COMPUTER COMPETENCY WILL ENHANCE STATISTICAL LITERACY

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ABSTRACT

Statistical literacy among society is crucial in facing era of globalization and competitive market. Hence, statistic subject becoming a core subject thought at most of the university program. However, the name of the course is varies according to needs of the program curriculum. Statistic is not an easy subject and not attractive to students. Therefore, through action research approach this study attempt to introduce computer knowledge that related to statistic through training may enhance students' learning. Undergraduate students of course Statistic for Decision Making are involved which is stood at 57 students. As mentioned in previous literature computer competency will enhance students learning in statistic. However it was not conducted in the form of action research. Therefore, the training was conducted which is tailored to the needs of the course contents. In order to assess the students' understanding two stages of survey was conducted before and after the training sessions. The survey questions were developed based on spreadsheet module which is related to statistic. Rasch Analysis Model under Item Respond Theory was applied in evaluating the level of understanding before and after the introduction of spreadsheet statistical function in the software to the students. Winsteps version 38.1.0 is used as a tool in analysing the data collected from the survey questions. The spreadsheet software is chosen rather than other software because of its popularity among the practitioners and also easily available and easy to learn. The result shows that students' computer competency are improved after the training sessions. During the training session students are very curious and enthusiastic to learn about the statistical function that can help them to understand statistic. Their competency has reflected in their statistic assignment where the quality of assignment has improved. Sincerity and creativity in teaching may help students' enhance their knowledge as well as skills.

Field of Research: *Compute competency, Statistical literacy, Rasch Analysis Model, Excel software, Item Respond Theory*.

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1. Introduction

In the era of globalisation and competitive market, our society has entered into an age of information where people need to be statistically literate not only at work place but also in everyday life (Tishkovskaya & Lancaster, 2012). For the students' to become tomorrow's productive worker they need not only statistically literate, but also able to formulate and interpreting data in efficient, effective and accurate manner.

Due to the importance of the subject, therefore most of the undergraduate courses had introduced the course of Statistics. This course can be basic, intermediate or advance statistic depending on the program curriculum. The goal of teaching this course basically to equip students with the basic idea of statistics and able to apply what they learn to the real-world situations. However, according to Garfield, (1995) teachers always express their frustration about students ability to acquire the statistical knowledge and apply it.

Garfield, (1995) in the research proposed that computer-based teaching may help to increase student interest and understanding in learning statistic course. In Garfield & Dani Ben-Zvi, (2007), they reviewed how technology developed statistical literacy and reasoning among students. While Lane & Peres, (2006) conduct research on simulation training as teaching tool in teaching statistic. They conclude that simulation technique had significant role in enhancing students' ability to study random process and statistical concepts. However the focus of this research is on random process using Rice Virtual Lab in Statistics (RVLS) not on the general software like Microsoft Excel. Due to that this research attempt to evaluate students understanding of statistical subject with the help of computer. By having the computer knowledge it may be speed-up the work and can avoid calculation error. The software applied in this research is Microsoft Excel. This software is identified because of easily been operated and easily acquired and sufficient for day to day use. The help of command software may help students to enhance their knowledge and this knowledge can prepare in working environment.

This study adopted action research technique and Rasch Analysis Model to evaluate students' statistical literacy through Microsoft Excel competency. The second semester students from Statistic for Decision Making course are identified as respondents. They are expected to be able to have smart and fast decision. This knowledge also not only improve statistical literacy but also might improve their efficiency and accuracy in preparing assignment or project paper which are dealing with data analysis and also become tomorrow's productive citizens (Latham & Gross, 2007). Hence, this study attempt to evaluate students' computer literacy before and after acquiring computer knowledge in enhancing statistical literacy.

