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USE OF RASCH ANALYSIS TO DEVELOP AN ARABIC LANGUAGE SURVEY (STPLTS) TO MEASURE OMANI SCIENCE TEACHERS' VIEWS TOWARDS THE CLASSROOM APPLICATION OF PEDAGOGICAL LEARNING THEORIES

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Abstract. *A range of pedagogical learning theories has been proposed to guide science teachers' classroom teaching. This study presents the results of the development and use of an 18-item Arabic language rating scale survey to assess Omani teachers' (N = 400) views towards the application of selected pedagogical learning theories of potential use in their science classrooms. The current study was a quantitative approach following the survey design. Rasch analysis was used to guide the analysis of the instrument. The results suggested that one dimension was defined by survey items and item independence. Person and item reliability were acceptable. Analysis of category probability curves showed acceptable measurements from the rating scale. The Wright Map matched theory and so provided guidance for the future teaching of Omani science teachers. This study adds to the literature reporting the results of science education data collected from science teachers who teach for international use in general, and for Oman and Arab countries in particular. Perspectives and contributions of the study findings on improving science teaching and learning are discussed.*

Keywords: *Rasch analysis, science teachers' views, Oman, pedagogical learning theories*

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Introduction

The teaching process faces many difficulties if science teachers do not have theoretically supported principles or guidelines to promote classroom learning. In addition to professional competence and motivational orientations, teachers' beliefs are a vital aspect of teachers' overall competence. How teacher's beliefs affect teaching processes and students' outcomes have been well documented (e.g., Baumert & Kunter, 2013; Ertmer, 2005). Teachers' views on pedagogical learning theories (PLT) are one aspect of their beliefs, which are defined as "an organized body of concepts and principles developed to explain certain phenomena; a description of possible underlying mechanisms to explain why certain principles are true" (e.g., Ormrod, 2006, p. 253). Certainly, pedagogical learning theories may open specific routes to improving student learning outcomes, and therefore teacher performance in the classroom. Particularly in lower-secondary school science classes, the teacher's instructional quality is vital, since student interest and motivation in science subjects decline during adolescence (Mullis et al., 2020) and high-quality instruction –provided by high-performing science teachers – is a crucial key to fostering students' (life-long) interest in science. A related consideration is that students' achievements are strongly related to science teachers' actions in the classroom, as the teachers' actions are guided in part by their perspectives and outlook. In the context of the Omani public school system, the latest TIMSS results show that the 8th-grade students' score is significantly lower than the international mean in science (Mullis et al., 2020).

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For a better understanding of the results of our study, we feel it helpful to provide some background of the teaching of science in Oman. In Omani schools, male and female students are taught in separate schools by teachers from both sexes in lower secondary schools (Cycle 2, grades 5–10) and by teachers of the according sex in upper secondary school (Cycle 3, grades 11–12). The class size for the public lower secondary schools on average is 29 students, while the class size for upper secondary schools is 28 (Ministry of Education (MoE), 2021). Typically, an Omani science teacher teaches 24 science lessons in different classes per week. The language of education for all classes in public schools is Arabic. Over the past few decades, the general Oman education system has experienced significant reforms, partially because students' achievements are not high when participating in large-scale assessments such as TIMSS 2007, 2011, 2015 (Mullis et al., 2020). A recent study in Oman identified one of the weaker aspects of students' performance in TIMSS to be their ability to apply their prior knowledge to new situations and relate science to daily natural phenomena (Shahat et al., 2022b). The suggested reforms included developing science and mathematics curricula through agreement with Cambridge University Press in 2017 (MoE, 2020). The new Cambridge curricula, implemented in 2018, was designed to address concerns in four content areas: Scientific inquiry, Biology, Chemistry and Physics. These curricula differ from previous curricula in Oman by focusing on providing a structure for teaching and learning and by providing ways to assess students' ability and understanding. The MoE supports teachers who teach the new curricula. The Specialist Centre for Professional Training of Teachers at the MoE teaches them methods of teaching content and assessment.

