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ANALYSIS OF PSYCHO-DIMENSIONAL PROPERTIES ONLINE TEST WITH INSTANT FEEDBACKS FOR UNDERGRADUATE STUDENTS IN DATA ANALYSIS METHODS COURSE 1

Chuthaphon Masantiah[1]

Abstract

The objectives of this research were to 1) create an online test with instant feedbacks for undergraduate students in Data Analysis Methods course 1 and 2) analyze psycho-dimensional properties of a provided online test for data of instant feedbacks. The target groups were 3 experts and 30 students of the Faculty of Education. The research tool was an online test with four-multiple choices for suggestion instant feedbacks. The statistics used for data analysis were mean, maximum and minimum. Psycho-dimensional properties analysis consisted of content validity, reliability, difficulty index and discrimination power. 1) The online test was created with 8 sets of the tests. Each set consisted of 8 questions, with content of sets 1 and 2 about the introduction of statistics; sets 3 and set 4 about the measure of central tendency; sets 5 and 6 about the measurement of distribution and sets 7 and 8 about inferential statistics. All 8 sets were provided for suggestion instant feedbacks. 2) The psycho-dimensional properties of an online test with instant feedbacks were that (1) content validity met criteria with the assessment results in correspondence between questions and objectives with a value of 0.50 or higher for all questions, (2) reliability met criteria with a value of 0.80 or higher, (3) difficulty index for all questions met criteria with a value of between 0.50-0.80, and (4) discrimination power for all questions met criteria with a value of 0.20 or higher.

Keywords: Instant feedbacks, Psycho-dimensional properties, Undergraduate students, Online test

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[1] Dr. Chuthaphon Masantiah is an Assistant Professor and a lecturer of the Department of Evaluation and Research, Faculty of Education, Ramkhamhaeng University, Thailand. E-mail: chuthaphon.star@rumail.ru.ac.th

Introduction

At present, Ramkhamhaeng University has a policy on teaching and learning management leading to a Smart University, which aims at all faculty lecturers to apply technology to facilitate learners to study anywhere, anytime and repeatedly through the media and technology with the allocation in the form of a cyber classroom that can be viewed through learning via the Internet and video lectures (Course on demand) (Ramkhamhaeng University, 2020).

The conditions of teaching and learning in the Bachelor of Education Program in Evaluation, majoring in Evaluation and Educational Research (Revised Curriculum, 2019), Faculty of Education, Ramkhamhaeng University revealed that approximately 40% of the students enrolled but did not attend their classes. This group of the students will only take the exam possibly due to their limits of time, place, and career that obstruct the class attendance. Although other learning channels of Cyber classroom or Course on demand are provided for their convenience, they still have relatively low academic achievement or some of them do not meet the criteria in requisite courses such as Data Analysis Methods course 1 (MER 3701 and course) and Introduction to Statistics and Educational Research (MER 2003). Both of these courses are subjects related to each other, but the live telecast through Cyber classroom is not provided for the Data Analysis Methods course 1. Also, the nature of the final exams of these courses is often considered as a measure and assessment knowledge emphasizing advanced cognitive behavioral domain based on Bloom's Taxonomy concepts: application, analysis, evaluation and creativity. Advanced thinking skills regarded as essential skills should be developed for all learners. (Cojorn, Sonsupap & Sitti, 2020) Meesanga & Kaosamlee (2020) said that the teacher students should have these advanced thinking skills which are really useful for their profession so as to be effective teachers in the future.

According to the problems of learning achievement in the course descriptions, the researcher has studied related documents and research articles and found that methods which help improve learners' achievement in higher education level depended on technological application. The learners should take self-training regularly and the feedbacks should be given to identify their shortcomings so that they can correct and develop themselves further (Killian, 2017). Therefore, creating the test similar to a post test for the learners to practice self-learning and recognize their own shortcomings through obtaining the feedbacks from the test. These should help encourage them to gain better academic achievement. Based on the feedback model, the RISE Model of Wray (2013) was classified into 4 levels in ascending complexity of data including Reflect (R), Inquire (I), Suggest (S), and Elevate (E), consistent with the cognitive domain of Bloom's Taxonomy. In the past, the research applying the RISE model for the feedbacks to develop the learners in higher education level revealed that providing the feedbacks from the application of the model helped the learners more effectively, whether in the context of teaching on-site or online (Lin & Tseng, 2019; Chicca, 2022). Therefore, the researcher chose a part of suggestion feedbacks of the RISE model to create a test after the learners submitted their responses. It was very uncomplicated and suitable for all levels of learners' abilities.

