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The Content and Construct Development of CGMs Device Adoption Model

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ABSTRACT
The authors formed an instrument to facilitate the intention of wearable continuous glucose monitoring device adoption in smart healthcare system. Initial survey items were reviewed by five content experts for construct-fit and readability. Here, seven factors were identified from various researches to build up an adoption model of wearable Continuous Glucose Monitoring System. This research planned to develop and validate an adoption model for wearable CGMs device adoption. At this point, for eight constructs total 33 numbers of items were assessed by five academic experts related to information system department and finally, we selected 31 items for measurement. Meeting session was conducted with the experts in this study for content validation process. For the analysis content experts' unity, two quantitative approaches named Content Validity Ratio (CVR) and Content Validity Index (CVI) were performed. From 33 items, 31 were selected finally, as the CVR critical value is followed by 0.75 (N=5) and 2 items were rejected. In attendance, we also did some change in structure of the items as per the expert comments. After that, obtained items were calculated using CVI. The acceptable final value of CVI is 0.80. Face validation process was also applied to the items of the constructs by the experts as well. This instrument is possible to be prospective for the measurement of adoption model especially for wearable CGMs device in smart healthcare.
Keywords: *Content Validity, measurement items, wearable CGMs device adoption*

INTRODUCTION

A summary of a study relies on the measurement of content validity of an instrument. Researchers who want to do the high quality measurement of an instrument, content validity is very important for them. In an instrument, the validity determines the extent to which it really reflects the constructs be examined [1]. In this study, for the content validity process authors provided 3 pursuant steps: domain identification, item generation and instrument formation. At first, the construct should be developed by the previous literature. After that, a set of items is generated and these items are given in a suitable sequence for the next stage of grounding. And for the process of judgement, it starts with the number of experts to evaluate each item and whole instrument [7]. Expert's opinions are significant as they reveal that the measurement items are very clear, effective and also reflective to the described constructs of the proposed model. CVI and CVR method are applied to identify the expert's opinion in our study. These all experts are selected based on their knowledge in IS research area and also in the domain of adoption model, quantitative research. They also have the qualification of Doctor of Philosophy (Phd) and actively perform research activities in Information System and Informatics domain. More of that the experts also give feedback about the item that already selected for construct development such as any changes in questionnaire, structural change of a question and also delete or add something to the items selected [6]. For the expert panelist, each of them is asked to put response in the subsequent question for each of the items as stated: 1. Essential 2. Useful but not essential and 3. Not necessary [8]. Then the responses from all panelists are pooled and the number indicating "essential" for each item is determined. If most number of panelists say essential then the item is accepted as the value of that item is then positive. But if the less half of experts say that the item is not essential then the item is eliminated as the value of the item is negative [8]. To the best of our knowledge, no work was done for validating items due to measure the intention to use smart wearable CGMs device. In this study, content validity of measurement items is assessed by the content validation experts' panel to develop an adoption model of wearable CGMs device for diabetes patients in smart healthcare system. Assessing, capturing and reporting steps were engaged to wearable devices like fitness tracker only. Second, readers can measure the content validity of selected items in this research [6]. The remainder of this study is like this: Section 2 provides the Related work of

this study; Section 3 describes the Research Method; Section 4 explains the Findings; Section 5 discusses the Discussion of Findings and finally in Section 6, Conclusion and future works are shown.

RELATED WORK

This division gives an outline of Instrument Development Process and Content Validity Process of the item selection for construct development of wearable CGMs device adoption model in healthcare.

Instrument Development Process

With a view to getting validated and reliable measurement items, developing and constructing the items is necessary [6]. In a study, the researcher did adversity quotient to measure of a polytechnic student's ability in academic studies. They applied CVR method for the measurement of quantitative procedures by Lawshe of polytechnic students [1]. Another study involved a survey among patients with isolated serratus palsy and also they did expert validation with 9 experts in orthopedics. For statistical analysis they applied CVR method for the validity of measurement items [2]. Some researchers developed new validity method to appraise cognitional failures in the industrial workplace by CVR and CVI. Some other researcher stated that CVI is necessary for doing the validation of measurement items in medical science research and they did the calculation with four point scale for the item measurement in CVI method [4]. One more study used constant comparative analysis for expert validation of the items selected for PACT survey in the field of quantitative research [5]. Defining each construct is vital as it reflects the measurement items that are understandable and related to the constructs. Confusion, deficient and invalid conclusion of constructs will be found if the definitions of constructs are not clearly identified. In other side, content validity process expert validation for the face validity of the items and constructs. At this juncture, expert's opinions are considered as important parameters and it can be done either qualitatively or quantitatively [7]. In Table 1, steps for developing measurement items are shown.