Currently there are no adequate culturally adapted instruments available for assessing teachers' views on pedagogical learning theories in order to a) evaluate the success of teacher training as mentioned above (Ambusaidi et al., 2022a) and b) explore teachers' views on PLTs for science instruction. As a result of these needs, the STPLTS was developed in an effort to understand Omni teachers' perspectives with regard to one issue that can have an impact on science teaching success and student science achievement.

Background and Literature Review

The Importance of Pedagogical Learning Theories for Teacher Performance and Student Achievement

Teachers' performance, especially instruction in the classroom, is central to achieving the aforementioned goals, which are also affected by teachers' beliefs and views (Bandura, 1989). Teachers' views can be defined as their beliefs, opinions, way of thinking or range of vision that they have about a topic (Matsumoto, 2009). Every teacher has implicit views on how students learn and how (science) teaching instructional practice can be most effective. Many educational theories with the goal of raising students' performance have been proposed, which seek to explain the process of teaching and learning. They vary in their bases, principles, and approaches (Stolz & Ozoliņš, 2018). Pedagogical learning theories address the same issue of how teaching and learning processes can be successful.

The present study defines Pedagogical learning theory (PLT) from the work of Kaya et al. (2021), which theory explains how students receive, process, and retain knowledge during learning, and how ways of learning are influenced by cognitive, emotional and environmental backgrounds, and past experience. Although PLTs can help teachers when planning and providing effective learning opportunities, it is often teachers' implicit views on teaching and learning (such as transmissive vs. constructivist views) that guide teachers' performance in the classroom. (Knight, 2015; McGarr et al., 2017; Stolz & Thorburn, 2020; Tang et al., 2019). It can be argued that the path teachers choose to guide their science instruction is influenced significantly by a) the extent of their knowledge of how learning takes place, b) the factors that affect students' learning, and c) methods that help teachers to develop their teaching (Swennen & Volman, 2019). The present study asserts that a critical factor of importance is assessing science teachers' views toward pedagogical learning theories.

Several researchers have discussed the importance of teachers' being familiar with different pedagogical learning theories. For example, Thorsten (2015) suggested that framing the teaching of a lesson within an explicit learning theory can change teachers' practical knowledge. By formulating a lesson with a learning theory, a teacher can better help students question habits and previous experiences. Runesson (2015) has suggested that applying pedagogical learning theories may improve teachers' practical knowledge. Furthermore, learning theory can add value to lesson concepts and learning. Clivaz (2015) and Thorsten (2015) have proposed that teachers make their own theory and theoretical principles and use them as resources for pedagogical design. Biermann et al. (2015) found a positive relationship between student teachers' engagement with the theory-practice link and their self-

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rated teaching skills. They concluded that teachers, who understand what they teach and how they teach it, improve their instructional performance, and gain more positive attitudes toward teaching itself.

In the context of Oman, the Cambridge science curricula need teachers who can use pedagogical learning theories so that teachers can focus on a student-centred approach efficiently. That is one reason that we designed the survey instrument we present here. Certainly, educators of science, and teachers at a national and international level, need to know more about teachers' views with regard to the science classroom application of pedagogical learning theories (Kaya et al., 2021). Being able to access science teachers' views towards pedagogical learning theories will certainly be beneficial in efforts to increase students' science achievement in Oman.

Previous Attempts to Explore Teachers' Views of Pedagogical Learning Theories

Several studies have focused on the topic of pedagogical learning theories and their role in classrooms. Surveys of varied formats have been developed to explore these issues (Clayton et al., 2014; Hennebry-Leung et al., 2019; Knight, 2015; McGarr, 2017; Nilssen & Solheim, 2015; Tang et al., 2019; Stolz & Thorburn, 2020). Tang et al. (2019) developed a questionnaire and interviews, and both instruments were used to explore the connection between student teachers' engagement with the theory-practice and their perceived professional competence. A survey consisting of two dimensions was developed. One dimension was the concept and principle of teaching and pedagogical learning theories; the second was the relationship between learning and teaching theories and teachers' classroom practices. McGarr et al. (2017) collected data on 23 student teachers' views of educational theory via one-on-one interviews. The analysis suggested four categories of student teachers (i.e., resisters, embracers, acceptors, rejecters). All these instruments lack features that focus on the practices of pedagogical learning theories in the classroom for in-service teachers.