A test is an important tool for evaluating and assessing the learners. If the test is qualified or has good psycho-dimensional properties, resulting in reliable outcomes, the psycho-dimensional properties of difficulty index and discrimination power will reflect the quality of

the test. The difficulty index reflects the proper number of learners who answer the exam correctly while the discrimination power reflects the test's ability to identify the students with different abilities. While the quality of the test can be determined by the validity and the reliability values, the validity can reflect the results obtained from the measurements of the test accurately and precisely. While the reliability is the consistency of scores for each item, it is influenced by discrimination power, i.e., the test with high discrimination power tends to have a high reliability value. Other factors affecting the reliability value include test takers' homogeneity, exam length, exam relationship, Exam time and the method of estimating reliability (Lawthong, 2008).

A multiple-choice test is widely used to measure learners' competency because it can be created to comprehensively measure with multiple-choice scores and developed as a standardized test. It can also measure the level of learning behaviors from a remembering level to an evaluating level. (Kanjanawasee, 2009) Due to the strengths of the multi-choice test, the researcher chose a multiple-choice test to create this online test. According to a study of documents and research articles, there are many popular programs that can be used to create an online test such as Kahoot, Google forms, etc. (Sawangboon; 2020, Kradangnga & Klinkesorn; 2022). In addition, the evaluation and assessment programs have also been developed for use in more specific contexts such as Tangpakdee (2020) had evaluation and assessment systems developed through website applications for schools under the Roi Et Municipality, Thailand.

When compared to traditional paper questionnaires (Paper-pencil Questionnaire), the application of online test has several strengths including (1) online questionnaire data storage has a low risk of data loss or destruction, (2) ease of use through a variety of devices covers the process of creating, collecting and analyzing the data, (3) a variety of information is included in the questionnaire such as audio, video, etc., (4) time and travel resources are less used for collecting questionnaires, (5) response rates of online questionnaires are relatively high, and (6) it stimulates the respondents' imagination. (Sounthornwiboon, 2018; Chaktrimongkhol & Klyasamrid, 2022; Plangsorn, 2022)

According to the strengths the multiple-choice test and the online test mentioned above, the researcher has been interested in creating an online test with instant feedbacks for undergraduate students in the Data Analysis Methods course 1 because it is provided without remote broadcast via Cyber classroom. The test was composed of a multiple-choice test with two-value using Google form. At the same time, the test needs to be quality checked by analyzing the psycho-dimensional properties of the content validity, reliability, difficulty index, and discrimination power in order to qualify the test and apply to create an online testing system to develop advanced thinking skills of the learners in the Data Analysis Methods course 1 (MER 3701), as well as learners' achievements. Furthermore, the development of learning and teaching materials should be conducted to support the context of Ramkhamhaeng University as a Smart University as well.

Objectives

1. To create an online test with instant feedbacks for undergraduate students in the Data Analysis Methods course 1.

2. To analyze the psycho-dimensional properties of an online test with instant feedbacks for undergraduate students in the Data Analysis Methods course 1.

Scope of Research

Contents

An online test with instant feedbacks for undergraduate students in Data Analysis Methods course 1 consisted of 4 contents: 1) introduction to statistics 2) measures of central tendency 3) measures of distribution and 4) inferential statistics.

Variables

Independent variable was an online test with instant feedbacks for undergraduate students in the Data Analysis Method course 1 consisting of 8 sets with 8 items of each set.

Dependent variables were the psycho-dimensional properties of the test consisting of (1) content validity (2) reliability (3) difficulty index, and (4) discrimination power.

Target groups

The target groups in this research consisted of 2 groups: (1) experts and (2) undergraduate students of the Faculty of Education.

(1) Three experts in the subjects of statistics and educational research and information technology were the professors with at least 3 years teaching experience at the higher education level.

(2) 30 undergraduate students of the Faculty of Education enrolled in the Data Analysis Method course 1, course code MER 3701, academic year 2020.

