requirement definition.** The health workers specified for a body-mass-index calculator that process the surveyed data of adults who are 60 years old and above, and the children who are 5-19 years old. These data included the client’s name, birthday, gender, height in meters, weight in kilograms, and the date of the survey. Using the Excel software, these data must be calculated, analyzed, and displayed automatically. It must also print nutritional status reports with format layout according to the predefined format of the Department of Education, Region VIII, Eastern Samar Division that included the office heading and the authorized signatories of the document.

The main report, as specified by the user, is a tabular presentation entitled, School’s Nutritional Status Record (SNSR). The column headings for data entry are No., Name, Sex, Date of Birth, Height, Weight, and Date of Measurement at the start and end of the survey. For computed values, the column headings are Age, BMI, and Nutritional Status. Another report that the user required was a further analysis of the nutritional status presented in a table and bar charts. The column headings of the Table reflect the number and percentile status in each category for the male and female clients during the start and end of the survey period. The row headings of the Table represent the six (6) nutritional status criteria: Severely Wasted, Wasted, Normal, Overweight, Obese, and Extremely Obese.

Consequently, the features of the product and process of the Program was designed based on the following user requirement: quick scheduling, immediate results and solutions, and easy to use. In this regard, quick scheduling translated to a program that helps the health worker generate automated reports without the need to still format its layout. This feature saves time for writing, calculating, analyzing, drawing tabular and graphical data presentations, and checking results.

On the other hand, immediate results and solutions meant that when the user finishes encoding, the program calculates and analyzes the BMI, extracts them into tabular and chart presentations, and generates the reports according to the required document format. The user may then hit the PRINT button to obtain the hard copies of the reports.
Regarding ease in using the program, the end-users requested that the Data-Entry Worksheet caters to limited-users, i.e., users with basic or no core excel skills like open document, data entry, and clicking buttons. They can input and update data, view the data input and output, and print the documents through the data management controls. The user cannot execute direct data manipulations in the worksheets.

**System requirement specification.** This specification covers the functional and non-functional system requirement, software quality attributes, and system interfaces. The system interfaces such as the SNSR describes the functional system requirement. This data-entry interface contained the management controls for adding, updating, viewing, and printing the data. When printed, the hard copy for office filing and submission to top Management or Non-Government financial support organizations include only the cells required for generating the nutritional status report. It accepts, formats, calculates, analyzes, and displays the data. Thus, the user must enter the appropriate information for data entry Number, Name of the client (Family Name, First Name, Middle Initial), Sex, Date of Birth, Date of Measurements, Height, and Weight. The program must then display the calculated values of the Age and Body-Mass-Index (BMI), and the result of the analysis of the Nutritional Status. This report must be auto-sized for printing in a legal-sized copy.

The Data worksheets of the program calculate the Age and Body-Mass-Index (BMI) of the client at the start and end of the measurement period based on the data accepted in the Data-Entry interface. The program must then analyze the BMI data to determine the nutritional status at the beginning and end of the measurement period. Also, the Data worksheets must store the reference data and calculated Age, BMI, and Nutritional Status.

The Summary worksheet calculates the summary of the nutritional status based on BMI-for-Age criteria for males, females, and overall status. It must tabulate the summary of the nutritional status based on BMI-for-Age. Likewise, based on BMI-for-Age criteria for the beginning and the end of the measurement period (BSY and ESY), the Summary worksheet must plot the bar graph of the nutritional status showing the total percentile, total male percentile, and total female percentile. This worksheet, which is filed in the Office filing and submitted to top Management or Non-Government financial support organizations, must be auto-sized for printing in one full legal-sized copy.

The worksheet for Table Poster must display the tabular summary of the nutritional status based on BMI-for-Age. Consequently, the worksheet for Chart 1 Poster must show the bar chart of the total percentile nutritional status based on BMI-for-Age criteria for the beginning and the end of the measurement period (BSY, ESY). The worksheet for Chart 2 Poster display the bar chart of the total male and female percentile nutritional status based on BMI-for-Age criteria for the beginning and the end of the measurement period (BSY, ESY). These worksheets, which are intended for posting and structuring the Office, must be auto-sized for separate printing in one full-sized legal-sized copies.