Clayton et al. (2014) examined pedagogical approaches to exploring theory and practice with preservice teachers, by reviewing teacher educators' views via a qualitative case study involving face-to-face semi-structured interviews with three teacher educators and their students in a course. The findings suggested the importance of (a) being aware of how theory practices in educator teaching contexts affect preservice teachers' capacities and inclinations to engage in effective probing, and (b) discerning when and where the best opportunities and times are to engage in probing to facilitate learning. The study found that teachers need to examine the theory-practice relationship more closely in their practice. Some factors were identified as influencing, constraining, or enabling teaching with theory-practice. In Nilssen and Solheim's (2015) study, Norwegian preservice teachers were encouraged to bridge theory and practice by following a student's learning processes over time. Open-ended questions revealed three critical components of a research project that made it successful: a) movement between field practice and coursework, b) the authenticity of the tasks and future relevance for the teaching profession, and c) experience field diaries and reflection logs. In a longitudinal qualitative case study, Knight (2014) explored students' conceptions of the relationship between theory and practice in their learning. Three interview phases (before course, during the course, at the end of the course), focus group and whole cohort triangulation, and documentary sources were used. The findings indicated that students were far from naïve as they entered training. The study identified essential shifts in the understanding and role of theory. Stolz and Thorburn (2020) examined how the contemporary academic literature considered a problem with the practices found in the field of physical education. They suggested that the relationship between theory and practice becomes noticeable when a method is ineffective or fails. An increase in the theoretical investigation inevitably leads to modifications to the practice or practices to achieve satisfactory progress and success. From their point of view, this has become an unavoidable problem in the field of physical education, given the broken relationship between theory and practice. Knight (2015) explored student teachers' conceptions of the role of theory in learning to teach by using small-scale longitudinal case studies. The results clearly showed that students were not naïve at the outset, as they entered training open to a wide range of learning styles, and they had a positive view of the potential contribution of theory to practice. The data suggested that theory becomes increasingly valued over time. None of these past studies specifically considered science teachers, which builds upon what has been learned through past studies.

The current study benefited from the previous studies in formulating our theoretical framework and identifying the appropriate consideration to be presented in the STPLTS instrument. The current study is built on the principles and practices of pedagogical learning theories and utilizes the literature of, e.g. Bates (2015), Kaya and Akdemir (2016), Schunk (2020), and Zhou and Brown (2015).

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Research Aim

Until now, no study has been conducted in Arab countries to check the use and views of science teachers about pedagogical learning theories. It was imperative to construct the Science Teachers Pedagogical Learning Theory Survey (STPLTS) to assess Omani science teachers' acceptance and use of specific pedagogical learning theories in their science classrooms. Hence, the main research aim was to develop items for the STPLTS, evaluate the scale's measurement functioning, and interpret the Wright Map to identify starting points for optimizing Omani science education. While this research was conducted in Oman, the findings of this study contribute to the broader literature that reports the results of science education data collected from science teachers teaching in an Arab-speaking country.

Research Methodology

General Background

The current study followed a quantitative approach, including survey design and analysis. Its main aim was to explore science teachers' views on pedagogical learning theories. The study was conducted from September to December 2020. All teachers participating in the study were informed that their participation would not affect their work at school. It was clarified that the data collection was for research purposes only. All data were fully pseudonymized, to ensure data linking on one hand but deleting all personal information of teachers that would allow the identification of individuals on the other.