Terminology

1. An online test referred to a tool used to develop advanced thinking skills of online learners by applying the Google form, which contained introduction to statistics, measures of central tendency, measures of distribution and inferential statistics.

It focused on the development of advanced thinking based on the cognitive domain of Bloom's Taxonomy, i.e., application, analysis and evaluation. However, in this study, it excluded the evaluation of creativity because the multiple-choice test could not measure creativity. The tool of this research consisted of 4 choices with 1 correct answer, a score of 1 for correct answer and a score of 0 for incorrect answer (Dichotomous).

2. The instant feedbacks referred to the message displayed each time when the answer was submitted. To create the test, suggestion feedbacks were used based on the application of Wray's RISE Model (2013). The suggestion feedbacks were alternatives recommended for self-improvement. The feedbacks provided ideas for better improving current behaviors or weaknesses. The respondents received only one type of the feedbacks.

3. Psycho-dimensional properties referred to the quality of an online test with instant feedbacks based on the results of the test and the item quality analysis, i.e., content validity, reliability, difficulty value index, and discrimination power.

Conceptual framework

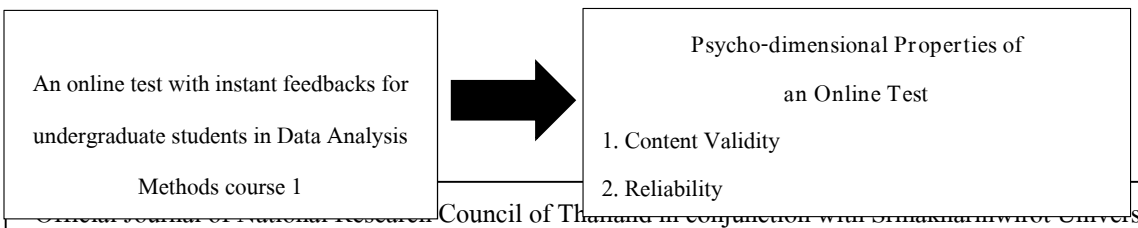

Figure 1. Research conceptual framework

Research Methodology

Target groups

The target groups for this research consisted of 2 groups: (1) experts and (2) undergraduate students of the Faculty of Education, with details as follows:

1.1 Experts

The experts were classified into 2 groups: a group of professors with the expertise in subject contents, and a professor specializing in educational information technology as follows:

1.1.1) 2 experts in Statistics and Educational Research were the lecturers with teaching experience at the higher education level for at least 3 years.

1.1.2) An educational technological expert was a lecturer with teaching experience in educational technology at the higher education level for at least 3 years.

1.2.3) Undergraduate students in the Faculty of Education enrolled in the Data Analysis Method course 1, course code MER 3701, academic year 2020.

Research Tool

The tool in this research was an online test with instant feedbacks generated by using Google form. Each set consisted of 8 items of 4-multiple choice with 1 correct answer. Therefore, to create the test, the researcher provided twice as many items as the actual test, with 16 items per set and 8 selected items. Each set had different contents: Set 1 and set 2 were the tests of introduction to statistics, set 3 and set 4 were the tests of measures of central tendency, set 5 and set6 were the tests of measures of distribution, and set 7 and set 8 were the tests of inferential statistics. All of the 8 tests had details of items as shown in Table 1.

Table 1. Details of the online test classified by contents and evaluation of cognitive domain of learning behaviors according to Bloom's Taxonomy.

Contents	Test	Measures of behavioral learning of cognitive domain according to Bloom's Taxonomy						Total (Items)	
		Applying		Analyzing		Evaluating			
		Created	Selected	Created	Selected	Created	Selected	Created	Selected
1.Introduction to Statistics	1	10	5	6	3	-	-	16	8
	2	-	-	4	2	12	6	16	8
	3	10	5	6	3	-	-	16	8

2.Measures of Central Tendency	4	-	-	4	2	12	6	16	8
3.Measures of Distribution	5	10	5	6	3	-	-	16	8
	6	-	-	4	2	12	6	16	8
4. Inferential Statistics	7	10	5	6	3	-	-	16	8
	8	-	-	4	2	12	6	16	8
Total (Items)		40	20	40	20	48	24	128	64

Data collection

1. 3 experts evaluated content validity of the online tests.