Table1. Items Measurement Developing Process in Existing studies

No	Measurement Items Development Process	References
1	Planning, Construction, Quantitative Evaluation, Validation	(Creswell, 2003)
2	Developing questionnaire, Expert validation (sampling, Research Location), Applying CVR method	(Mohd Effendi & Ahmad Zamri, 2015)
3	Questionnaire Development, Identifying Content Domain, Identifying Specific Categories, Modifying Items, Developed Effectiveness, Modifying Items, Identifying Experts	(Allahyari, Rangi, Khosravi, & Zayeri, 2011)
4	Define constructs, Develop Measurement Items, Purify and Select Measurement Items, Validate whole set of measurement items	(Ahmad, 2019)
5	Content Evaluation Panel, Validity of Judgment, Quantifying Consensus among Panelists, Item Selection, Content Validity Index (CVI)	(Validiry, 1975)

At this point of study, step 5 is similar to this study and in this research, 2 new steps are included for the better understanding of the instrument development process of CGMs device adoption questionnaire survey. So, the main 5 steps of this instrument development process are: (1) Define Each Construct; (2) Identify Previous Items described in Existing Studies using Mendeley & Endnote; (3) Develop Items; (4) Content Validation By Experts; (5) Select and Refine Measurement Items. After these, all steps CVR and then CVI methods are applied to develop the questionnaire survey for data collection of wearable CGMs device adoption model in smart healthcare.

Content Validity Process

Content validity of an instrument derives that the selected items of a construct are fully relevant of the construct or the selected items are representing the constructs as well. For measuring content validity, there are different approaches like qualitative or quantitative approach. For both of these approaches, the aim is same to validate the measurement items and give confidence from the assessment of the experts [6]. In qualitative approach there exists two method named as Delphi method and Q-sort method. Delphi method requires several rounds of approaches with the experts. This method requires more time to complete full process. In sort method, it requires to present all the experts at same time for meeting and giving feedback for the content validity. But both of these methods are inexpensive and flexible to lead [7].

On the other hand, Quantitative approach includes Content Validity Ratio (CVR); Content Validity Index (CVI) and Weighted Ratio (WR). These all methods are used for validating the content of items that involve statistical analysis. These methods not only give decision to accept or reject an item for the development of construct but also useful for time and cost saving. Now, for quantitative approach same level experts are invited via mail or email with a given time frame for the validation of the items measurement. So, the time frame is a good advantage for

the researcher to collect the feedback from the expert panel in a required time. For CVR and CVI method the feedback is collected from the respected experts with 3 point scale and then CVI is calculated to develop the final content with the items selected as per the comments of experts [17].

RESEARCH METHOD

Final items measurement is done with different number of qualitative and quantitative approaches. Especially these all methods are used to whether the selected items can reflect and measure the actual construct of the study or not. In this study, total 8 constructs were identified named as: Interpersonal Influence; Self-Efficacy; Personal Innovativeness; Attitude toward a wearable device; Health Interest; Perceived Value; Trustworthiness and Intention to Use. This study prosecutes quantitative content validity approach from Lawshe model with 3 point scale as: Essential; Useful but not necessary and Not necessary [8]. For doing expert validation this study first met with experts with hard copy of items measurement, collected feedback from them and then discussed about the change or correction for finalizing the items measurement. This study comprises 5 main steps for the whole content validation process for developing the questionnaire of wearable CGMs device adoption model in smart healthcare. Figure 1 shows the steps of this study's main steps for content validation.