Sample Selection

The sample consisted of science teachers ($N = 400$) teaching in grades 5–10 who agreed to answer the survey and participate in this study. Teachers taught in 11 regions in Oman. They were selected by a stratified random sampling method, which allowed a representative sample of teachers to be selected in each category (i.e., teaching experience, sex, and having completed a teacher education programme). According to Kadilar and Cingi (2005), stratified random sampling is a helpful blend of randomisation and categorisation, which enables both quantitative and qualitative research to be undertaken. Teachers could participate in or opt-out of the study, and teachers who agreed to participate provided their consent. All science student teachers participated voluntarily. The sample was selected, and data collected with official permission from the educational authorities at the Omani Ministry of Education. Table 1 provides information regarding the sample.

Table 1
Sample Statistics

	Teacher's major course		
	Physics	**Chemistry**	**Biology**
Teaching experience (more than 5 years)	43.1 % (*n*=174)	41.8 (*n*=169)	32.9 (*n*=133)
Sex (female)	40.1 (*n*=162)	60.4 (*n*=244)	48.0 (*n*=194)
Completed a teacher education programme (BSc)	34.2 (*n*=138)	44.3 (*n*=179)	21.2 (*n*=86)

Instrument and Procedures

The current study used teachers' views on the relevance of theory as a starting point to build statements (Cheng et al., 2010; Knight, 2015; McGarr et al., 2017; Tang et al., 2019). The present study considered teachers' views on pedagogical learning theories (PLT) as one aspect of their beliefs, which are defined as "an organized body of concepts and principles developed to explain certain phenomena; a description of possible underlying mechanisms to explain why certain principles are true" (e.g., Ormrod, 2006, p. 253). The researchers of this study

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self-developed the STPLTS by utilizing previous studies to construct the STPLTS instrument items (Hodson et al., 2012; Sjølie, 2014). Most of these studies emphasized observations and focus group interviews. For example, Hodson et al. (2012) studied how student teachers made sense of their learning and professional development in the university and the school. Sjølie (2014) has also categorized different views by student teachers of the role of theory within teacher education. These views can make practice explicit; expand teachers' horizons, prescribe practice; act as a professional knowledge base; be explicitly divorced from practice, and be implicit within actions. The STPLTS instrument covers the principles and the practices of pedagogical learning theories. Considering the cultural differences, education settings, and Arabic language in Oman aspects, altogether, 20 items were developed, consisting of statements the teachers must agree to, using a 4-step Likert scale ranging from "strongly disagree" =1 to "strongly agree" =4 (Strongly Disagree, Disagree, Agree, Strongly Agree). To evaluate aspects of the construct validity of the STPLTS, the items (N = 20) were presented to six professors with at least 15 years of experience in school and academic teaching as well as in educational supervision. Those experts were asked to give their opinions with regard to a number of criteria: relationship of the phrase to the topic, linguistic accuracy, and suitability for a Likert scale. In addition to the consideration of these topics, we also computed Cohen's Kappa; the values for overall pairwise comparisons between all judges were acceptable in the range of .55-1.0 (Becker, 2000). Some minor modifications were made to two items from the comments provided. For example, a behavioural verb was placed at the beginning of item 4. The STPLTS'S items were translated from Arabic into English with stringent quality control of the translation process, including back translation and help from native Arabic and English speakers with experience in science education. The final STPLTS is provided in Table 2 in both Arabic and English.