2. The results of the content validity were evaluated to improve the item construction and selection with an IOC of 0.50 or higher by selecting 8 items from 16 items in each set.

3. The 8 online tests were conducted after the classes of the course code MER 3701, taking 20 minutes each time via a smartphone, a tablet, an iPad or a notebook using the Internet network of Ramkhamhaeng University.

4. The results obtained from the Google form were brought into a packaged program for data analysis, including reliability, difficulty index and discrimination power.

Data analysis and statistics

An analysis of psycho-dimensional properties of an online test with instant feedbacks of undergraduate students in the Data Analysis Methods course 1.

1. Descriptive statistics of psycho-dimensional properties was the range of content validity determined by the IOC (range) and the maximum, the minimum and the mean of the difficulty index (p) and the discrimination power (r) of each item.

2. Statistics used in the analysis of psycho-dimensional properties of the tests and the items.

2.1 Content validity from the Index of Item-Objective Congruence (IOC)

2.2 The formula KR 20 was used to analyze reliability of the test by using the Test Analysis Program (TAP) Version 6.65.

2.3 The difficulty index (p) was analyzed by using Test Analysis Program (TAP) Version 6.65.

2.4 The discrimination power (r) was analyzed by using Test Analysis Program (TAP) Version 6.65.

Results

1) Results of creating an online test with instant feedbacks of undergraduate students in Data Analysis Methods course 1.

8 sets of the tests were created with 8 items of each test as follows: Set 1 and set 2 were the tests of introduction to statistics, set 3 and set 4 were the tests of measures of central tendency, set 5 and set 6 were the tests of measures of distribution, and set 7 and set 8 were the tests of inferential statistics. All of the 8 tests had the details of the instant suggestion feedbacks as shown in Table 2

Table 2. Sample test of set 1: Introduction to Statistics-item 5 and Suggestion Feedbacks.

Sample test questions	Difficulty index (p)	Discrimination power (r)
Set 1: Introduction to Statistics: Part 1 Item 5 5. Career variables that usually appear in the questionnaire. How can you analyze quantitative data? ○ 1. tallying frequency or mode (correct answers) ○ 2. mean or median ○ 3. tallying frequency or median ○ 4. mean or mode	0.53	0.73
Suggestion Feedbacks for learners choosing incorrect answer Comments for incorrect answers: Career variables were qualitative variables classified as nominal scales as domicile variables using descriptive statistics such as frequency or mode, but mean or median was not found. Thus, Item 2 was wrong because the mean and the median of career cannot be found. Item 3 was wrong because the frequency of career can be found, but not the median. Item 4 was wrong because the mode of career can be found, but not the mean.		

2) Results of the psycho-dimensional analysis of the online tests with instant feedbacks for undergraduate students in the Data Analysis Method course1.

The psycho-dimensional properties of the online tests with instant feedbacks overall considered revealed that (1) all online tests met the reliability criteria with the value of 0.80 or higher. (2) All online tests had content validity and met the criteria with the Item Objective Congruence Index between items and objectives with the value of 0.50 or higher, as shown in Table 3.

Table 3. Results of the psycho-dimensional properties analysis by considering the IOC value and the reliability of the online tests.

Test	Numbers (Items)	Psycho-dimensional properties of the test (Test)	Results of the evaluation of

		Range of values IOC	Reliability	psycho-dimensional properties
Set 1: Introduction to Statistics: Part 1	8	0.67-1.00	0.828	Approval
Set 2: Introduction to Statistics: Part 2	8	0.67-1.00	0.801	Approval
Set 3: Measurement of Central Trends: Part 1	8	0.67-1.00	0.814	Approval
Set 4: Measurement of Central Trends: Part 2	8	0.67-1.00	0.808	Approval
Set 5: Measurement of Distribution: Part 1	8	0.67-1.00	0.827	Approval
Set 6: Measurement of Distribution: Part 2	8	0.67-1.00	0.806	Approval
Set 7: Inferential Statistics: Part 1	8	0.67-1.00	0.812	Approval
Set 8: Inferential Statistics: Part 2	8	0.67-1.00	0.820	Approval

The psycho-dimensional properties of the online tests with instant feedbacks when classified by the difficulty index and the discrimination power revealed that (1) the difficulty index of all items met the criteria with the value between 0.50 to 0.80 and (2) the discrimination power of all items met the criteria with the value of 0.20 or higher, as shown in Table 4.