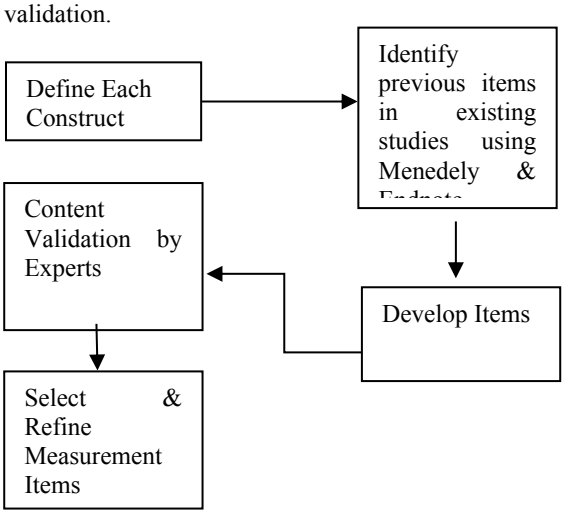

Figure 1. Steps for Content Validation

FINDINGS

Define Each Construct

This step provides construct's definition clearly and exactly based on previous literature and proposes new form of construct for wearable CGMs device adoption research. Table 2 shows operational definition of each construct. For measuring, observing data, an instrument is considered as quantitative data collection tool [24]. In this study, questionnaire will be used as an instrument and all of them are based on previous studies. The questionnaire was selected from different studies which are very relevant to adoption model based research and also used in healthcare related activities. Finding out the good items is very important and if many researchers have the same type of items good as those have been cited man times [24]. When the scores of each item will get more accuracy then the items will go for pilot test. Table 2 shows the definition of each construct for this research method of wearable CGMs device adoption model.

Table 2. Shows the definition of each construct with references

Factors	Definition	Source
Interpersonal Influence	It is clearly identified that as an influence of others "on an individual's intention to perform a behavior or attitudes toward the behavior", can frequently report for individual's decision creation.	(Yup & Lee, 2018)
Self Efficacy	Self-efficacy means an individual's belief that s/he has the capability to perform the behavior in question.	(Yup & Lee, 2018)
Personal Innovativeness	It is defined as the degree to which an individual makes innovation decisions independently of the communicated experience of others.	(Yup & Lee, 2018)
Attitude toward a wearable device	It refers to the attitude of a person toward a behavior or product which can control their purpose to accept the service.	(Yup & Lee, 2018)
Health Interest	It is defined as consumers who are more interested in health are expected to have higher intention to adopt wearable healthcare device when other factors are equal.	(Yup & Lee, 2018)
Perceived Value	Perceived value is described as trade-off between desirable attributes and sacrifice attributes.	(Yang, Yu, Zo, & Choi, 2016)
Trustworthiness	It is defined that trustworthiness is the degree of confidence in the communicator's intent to communicate the assertions s/he considers most valid.	(Ayeh, Au, & Law, 2013)
Intention to Use	It is defined as psychological state of the people's general minds to use specific services and systems.	(Rupp, Michaelis, McConnell, & Smither, 2018)

A. Identify previous items in existing studies

The measurement items were identified by deductive and inductive approaches. For each of the constructs, multiple numbers of items were gathered and then mostly relevant and most cited items were selected for each of the construct. We reviewed the items as per the high qualified journals and which was published in most recent time as well. In some research the items were measured in 3 Likert-scale and some others applied 5 Likert-scale also whereas we used 5 point Liker-scale to show the appropriate and accurate response of the respondents. Thus this study questionnaire used 5 point measurement scale as 1. Strongly agree; 2. Agree; 3. Neutral; 4. Disagree and 5. Strongly disagree to reflect the expert's assessment items.

B. Develop Items

For creating expert validation form, we selected most relevant items from more quantity of existing items based on our research domain. Then we finalized 4 items for Interpersonal Influence; 5 items for Self-Efficacy; 4 items for Personal Innovativeness; 3 items for Attitude toward a wearable device; 5 items for Health Interest; 4 items for Perceived Value; 3 items for Trustworthiness and 3 items for Intention to use.

C. Content Validation by Experts

There need at least 4 experts for measuring the items of content validation process by Lawshe [8]. Some of the researchers determined expert's opinion from 6 or 9 experts. For this study we invited 9 experts by email. From all of those we got opportunity to collect opinion from 5 experts. All of those experts are from Information System Department. We met with the expert panelists in different time and collected their valuable response for our content validation. The panelists expressed their opinion in 3 point scale and for item selection by questionnaire they agreed about 5 point Likert-scale for instrument development. They reviewed all the items, constructs and their definition. Here, they gave responses for 33 items and 8 constructs as well.