2 Related Literature

2.1 Statistical Literacy

There are numerous definition of statistical literacy but the most cited is one by Wallman, (1993) in her presidential address to the American Statistical Association:

> *"Statistical literacy is the ability to understand and critically evaluate statistical results that permeate our daily lives-coupled with the ability to appreciate the contributions that statistical thinking can make in public and private, professional and personal decisions."*

This idea has led Gal, (2002) to propose statistical literacy model comprises of two broad interrelated components, that are (1) a knowledge component which consists of five cognitive elements: literacy skills, statistical knowledge, mathematical knowledge, context knowledge and critical questions; and (2) a dispositional component consists of three related but distinct concepts; namely: critical stance, beliefs and attitudes (Tishkovskaya & Lancaster, 2012). Gal,(2002) further mentioned in the article that ability to discuss personal understanding of data, reactions to data, and concerns over conclusions and to communicate about statistical information are parts of being statistically literate.

Due to the importance of statistical literacy among the society therefore the curriculum for higher education has incorporated basic statistical knowledge as core program subject which every students has to pass this subject in order to get degree in specify program. This statistic course are design to equip students with basic concepts of statistic as well as the simple formula applied and ability to read and explain the data that was derived from the manual or automated calculation. For the student to become effective and efficient workers practical computing skills and theoretical system knowledge have become mandatory components for them (Larres, Ballantine, & Whittington, 2003). Latham & Gross, (2007) also stated that information literacy skills are crucial if today's students are going to become tomorrow's productive citizens. Hence, computer competency may play an important in maximizing students' learning especially in statistical course.

2.2 Computer Competency

Computer competency is defined as the knowledge and ability to use computers and related technology efficiently, with a range of skills covering levels from elementary use to programming and advanced problem solving. Having basic computer skills is a significant asset to the individual. Seddon (1987) defines computer literacy as 'being able to use computer effectively and efficiently when the need arises', where 'effective' and 'efficient' are defined as being able to use a spreadsheet program or excel program, possibly a word processing package, and in addition, being familiar with an operating of a large computer.

Van Vliet, Kletke, & Chakraborty, (1994) when on to operationalize a research instrument based on the definition of computer literacy by first identifying areas of computer literacy (in their case general computing, spreadsheets, word processing and database literacy) and then developing questions which would enables them to measure the computer literacy of undergraduate business students. Van Vliet et al., (1994) definition of computer literacy acted as a starting point for this research. However this research just focused on the spreadsheets literacy or Microsoft Excel.

3 Methodology

3.1 Research design

A research design is a guiding framework for the collecting and gathering of relevant data with a view to providing answers to the various research questions. The main objective of this study is to examine students' computer competency and statistical literacy. This research is following the action research design where it comprises of different cycles. The fundamental of action research is involving observation, reflection, planning and act as shown in Figure 1 below. The proses will continue until the intended objectives are achieved.

Figure 1: Action research cycle

The population for this study involved students from the course of Statistical Technique in Making Decision which is stood at 57 students. They are from the degree program name Bachelor of Operation Management. This statistical course is a prerequisite subject for other program course. Beside as prerequisite subjects but the knowledge and skill acquire in this class will prepare them with basic research which they will used it in final semester when they studies research methodology course.

3.2 Data collection

In evaluating student computer competency and statistical literacy, three cycles of collecting information and analysis are involved. The first cycle involved in determining the problem encounter by the student in the classroom. The problem identifying is through observation during classes and also students' activities. Student was asked about their knowledge towards Microsoft Excel verbally. Majority of them know about the Microsoft Excel but seldom used it in their assignment or other works. Due to that I planned to conduct a short training about Microsoft Excel telling them the benefit they can gain from the software and how software can improve their quality of learning especially in statistic.

Before the training was conducted it is important to assess the level of competency of the students and also helping me to emphasis on difficult topic. Therefore the training session can be more objective. The questionnaires was developed based on literature and also the Microsoft Excel training module (Excel, 2007). Each student is required to identify their level of knowledge about the selected functions in Microsoft Excel that related to statistic. The scales are range from 0 to 3 which 0 - Don't know, 1- Know but not use, 2-Familiar and 3-Expert. The questionnaire was up-load to university portal through Google Drive. The data collected from this survey was used to assess the initial competency student towards statistical function in Microsoft Excel.