Table 2
The 20 Items in the STPLTS

No.	Item
	أتصور أن نظريات التعليم والتعلم.. **I see learning and teaching theories as …**
1	تتكون من مجموعة من المفاهيم والحقائق والمبادئ تنتظم في بناء ذا قيمة ومعنى. consisting of concepts, facts, and principles organized within a valuable and meaningful structure.
2	تُعبر عن نموذج لربط المبادئ والأفكار مع بعضها وتفسير آلية عملها. expressing a model to connect principles and ideas and explain how principles and ideas work.
3	تنشأ نتيجة لعدة عوامل منها: الرغبة للتعلم، وفهم طبيعته.... الخ emerging from several factors such as learning desire (learning motivation) and understanding the nature of learning.
4	تنشأ كمحاولة لتفسير كيفية حدوث التعلم. explaining how learning occurred.
5	تُشير إلى مجموعة من المعارف المُشكّلة حول (الطالب-المعلم-المجتمع-البيئة). referring to a set of knowledge related closely to learners, teachers, community/society, and the environment.
6	تُشكل إطارا لتفسير التعلم لدى الطلبة. forming a framework to interpret the learning of learners.
7	تَستند على أدلة علمية تم اختبارها من الباحثين في مجال التربية وعلم النفس. relying on scientific evidence approved and attested by researchers in the field of education and psychology.
8	يُركز بعضها على أهمية التجربة الشخصية والفهم المبني على واقع الطلبة. partially focusing on the importance of personal experience and understanding the status of learners.
9	تتكون من مجموعة قوانين ومبادئ تستخدم لتنظيم الممارسات التدريسية وفهمها لدى المعلم. consisting of a set of laws and principles used for organizing and understanding teachers' teaching practices.
10	تُبنى على أسس فلسفية تتعلق بعوامل داخلية أو خارجية لدى الطلبة. being based on philosophical principles related to learners' internal or external factors.
11	تستند مبادئها على الطالب وتجاربه الشخصية لبناء المعرفة والسلوك. their principles being based on the learner and his/her personal experience in building up knowledge and behaviour.
12	تُنظم عملية التعليم والتعلم وتربط المعارف السابقة بالمعرفة الجديدة. organizing the learning and teaching process and link between previous and new knowledge.
13	تُقدم إطارا علميا لاستراتيجيات التعليم والتعلم. providing a scientific framework for teaching and learning strategies.

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14	تُقدم إطارًا لتفسير سلوك الطلبة ومصادر المعرفة وطرق اكتسابها لديه. providing a framework to explain behaviour, the source of knowledge, and the acquisition methods for learners.
15	تُقدم طرقًا لتقييم تحصيل الطلبة في العملية التعليمية. providing approaches to assess learners' achievement in the educational process.
16	تختلف مبادئها حسب المفاهيم التي ترتكز عليها وطريقة تفسيرها لها. their principles differing according to the concepts on which they are based and how they explain them.
17*	تتغير فلسفتها تبعًا لتغير الزمان والمكان. their philosophy changing according to a change of setting (time and place).
18*	يبنيها المعلم بناءً على خبراته السابقة في التدريس. teachers' building them up according to their previous experiences in teaching.
19	يفهمها المعلم من خلال الاطلاع على نتائج البحوث والدراسات التربوية teachers' understanding them by reading and exploring the results of other educational research and studies.
20	تُكسب المعلم فهمًا واسعًا لتفسير الأحداث التربوية. equipping teachers with a complete understanding to explain educational action.

*Items removed following the initial analysis

After the expert rating, the next phase was the empirical evaluation of instrument function. Data were collected, and the properties of the new instrument were evaluated. The instrument items were put together in an online survey by using the Google Form App (see Table 2 for more details about the sample). After receiving approval from the Omani Ministry of Education, the online survey was administered to all lower secondary school science teachers in the Sultanate of Oman.

Data Analysis

The psychometric functioning of the STPLTS was evaluated by using Rasch techniques. Rasch was developed by Georg Rasch (Rasch, 1960) and greatly extended by the University of Chicago's Benjamin Wright (Wright & Masters, 1982; Wright & Stone, 1979). Rasch techniques are frequently used in the field of science education (Soeharto & Rosmaiyadi, 2018; Yusuf et al., 2018) and fields such as medicine (Holmefur & Krumlinde-Sundholm, 2016; Malec et al., 2007). There are many reasons for Rasch techniques being utilized in these various fields of study to guide the development of rating scale instrumentation. One reason is that Rasch techniques take into consideration that the rating scale data is ordinal, and such data cannot be assumed to be linear. Additional reasons for the use of Rasch is that the technique provides numerous techniques to evaluate the functioning of an instrument (e.g., the use of a Wright Map to assess instrument functioning). Resources such as Boone et al. (2014), and Bond and Fox (2016)) can be consulted for an introduction to Rasch analysis techniques. The widely utilized Winsteps (Linacre, 2021) computer program was used to analyse the data. Altogether, key Rasch analysis techniques were used to evaluate the functioning of the STPLTS instrument. These broad considerations were a) Dimensionality and Fit, b) Item and Person Reliability, c) Reviewing Category Probability Curves, d) Independence, and e) Interpretation of the Wright Map.