D. Select and Refine Measurement Items

After getting response from the respected experts, we did some change in questionnaire format and also few changes. Then, we calculated CVR and CVI for each of the item individually by Excel file and with the formula given by Lawshe. CVI is considered after getting the result of CVR to find out the minimum value of an item whether to take or delete it as final item or not. The measurement model used for individual scale items in this study is CVR based on Lawshe Model. This step involves statistical analysis based on CVR and CVI [8]. For measuring the CVR of each item, the formula is:

$$CVR = (Ne - N/2) / (N/2)$$

Where Ne = Number of Experts who related the item as Essential
N = the total number of Experts

The equation for CVI is given below:

$$CVI = \sum_{n}^{1} \frac{CVR}{retained\ items}$$

Here, CVI is measured by the mean of CVR.

For this study, there were total 5 expert panelists the cut off point for excellent CVR was set at ≥ 0.99. The judgment of CVR value is given in Table 3.

Table 3. Minimum Acceptable CVR value by Lawshe [8]

Number of Experts	Minimum accepted CVR value
5	0.99
6	0.99
7	0.99
8	0.75
9	0.78
10	0.62
11	0.59
12	0.56
13	0.54
14	0.51
15	0.49
20	0.42
25	0.37
30	0.33
35	0.31
40	0.29

After doing CVR of each item, 3 items were rejected and reformed for finalizing the questionnaire as their CVR value were less than 0.99 as per the Table shown up. For CVI value this study accepted value which is upper or equal of 0.80 as the mean. CVR and CVI value for all the items are given in Table 4 as below.

Table 4. shows the CVR and CVI value of each item

Measurement Items	CVR	CVI	Result
Item 1	0.60	1.0	Accepted
Item 2	1	1.25	Accepted
Item 3	1	1.25	Accepted
Item 4	1	1.25	Accepted
Item 5	1	1.0	Accepted
Item 6	1	1.0	Accepted
Item 7	0.60	0.80	Accepted
Item 8	1	1.0	Accepted
Item 9	1	1.0	Accepted
Item 10	1	1.25	Accepted
Item 11	1	1.25	Accepted
Item 12	1	1.25	Accepted
Item 13	0.20	0.75	Rejected
Item 14	1	1.66	Accepted
Item 15	0.20	1.0	Accepted
Item 16	1	1.66	Accepted
Item 17	1	1.0	Accepted
Item 18	1	1.0	Accepted
Item 19	1	1.0	Accepted
Item 20	0.60	0.80	Accepted
Item 21	0.20	0.60	Rejected
Item 22	1	1.25	Accepted
Item 23	1	1.25	Accepted
Item 24	1	1.25	Accepted
Item 25	1	1.25	Accepted
Item 26	1	1.66	Accepted
Item 27	1	1.66	Accepted
Item 28	1	1.66	Accepted
Item 29	1	1.25	Accepted
Item 30	1	1.66	Accepted
Item 31	1	1.66	Accepted
Item 32	1	1.66	Accepted
Item 33	1	1.66	Accepted

DISCUSSION

The main purpose of content validity assessment in this study is to develop and validate the measurement items for wearable CGMs device adoption model. In this study, for measuring the validity of each item, the process was in a sequence like selecting the construct; define the construct and then selecting the item from existing study. After validation from expert, we applied CVR and CVI method for finalizing the items to develop the questionnaire. For making this, we meet with the experts one by one so that we can get the actual feedback from them for each of the item. We also went through some studies which were about the content validation approach and also item selection. For choosing good instrument of this study we followed the suggestion from Creswell. Overall, this study included face validation, content validation by expert and then calculated CVR and CVI for selecting the final and appropriate items measurement which reflects each of the construct very well. Finally, we got Item 13 and 21 as to be rejected in our validation process as both of them did not meet the requirement of validation process for instrument development in our study.

CONCLUSION

To conclude, it is hereby to state that, 31 items were selected for questionnaire development from 33 items which were sent to the experts for validation process. But at first of our study, we found out 40 more items from existing studies. This indicates that the process to measure the items in different steps was good approach which helped us to get the most relevant items for each construct to develop the final questionnaire of this study. Through the empirical analysis, the reliable and validated items were selected after some consideration such as, internal consistency and correlation coefficient in order to fulfill the validity test.

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