Based on the data collected it is confirmed that students has lower competency in this software. The detail finding is discussed in the following topic. Therefore a training session was set at the computer lab involving all the students. Each student was given a reference material and also the set objectives what are they going to achieve at the end of the session. The session was conducted informally where students can discuss among them and get more information from other sources. It was observed that, many questions were arises from the students arranging from simple to complex function. This shows that they are keen and enthusiasm to learn something that they already know but did not practice it. This created an active learning among students.

In order to evaluate the level of competency after the training sessions, once again students were asked to respond to the same questionnaires that available in the university portal. In general the result shows that, level of competency among students are increased. They also requesting more training sessions like this are conducted and prolong the time.

4. Finding and discussion

4.1 Descriptive analysis

The useable data are 52 from 57 students which stood at 91% from determined population. The respondents are represented by gender and race as tabulated in Figure 2 below. It was noted that, the female students is more than the male students with 65% against 35% respectively. In this class the races can be group into four categories that are Malay, Chinese, Indian and foreigner (Indonesia and China). The majority is Malay with 63%, followed by Chinese 29% and others 2% each.

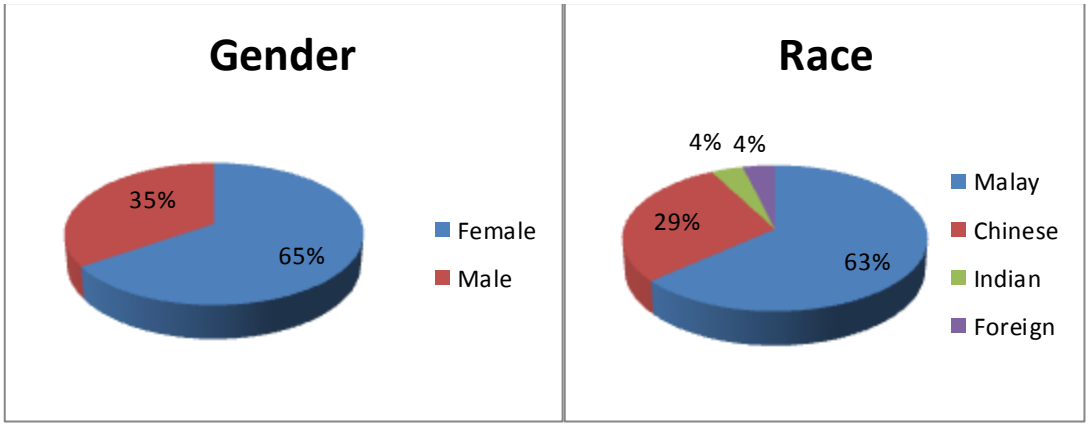

Figure 2: Respondents by Gender and Race

4.2 Goodness of fit

As discussed earlier, this study is based on IRT, which requires the data to fit a particular model with special qualities (Andrich, 1985). In this context, the validity of the measurement scales is analyzed within the Rasch unidimensional measurement framework. If the data met the requirements of the models, together with their implications, such as the order of the intensity of items, it contributes to evidence of construct validity of the scale in question. This was assessed through fit statistics and the Person Separation Index for reliability of the scales. However, before further analysis is conducted, the data cleaning and screening activities take place.

4.2.1 Data Cleaning and Screening

Data cleaning was conducted to determine the missing data and it was identified that 47 data were missing from 4,737 which represents 1%. According to Bond & Fox, (2007), since the percentage of missing data is small, no item scores or respondents will be excluded from the data collection. Table 1 below shows the frequency of responses

Table 1: Frequency of responses

Category label	Category score	Observed Count	%
0	0	860	18
1	1	1188	25
2	2	1727	36

3	3	962	20
Missing		**47**	**1**

4.2.2 Rating scales

Once the data cleaning was completed, the next step was taken to ensure that the appropriate rating scales are applied. In this study, the 4 rating scales are used to measure the items. According to Bond & Fox (2007), each of the rating categories should have a distinct peak in the probability curve graph. If it is not or is observed to be flat, further investigation is required and collapsing activity may need to be implemented. However, the rating scales in this study as shown in Figure 3 below, all the rating categories have distinct peak, therefore no collapsing is required.