Research Results

Dimensionality and Fit

Analysis of fit provides an evaluation of the dimensionality of the STPLTS, which is important for researchers to be confident that all items of an instrument measure a single construct. For the analysis, the present study evaluated the MNSQ Outfit and MNSQ Infit statistics. It used a range of MNSQ from 0.5 to 1.5, a range used by researchers such as O'Connor et al. (2016).

The study conducted an initial analysis of fit. The results suggested that two items (17 and 18) did not fit. We removed those two items, and then all our items fit with appropriate MNSQ (Table 3) values. We also used two additional techniques to evaluate dimensionality. Li et al. (2016) has proposed that if the biserial point of each item is above 0.3, it is evidence of unidimensionality. For our data, all items exceed this threshold (Table 3). Principal Component Analysis of Residuals (PCAR) was also used to evaluate dimensionality. Researchers such as Setari et al.

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(2016) have suggested that an eigenvalue of the 1st contrast below 2.0t provides evidence of an instrument measuring a single construct. In this data set, the eigenvalue of the 1st contrast was 1.83. Thus, the data fit the Rasch model, and one construct is supported.

Table 3
Summary of the Rasch Item Statistics for Each Construct of the STPLTS

Item Number	Total Score	Total Count	Measure (Logits)	Model S. E. (Logits)	Infit MNSQ	Outfit MNSQ	Pt Measure Correlation
A1	1402	400	–0.77	0.10	0.95	0.87	0.59
A2	1348	400	–0.23	0.10	0.83	0.84	0.65
A3	1353	400	–0.28	0.10	1.19	1.30	0.55
A4	1339	400	–0.15	0.10	0.94	0.91	0.62
A5	1367	400	–0.41	0.10	1.01	0.97	0.60
A6	1330	400	–0.06	0.10	0.87	0.86	0.66
A7	1353	400	–0.28	0.10	1.03	1.00	0.62
A8	1277	400	0.40	0.09	1.05	1.17	0.61
A9	1349	400	–0.24	0.10	0.79	0.76	0.67
A10	1298	400	0.22	0.09	0.95	0.94	0.66
A11	1211	400	0.92	0.09	1.38	1.43	0.61
A12	1338	400	–0.14	0.10	0.80	0.76	0.68
A13	1348	400	–0.23	0.10	0.82	0.87	0.66
A14	1295	400	0.24	0.09	0.99	1.05	0.65
A15	1281	400	0.36	0.09	1.01	1.06	0.65
A16	1292	400	0.27	0.09	1.13	1.21	0.60
A17	DELETED	-	-	-	-	-	-
A18	DELETED	-	-	-	-	-	-
A19	1268	400	0.47	0.09	1.21	1.27	0.61
A20	1334	400	–0.10	0.10	0.96	0.98	0.64

Table 3: Item Number, Total Score is the total raw score for each item from all respondents, Total Count is the total number of respondents answering an item, Measure is the item measure in Logits, Model S.E. is the standard error of the item measure in logits, Infit MNSQ is an assessment of item fit, MNSQ Outfit provides an assessment of item fit, Pt. Measure Correlation is Point Measure Correlation.