Table 4. The results of the psycho-dimensional properties analysis of the online tests classified by the difficulty value and the determinant power.

Test	Numbers (Items)	Psycho-dimensional properties of the test (Item)		Results of the evaluation of Psycho-dimensional properties
		Range of difficulty index (mean)	Range of discrimination power (mean)	
Set 1: Introduction to Statistics: Part 1	8	0.53-0.73 (0.608)	0.20-1.00 (0.650)	Approval
Set 2: Introduction to Statistics: Part 2	8	0.53-0.73 (0.625)	0.20-1.00 (0.653)	Approval
Set 3: Measurement of Central Trends: Part 1	8	0.50-0.73 (0.592)	0.50-1.00 (0.648)	Approval

Set 4: Measurement of Central Trends: Part 2	8	0.50-0.73 (0.521)	0.45-1.00 (0.727)	Approval
Set 5: Measurement of Distribution: Part 1	8	0.50-0.73 (0.654)	0.50-1.00 (0.738)	Approval
Set 6: Measurement of Distribution: Part 2	8	0.50-0.80 (0.679)	0.20-1.00 (0.675)	Approval
Set 7: Inferential Statistics: Part 1	8	0.50-0.73 (0.529)	0.45-1.00 (0.727)	Approval
Set 8: Inferential Statistics: Part 2	8	0.57-0.80 (0.596)	0.36-0.91 (0.636)	Approval

Discussion

1) Discussion of creating an online test with instant feedbacks for undergraduate students in the Data Analysis Methods course 1.

The online tests with instant feedbacks for undergraduate students in the Data Analysis Methods course 1 in this research were created by using the Google form. All 8 tests had details of the instant suggestion feedbacks as follows: Set 1 and set 2 were the tests of introduction to statistics, set 3 and set 4 were the tests of measures of central tendency, set 5 and set 6 were the tests of measurement of distribution, and set 7 and set 8 were the tests of inferential statistics. The Google form was applied for teaching, learning and testing management in the context of higher education consistent with the research of Kradangnga & Klinkesorn (2022). They applied the Google form to manage online teaching and learning management for undergraduate students. Whilst, Sawangboon (2020) said that the right technology would result in accurate evaluation results in accordance with the objectives set by the teacher. The most common programs applied for online evaluation and assessment were Google form including Kahoot. However, with the limitations of the Google form, although both multiple choice and subjective tests were created, the program could not check the answers and not provide feedbacks from open-ended answers. Therefore, in this study, the tests with open-ended answers were not used to evaluate advanced thinking. The nature of the tests was not as diverse as it should be when it was compared to other programs such as programs Dugga, a charged program which was used to create and check the answers for many types of tests. The research of Jantana and Pradujprom (2020) developed a computer program based on the concepts of a system development cycle by using a Waterfall Model to create automated tests in consistence with the contents and contexts of the test. The research by Fiothong et al. (2021) designed a scoring method for subjective tests to assess the level of mathematical proficiency through digital technology. Therefore, in application of the classroom context, the teachers or researchers may consider choosing an online testing program in consistence with the nature of the tests because each program has different features.

When considering the nature of feedbacks used in the online tests so as to help. the learners realize their strengths and weaknesses, the suggestion feedbacks appeared as soon as an answer was submitted and the information was provided on the wrong answer that

emphasized the rationale features for how each distracter was wrong. As designed for all eight sets of the tests consisting eight items for each, the characteristics of feedbacks in this study were consistent with Chicca's research (2022) with application of Wray's RISE Model (2013) to provide feedbacks for nursing students classified into four levels of feedback: Reflect, Inquire, Suggest and Elevate. Moreover, Lin & Tseng (2019) applied the RISE Model to develop undergraduate students in the context of online teaching and learning management revealed that the feedbacks using the RISE model was effective in consistence with this research on applying the RISE Model to develop undergraduate students and apply it for online testing. Therefore, it reflected that the RISE model could be applied to develop undergraduate students in the context of online teaching and learning management.

2) Discussion of the psycho-dimensional analysis of the online test with the instant feedbacks for undergraduate students in the Data Analysis Methods course 1.