**Non-functional system requirement.** The requirements that are not covered by the functional requirements of the Program include the performance requirement. The database capacity of this program must depend on the limitation of the processor and operating system, it shall support the use by individual users, and it must have no other specific performance requirements that will affect the development. For these purposes, the specifications for accommodating the software interfaces with other software products or users consist of the following:

- hardware interfaces like the operating system: (a) Windows 9x or above, (b) Processor: Pentium III or 2.0 GHz or higher, (c) RAM: 256 Mb or more, and (d) Android 5.0 or above;

The safety requirement of the program included a database backup to protect the database from the virus or operating system failure. On the other hand, the security requirements to protect the software from accidental or malicious access, use, modification, destruction, or disclosure must consist of installing passwords and read-only features on the SNSR's cells. These cells are reserved to display the calculated values of the Age and Body-Mass-Index (BMI), and the result of the analysis of the nutritional status. The Data, Summary, Table Poster, Chart 1 Poster, and Chart 2 Poster worksheets are also hidden by default, password-protected, and read-only. The data visibility of the sheets hidden by default maybe achieve during printout ONLY. Moreover, additional features in the program must be incorporated to check the data integrity of the critical variables. Nonetheless, making the program user-friendly through the specified user and system requirements maintain the software quality attributes on accuracy, reliability, security, and compatibility.
For the standard requirements of the BMI classification for nutritional status analysis, the following must be followed: Extremely Obese >+3SD; Obese: >+2.0 SD; Overweight: >+1.0 SD <=+1.0 SD; Wasted: <-2.0 SD; Severely Wasted: <-3.0 SD.

Project interaction design models. Using a data flow diagram, a dynamic model showed the interaction of the program with its environment such as the activity diagram in Figure 3. This figure indicates the basic operations of the user in the e-BMIC application that includes the printing of the report and the encoding of the client's information like the name, sex, birthday, date measured, height, and weight. Through the program, these pieces of information are inputted into the Measurement Master and processed to produce the summary reports and posters. At some point, however, the user may request to view the records.

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Figure 3. The activity diagram on the basic operation in the e-BMIC for the user.

Figure 4 shows the sequence of the cataloging operation of the user. Each time the user enters the data, the system immediately catalogs the data. The user may opt to accept or reject both the input and processed information as part of data integrity checking.

Figure 4. The sequence diagram of the cataloging operation that is done by the user.
Figure 5 is the sequence diagrams on the generation of the reports. The individual input and computed data of the client is extracted to produce the summary reports and posters. The figure shows that the production of these reports requires additional processing such as sorting of the gender and nutrition status to obtain the percentile values needed for the auto-generation of the tables and charts.

![Sequence diagram showing how the program generates the reports](image)

**Software Testing and Implementation**

The office file report on the nutritional status during the 2009-2010 school year was used as the sample to ensure the accuracy and reliability of the report. The user inputs the needed data into the e-BMIC application and compared the application outputs with the computed data contained in the 2009-2010 report. The probability of errors determines the accuracy and reliability of a software application. Since defect removal efficiency is one of the metrics used for assessing the effectiveness of software testing, the target of the test is to achieve a removal rate of 100 percent (Validata Group, 2016).

The acceptance testing for software application considers usability test as one of the best practices (ProfessionalQA.com, 2016). For this purpose, I used the System Usability Scale (SUS) since it is not only inexpensive, it is also an effective tool (Bangor, Kortum, & Miller, 2009). I selected the respondents in this test from the health workers in the Division of Eastern Samar.

**Results and Discussion**

The design and testing phase of the e-BMIC completed on schedule according to the request of the end-user. The succeeding section discusses the results of the study.

**Software Design**

After the preliminary stages of the conceptualization and program design, there was a survey on the Microsoft Excel proficiency of the 13 identified end-users for incorporation in the design. Table 1 shows the result of the survey.