Item Reliability and Person Reliability

Rasch techniques also provide an assessment of item reliability and person reliability. Furthermore, they allow the computation of item-separation indices and person-separation indices. The Rasch reliability indices are analogous to alpha, but these values take into consideration many issues, such as that the rating scale data is ordinal. The separation indices provide a mechanism by which one can assess how well an instrument is separating persons and items. Malec et al. (2007) have suggested target values of person reliability of 0.8 or higher, item reliability of 0.9 or higher, person separation of 2.0 or higher, and item separation of 4.0 or higher. For the STPLTS instrument, person reliability was 0.88, item reliability was 0.94, person separation was 2.77, and item separation was 3.92. Thus, all these thresholds were met, with the exception of item separation. However, the item separation was very close to the target value.

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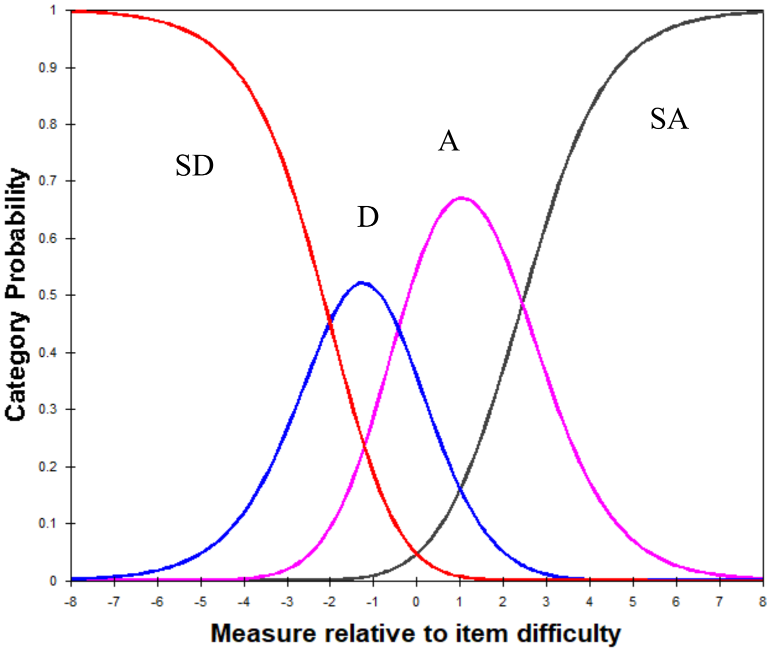
Rating Scale Functioning by Reviewing Category Probability Curves

Rasch techniques provide a variety of methods by which nuances of functioning of the rating scale can be evaluated. The most common method of assessing rating scale functioning is a review of the so-called probability curves (Fitzpatrick & Hill-Briggs, 2015). Figure 1 provides the probability curves for the STPLTS instrument. When an instrument rating scale is well functioning, one should observe distinct peaks where each rating scale category is most probable. The observed analysis is presented in Figure 1, and we observe the target pattern.

Figure 1
Category Probability Curve for the STPLTS Instrument



Note. SD= strongly disagree; D= disagree; A= agree; SA= strongly agree

These curves can also be reviewed regarding the location and spacing of the Andrich Thresholds. These are located at the intersection of the curves for adjacent categories (e.g. where the rating scale curve for Strongly Agree intersects the curve for Agree). Linacre (1999) has suggested that the Andrich Thresholds should be ordered, the gaps between adjacent Andrich Thresholds be greater than 1.4 logits, and that gaps between adjacent Andrich Thresholds be less than 5.0 logit. The gaps for this study are 1.58 and 2.86, and the Andrich Thresholds are ordered.

Linacre (1999) has also suggested additional aspects of the rating scale that should be reviewed. These additional considerations are observed counts for each rating scale category of at least 10, observations uniformly distributed, average measures need to increase monotonically with each rating scale category, and Outfit MNSQ values should be less than 2.0. The suggestions outlined by Linacre regarding rating scale functioning are all abided to; Table 4 provides this data.