All online tests had content validity that met the criteria with an assessment of the correspondence between the questions and the objectives with the value of 0.50 or higher. This reflected that all of the 8 online tests had the content validity. Accordingly, in the process of creating the online tests, the researcher created a Test Blueprint, resulting in the measurable test in accordance with the objectives and the cognitive domain of learning behaviors. This was consistent with the study of Abdellatif and Al-Shahrani (2019), who said that the Test Blueprint facilitated to create the test faster. In addition, the Test Blueprint also specified the representatives of the course contents which engaged the test with the psychological properties known as accuracy and reliability (Eweda, Bukhary & Hamed, 2020).

All of the online tests had the reliability value of 0.80 or higher. The KR-20 formula was used for all psycho-dimensional properties in this study because the questions in the test were scored with 0,1 and every item had the different difficulty values in consistence with Kumyoung (2021). He studied academic achievement in educational research on teaching and learning management according to the theory of self-knowledge among undergraduate students and creating 12 chapters of the tests with 10 items of each chapter to follow up classes. The reliability values analyzed by using the formula KR-20 revealed that all the tests had the reliability values of between 0.69 to 0.87. In addition, it was in consistence with the research by Danpradit, Suttamart & Boonplian (2021), emphasizing on a multiple-choice test of educational evaluation and assessment. The analysis of reliability using the formula KR-20 revealed that all of the tests had a reliability of between 0.77 to 0.84. The results reflected that the online test had the consistency of the results which were obtained from the evaluation. The high reliability of the psycho-dimensional properties analysis probably related to a number of factors including: 1) Validity factors, if the evaluation was validated, it would also result in the accuracy (Amornrattanasak, 2014; Middleton, 2022). Thus, content validity of the test resulted in high reliability of the online test as well. 2) Examination management factors included the proper time to complete the test, without too much or too little time, resulting in the high reliability (Kanjanawasee, 2009). In this study, there were 8 tests, with 8 items each and 20 minutes long for each test, and 3) Characteristic factors of the test were determined by the difficulty index as the test with medium difficulty index resulted in a high-fidelity test (Amornrattanasak, 2014). This research revealed that all the tests had the mean of difficulty

values ranging from 0.50 to 0.80, reflecting that the tests had moderate difficulty values, resulting in high reliability.

All the items met the criteria with the difficulty index of between 0.50 to 0.80, reflecting that the online tests had a moderate difficulty level, consistent with Kanjanawasee (2009), who said that the entire test should have a moderate difficulty index of 0.50. The content of this research was designed to measure 3 levels of cognitive domain of learning behaviors, namely application, analysis and evaluation in the same proportions so that the tests were not too difficult or too easy.

The discrimination power of all items met the criteria with the values of 0.20 or higher, reflecting that the test had good ability to distinguish between high and low groups well. This was consistent with the psycho-dimensional properties analysis of the Educational Research Achievement Test of Kumyoung (2021) with 12 tests. The results of discrimination power analysis of all test items with a value of higher than 0.40. This probably related to the psycho-dimensional analysis of the items with moderate difficulty values or closer to 0.50, resulting in the higher level of discrimination power (Insombat, 2011). The results revealed that the tests had the moderate difficulty index, resulting in a higher discrimination power.

Suggestions

Suggestions for applications

1. Instructors in the Data Analysis Methods course 1 (MER 3701) as well as the subjects with similar and related contents such as Statistics and Introduction to Educational Research (MER 2003), can take this online test, which was approved for the criteria of psycho-dimensional properties and can apply them in the test management with the assessment context for learners' development.

2. Full-time instructors and the instructors responsible for the Bachelor of Education program majoring in Evaluation, Assessment, and Educational Research (Revised Curriculum 2019) will be able to apply these guidelines for creating a computer-based testing system with instant feedbacks in other courses that have similar contents as the Data Analysis Methods course 1(MER 3701) to support the entry of Ramkhamhaeng University into a smart university.

Suggestions for further research

1. An online test consisting of a larger number of test items should have more items than it is really used so as to get higher reliability of the psycho-dimensional properties.

2 . Item Response Theory (IRT) should be applied to analyze the psycho-dimensional properties of the test items which are different from the Classical Test Theory (CTT). However, the IRT can also be applied to analyze guessing values including the information values of tests and items which are useful in determining even the more credibility of psycho- dimensional properties.

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