**Table 1**

<table>
<thead>
<tr>
<th>Excel Task</th>
<th>Percent</th>
<th>Excel Task</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Basic</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open files</td>
<td>61.5</td>
<td>Create the formula using the SUM function</td>
<td>38.5</td>
</tr>
<tr>
<td>Save files</td>
<td>61.5</td>
<td>Use the fill handle to copy a cell</td>
<td>38.5</td>
</tr>
<tr>
<td>Enter data</td>
<td>61.5</td>
<td>Create the formula using the SUM function</td>
<td>38.5</td>
</tr>
<tr>
<td>Set up printing</td>
<td>46.2</td>
<td>Advanced</td>
<td></td>
</tr>
<tr>
<td>Copy and delete data</td>
<td>61.5</td>
<td>Create the formula using the IF function</td>
<td>00.0</td>
</tr>
<tr>
<td>Insert worksheets</td>
<td>38.5</td>
<td>Use absolute references</td>
<td>00.0</td>
</tr>
<tr>
<td>Center across selection</td>
<td>38.5</td>
<td><strong>No knowledge</strong></td>
<td>38.5</td>
</tr>
<tr>
<td>Merge cells</td>
<td>38.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 1 indicates that there was a higher percentage (61.5% - 38.5%) of users who know how to execute the following basic Excel tasks: entering data, opening and saving files, copying and deleting data, and setting up for printing. The users who indicated not knowing how to use Excel (38.5%) confirmed knowing how to use a cell phone, upon interview. Therefore, it was decided to create a body mass index calculator that would be easier to use by users with little or no knowledge of Excel yet knows about navigating the format of mobile phones.

Figure 6 presents an overview of the e-BMIC application that addressed the design requirement components. Programmed in Visual Basic Application for Excel, it opens to the protected Data Entry worksheet that allows the view of the data display. All other sheets and cells such as those with program codes, computation, summary report, and posters are hidden and protected with passwords. For mobile devices, when the application opens, all worksheets are hidden.

![Image of the e-BMIC application](image)

**Figure 7.** The data-entry window of the electronic body-mass-index calculator with the four data management controls.

There are four data management modules that the user may click to perform the data-entry related task even with limited knowledge and skills in Excel. The data presentation seen in this worksheet is a user-specified format for the hard copy of the report of the school’s nutritional status record. The printed report also includes the additional formatting information inputted through the “Print Report” button.

The “Add New Record” button opens the pop-up menu in Figure 7 to create a new file. The Program autosaves and processes the data immediately when the user enters the required information so that than individual client’s BMI value and nutritional status is seen in both pop-up menu and worksheet.

![Image of the e-BMIC application](image)

**Figure 7.** The “Add New Record” and “Update Existing Record” user-interfaces of the electronic body-mass-index calculator (e-BMIC).
Hitting the “Add New Record,” “Delete Record,” and “Close” buttons clear all the information from the menu display. However, only the “Delete Record” button can delete the record from the database after confirmation through the prompt, “Are you going to delete the record? Please enter a data.” Entering a data loads the database record of the client, and the user may select the data to delete by pressing the delete or backspace on the keyboard.

To update the existing data, the user hits on the “Update Existing Record” on the Data Entry window. This action results in a pop-up menu shown in Figure 7. The user can enter an existing data to load a client’s record that needs updating or enter a new record into the database of an existing file.

After entering the data, the user can view the reports by hitting the “View Report” button on the worksheet. The data required in the pop-up menu shown (Figure 8) defines the range of data and the report to be viewed.

![Figure 8. The “View Report” user-interface of the electronic body-mass-index calculator.](image)

Likewise, the user may hit the “Print Record” button to obtain the auto-formatted hard copy of the required reports. This action will activate the pop-up menu for printing (Figure 9). To generate auto-formatted reports according to the specifications of the organization, the information related to their organization’s office heading and, the names and position of the signing officers had to be inputted by the user. The user may opt to hide or show the column for Height2 in the main report document - School’s Nutritional Status Record. The user can also view the report before printing.

![Figure 9. The “Print Report” user-interface of the electronic body-mass-index calculator (e-BMIC).](image)

This study on the body-mass-index calculator created an application for personal computers and mobile users. Its accessibility and portability will, however, depend on the processor and operating system of the device. Three significant features differentiate it from existing BMI calculators. First, the application is programmed to automatically calculate nutritional status and generate reports without data migration to achieve the user desired format. Its second significant feature is the provision of data management menu in the data entry worksheet to allow users with limited excel knowledge and skills. Lastly, a third
differentiating feature of the application is its capability to immediately monitor an individual client’s nutritional status with a display in both data-entry pop-up user-interface window and excel worksheet.