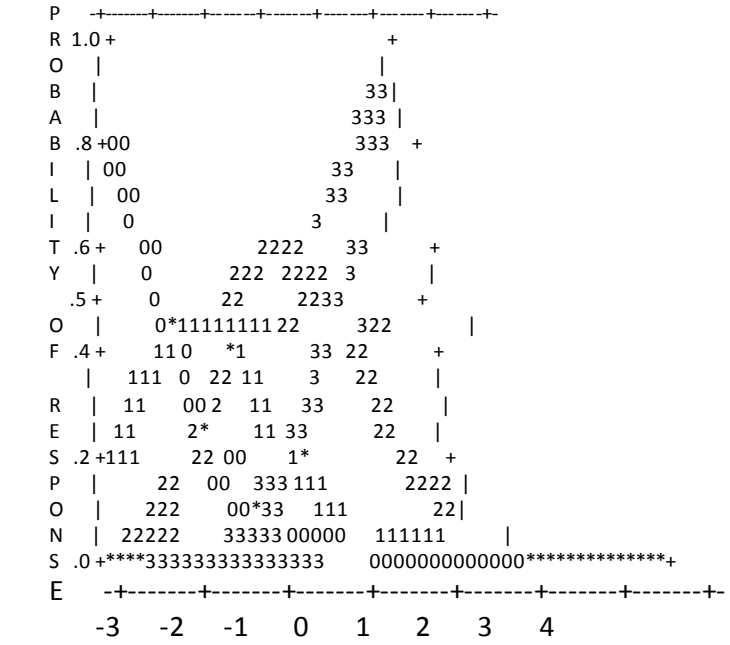

Figure 3: Rating Categories

4.2.3 Fit statistic

As mentioned earlier, under Rasch philosophy, the data collected must fit the Rasch model's specification (Azrilah Abdul Aziz et al., 2007; Bond & Fox, 2007) rather than establishing "best fit line". The concept of fit is a "quality-control mechanism" and it is important to ascertain whether the assumption of unidimensionality holds up empirically (Bond et al., 2007). Therefore the instrument is subjected to validity and reliability. As mentioned by Azrilah Abdul Aziz (2010), Bond & Fox (2007), Fisher (2007) and Linacre (2004), for the data to be considered as fit to the model, the criteria like Point measure correlation (PtMeaCorr) should be between 0.4 and 0.8 logit. 'Outfit mean square' (MNSQ) shall lie between 0.5 and 1.5 logit. Finally, the Outfit Z-standard' (ZSTD) must fall within -2 and 2 logit.

Linacre, (2004) suggested that those items located outside from the ranges must be separated for purposes of modification or repair prior to discharge. This is because of, the suitability of the item will impact and affect the reliability and validity of an instrument. From the 81 items, all the data fall within the criteria mentioned above. The following Figure 4 shows all the data within the 95% confidence interval or the z-value ± 1.96, which is fits to Rasch Model.

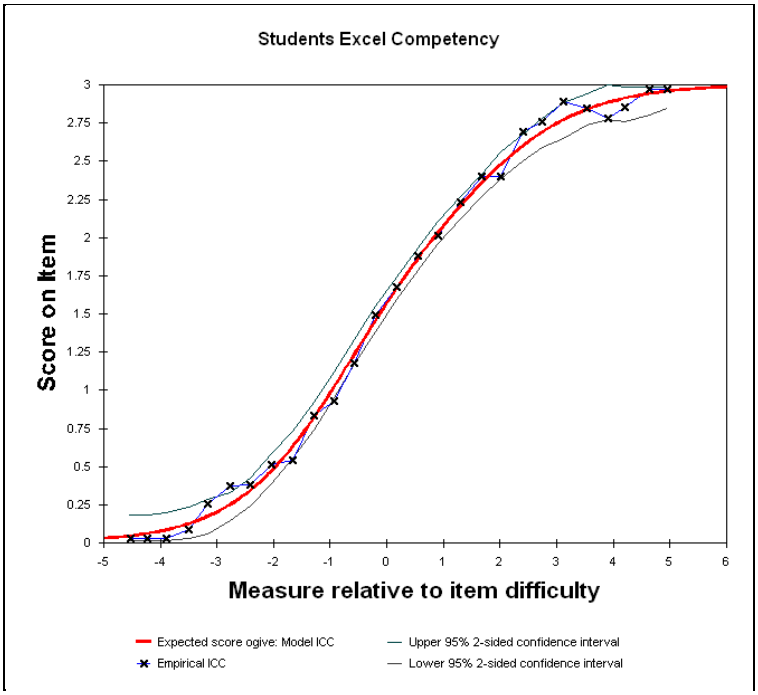

Figure 4: *Category probability curve*

4.2.4 Finding and discussion

The mean for all the items indicated as $Mean_{Item}$ always starts at 0.00 *logit* and the $Mean_{Person}$ is observed at 0.15 *logit,* for illustration refer Figure 5. Figure 6 represent the item-person variable map before and after the training. The map is divided into two parts, on the right is represent items which is arranging from easy to difficult to perform, from below up. While on the left of the graph represent the ability or competency of respondents. It is arranging from low to high competency or ability. This variable map is always calibrated to zero setting reflect the scale of the ruler.

From the variable map it is noted that the most difficult item is located at 2.65 *logit* and the easiest item is located at -1.91*logit,* with the standard deviation of 1.13 *logit* which inferring the small spread within the data. While the maximum logit for person is 3.22 *logit*, the minimum *logit* for person is -1.99*logit* and its range is 6.52 *logit,* which indicate a bigger spread among the respondents. The data also shows that there are respondents are above the maximum item *logit,* which indicates respondent's ability in performing the items. Refer Figure 8 for illustration.

The reliability issues in Rasch Model are always mentioned in terms of person and item reliabilities. In this study, the person reliability is reported as 0.98, which is deemed to have'Excellent' reliability (Fisher, 2007), showing the stability of the person response validity. While item reliability index is at 0.96 which is of 'Excellent'reliability (Fisher, 2007), inferring that the assessment tool can discriminate the person ability and the difficult item.

In answering the research question of this study, is to identify the level of computer competency among students in learning statistic. The result is presented graphically as Figure 8 below, showing that there is different competency level among students. There are two students namely 224894, 226821 located at the highest logit presume that they know how to apply statistical function in Excel software. While 14 students are allocated above the $Mean_{item}$ and eleven students above the $Mean_{person}$ but below than $Mean_{item.}$ About 25 students or 48% of the students allocated below than the $Mean_{person}$ which indicated that 48% of students are having low competency on Excel functions.

In comparing the students' competency before and after the Excel training provided to the students is tabulated in the form of the different $Mean_{item}$ before and after the training as shown in table 2 below. It shows that the $Mean_{item}$ is decreases from 0.84 *logit* to -0.84 *logit* these implies that all the excel functions in average are much easier as compared to before the training. This also indicate that the students competency level towards excel functions are increased. Figure 9 illustrate graphically the improvement of students' competency. It was noted that the most difficult item before the training is item B46 which is representing how to apply freeze panel function which is useful in input data. However after the training session this item is move from 2.65 logit to 0.68 logit implies that this item becoming easy to students. However, among all the 52 students that participate in this exercise 2 students represented by matrix number 227640 and 227690 are unable to benefit from this training session. These two candidates need further attention and coaching to enhance their computer competency as well as statistical literacy.

Table 2: $Mean_{item}$ before and after training

	Before training	After Training
$Mean_{item}$	0.84 logit	-0.84 logit

4.2.4 Reflection and conclusion

It was noticed and proved that students computer competency in applying statistical function in Excel were improved as compared between before and after the training session. The training session was conducted to provide platform for students to apply statistical function in enhancing the statistical literacy. This promote for active learning among students. I believed this active learning can assist students to enhance their understanding towards statistical subjects and made them confident in learning statistic. Teaching and learning using computer laboratory also may assist students in speed-up the calculation and also able to relate the utilization of statistic in real life.

When I embarked in the action research, I have little knowledge about it. However, it is precisely through action research that I actively seek the students' feedback, listened emphatically to their learning problem and made this subject more accessible to them.

I strongly believed that if we are sincere in our teaching, we will find ways and mean to improve our students' understanding through innovate our teaching technique. Every step taken will create positive energy and bring about the desired learning outcomes.