Software Testing and Implementation

There were 202 cases in the nutritional status report used for the dry run and testing the reliability and accuracy of the output from the e-BMIC application. Comparing the application-generated computed values and analysis with the manually-computed nutritional status report of SY 2009-2010, the format errors consisted of failure to accurately position the Office heading and signatories. There were also 4 cases found to have BMI values different from the values in the source report, but these were user failures in inputting the correct information. However, 1 of these errors gave the computed age higher than 60 years, yet the BMI was analyzed. Thus, program codes were revised to change the document heading layout and catch computation errors by prompting the users when the calculated age is not within the range of 5 years to 60 years old. When the application was tested by two skilled computer encoders using the same data, the reports generated were error-free. This result means that the application was accurate and reliable, and the tests conducted were effective.

The user acceptance testing sampled 20 cases from the nutritional status report of SY 2009-2010. Thirteen health workers were made to use the e-BMIC application and assess its usability through the SUS instrument (Bangor, Kortum, & Miller, 2009). There were minimal modifications in the questionnaire like changing the word “system” with “e-BMIC application.

The seven scales in the SUS included the following: Worst Imaginable, Awful, Poor, OK, Good, Excellent, and Best Imaginable. The scales on Worst Imaginable, Awful, and Poor, were excluded in Table 2 since the result of the evaluation was zero.

Table 2

<table>
<thead>
<tr>
<th>Adjective Rating</th>
<th>Proportion of Users</th>
<th>Mean SUS Score</th>
<th>Acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. OK</td>
<td>7.69</td>
<td>60.0</td>
<td>Low Marginal</td>
</tr>
<tr>
<td>1. Good</td>
<td>36.84</td>
<td>67.5</td>
<td>High Marginal</td>
</tr>
<tr>
<td>1. Excellent</td>
<td>67.15</td>
<td>79.1</td>
<td>Acceptable</td>
</tr>
<tr>
<td>1. Best Imaginable</td>
<td>7.69</td>
<td>95.0</td>
<td>Acceptable</td>
</tr>
<tr>
<td>Overall Mean Score</td>
<td></td>
<td>81.3</td>
<td>Acceptable (Excellent)</td>
</tr>
</tbody>
</table>

The test showed that most of the end-users (67.15%) assessed the application as excellent. Similarly, with a mean SUS score of 81.3, the application was judged as excellent, which indicated that it is user-friendly. Moreover, since this score is above 80, it showed that the e-BMIC is more likely to be recommended to their friends by the end-users (Sauro, 2011).

Conclusions

Ambitious visions provide direction in shaping many information technology innovations such as simulations and composition tools that facilitate the efficient integration of human-computer interaction and user interface design. However, the resulting technology is only as good as the identification of the specifications that serve the needs of its end-users. Thus, the end-users’ desire to make it easier to use Excel in generating nutritional status reports based on office document format and modified WHO BMI standard was given priority in designing the e-BMIC.

The proficiency level in Excel of most of the identified end-users was basic. A lesser equal proportion of users were moderately proficient or did not know Excel. The e-BMIC application was therefore written using Visual Basic Application for Excel that can run on personal computers and mobile devices. For health workers conducting field monitoring and reporting, especially in rural communities, the e-BMIC application for mobile users is a useful tool.

The application has four user-interfaces that make technology-human interaction less complicated and effectively process the encoded information. Its major distinctive feature is the automatic calculation of
nutritional status and, generation and formatting reports without data migration. A second unique feature is the provision of data management modules for data entry to allow users with limited excel knowledge and skills. Lastly, it can display an individual client’s nutritional status in the data-entry user-interface immediately, as well as, in the excel worksheet. The current free and marketed body-mass-index calculators are not able to adequately address the above-stated features.

The e-BMIC application was designed and fully functional for Eastern Samar Division of the Department of Education in the Philippines based on its accuracy and reliability for generating nutritional status reports. It has an excellent assessment of usability and more likely to be recommended to users. These are indications of its user-friendliness and effectiveness. However, when document layouts deviate from the autoformats of the program, modifying the report will require advanced knowledge and skills in Excel and a better understanding of programming.

Nonetheless, the program may be revised to maintain its usability, but this approach must carefully weigh the goal to make the program universal versus the desire to make it as user-friendly and straightforward as possible to the techno-challenged users. Since most organizations have specific document layout requirements and not everybody in its workforce is computer-savvy, the directions of innovations for the above-stated purpose will continue to be the creation of applications dedicated to a specific organization. However, imminent upgrades of spreadsheet host software and mobile devices will make the e-BMIC application more accessible to access on mobile devices. As technology develops, the future of this application is still on its continued upgrades to intensify its usability and capability for general purpose implementation.

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