TABLE 1.0 Students Excel Competency ZOU662WS.TXT Jun 11 20:26 2014
INPUT: 52 Person 92 Item MEASURED: 52 Person 46 Item 4 CATS WINSTEPS 3.69.1.16

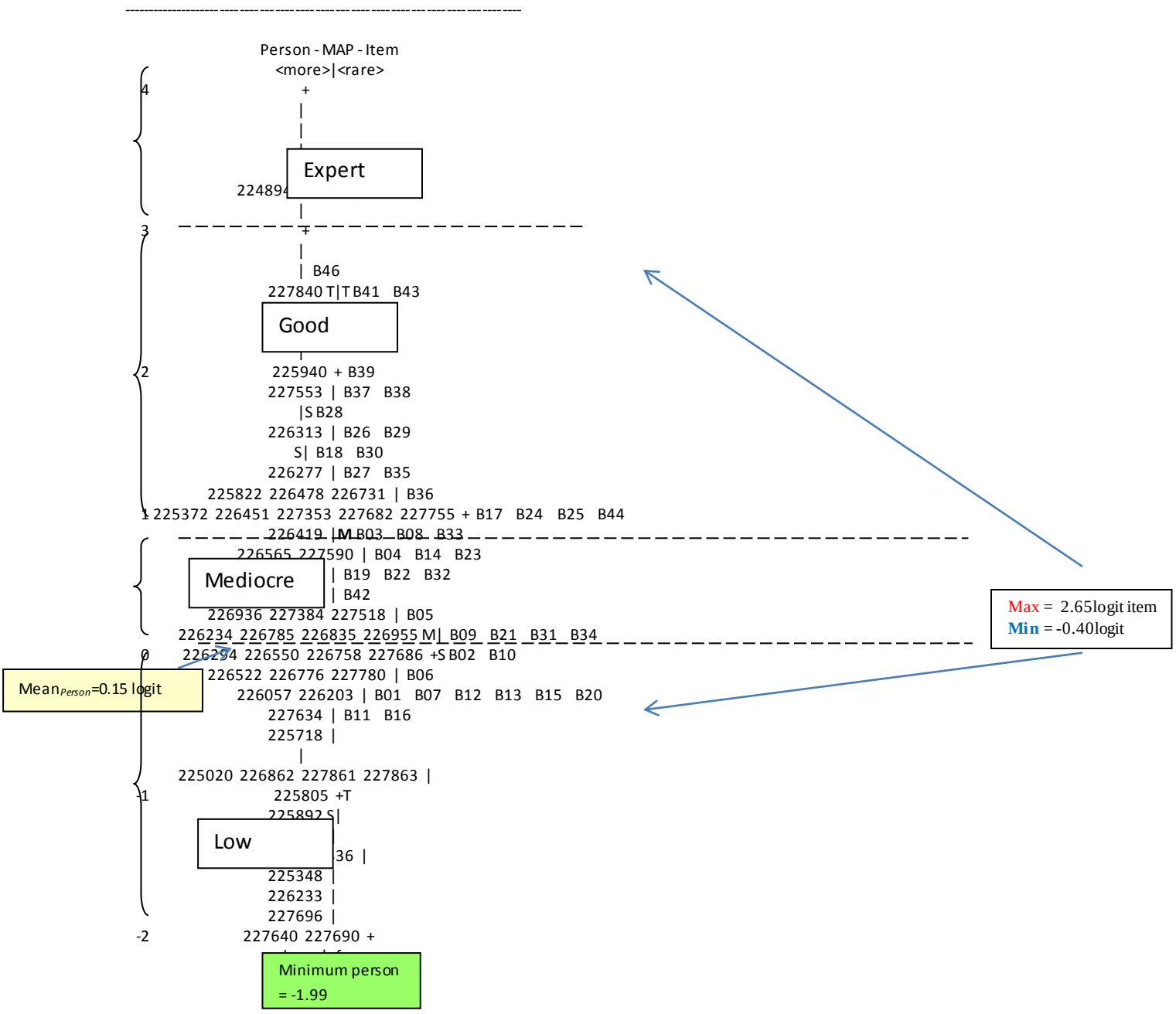

Figure 5: Item-person variable map before training

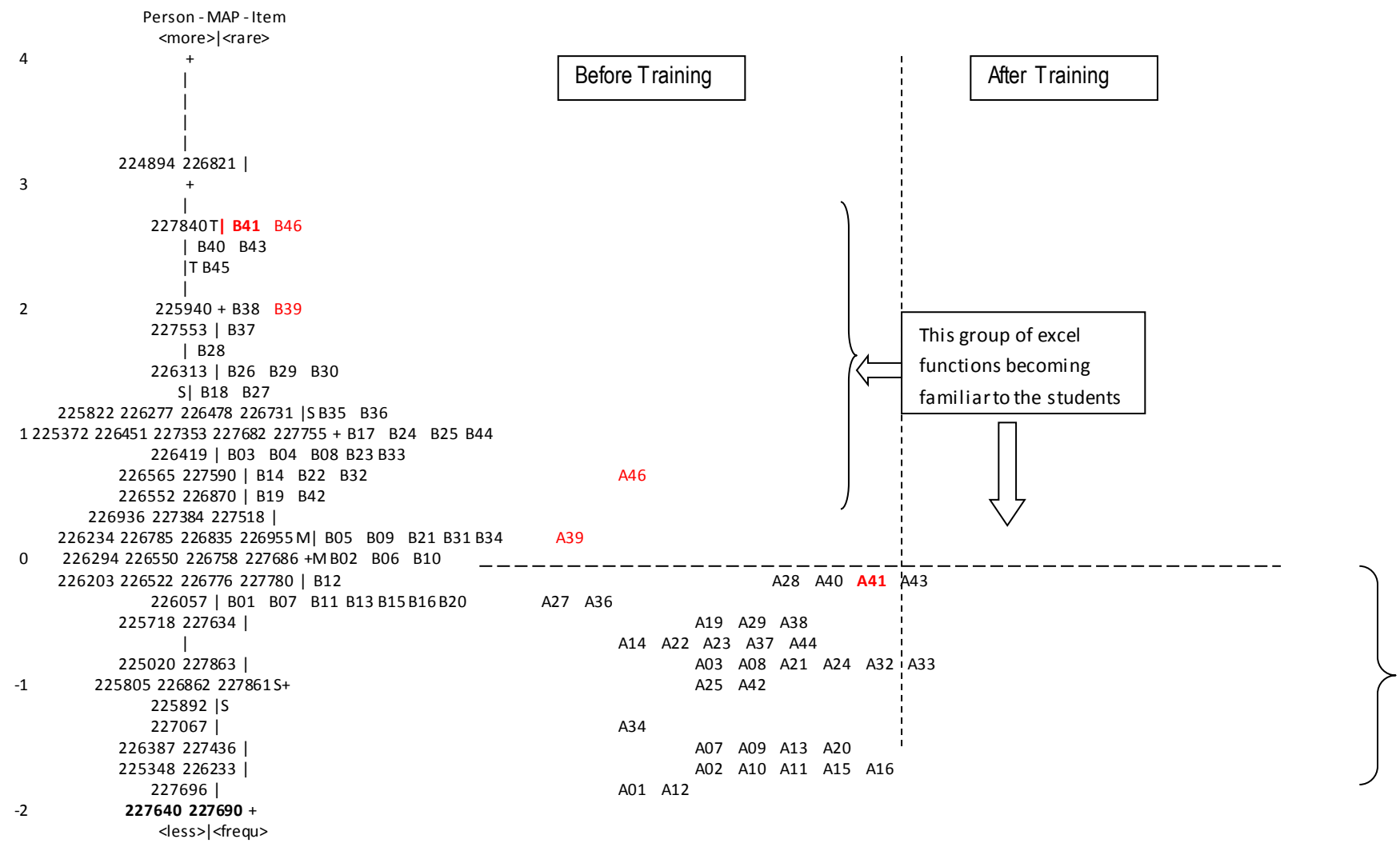

Figure 6: Item-person variable map before and after training

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