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Table 4
Summary of the Rating Scale Performance the STPLTS

Category Label	Observed Count	Observed%	Observed Average (Logits)	Infit MNSQ	Outfit MNSQ	Andrich Threshold	Gap (Logits)
Strongly Disagree	114	2	0.24	1.51	1.89	NONE	
Disagree	741	10	0.47	0.98	1.02	–2.01	1.59
Agree	3193	44	1.50	0.88	0.87	–0.42	2.86
Strongly agree	3152	44	2.97	0.96	0.96	2.44	

Table 3: Category Label, Observed Count is the number of respondents selecting the category, Observed % is the percent of all respondents who selected a specific category, Observed average is "the average of the (person measures - item difficulties) that are modelled to produce the responses observed in the category" (Linacre, 2021), Infit MNSQ is "the average of the INFIT mean-squares associated with the responses in each category" (Linacre, 2021), Outfit MNSQ is "the average of the OUTFIT mean-squares associated with the responses in each category" (Linacre, 2021), Andrich Threshold is "the calibrated measure of the transition from the category below to this category," (Linacre, 2021). Gap is the difference in adjacent Andrich Thresholds.

The Observed count column is above 10 for each rating scale category. The Observed count column reveals an increase with the rating scale category, but no decrease at the highest rating scale category. The average measure (Category Measure) increases with each rating scale category, and the Outfit MNSQ for the rating scale categories is below 2.0. Thus, utilizing a wide range of techniques to evaluate the rating scale functioning, the scale appears to be well functioning.

Independence

A component of our analysis consisted of evaluating the independence of items. Fitzpatrick and Hill-Briggs (2015) have suggested that a review of correlations between item residuals can be used to evaluate independence. Those authors have suggested that if correlations are below .7, that provides evidence of independence. In our study, all items exhibited a correlation below .7.

Wright Map

Figure 2 provides a Wright Map. In terms of our work with science teachers, there are several patterns in the Wright Map that we feel were informative for us in our work with Omani science teachers. Needless to say, some of those patterns would be helpful for the training of science teachers outside of Oman. There are also patterns in the Wright Map that helped in evaluating some components of the measurement functioning of the instrument.

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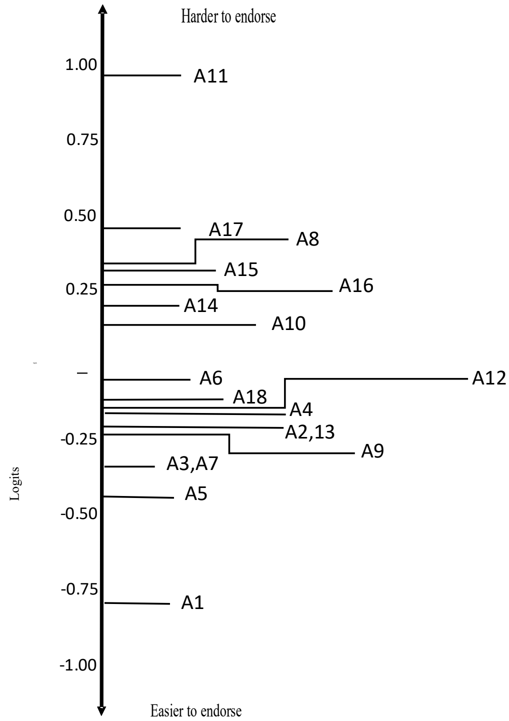
Figure 2
The Wright Map of the STPLTS



Note. Items are organized on the logit item measure scale. Items with a lower item measure were easier for the respondents to agree with than items with higher item measures. For example, item A10 was easier to agree with than item A15.

The Wright Map was used to examine the spacing and order of items. The items were generally distributed throughout the variable of the STPLTS. The ordering of item by difficulty reflects the rating scale categories selected for items. We found that items A2 and A13 were close together, which indicates that these items mark similar parts of the construct. This means that they may be redundant for measurement, suggesting that one could delete one of the items to help the instrument measure more efficiently (Davis & Boone, 2021). For other items very close to each other, one might consider removal of 1 or 2 more items. There are also cases of gaps between items. For example, the gap between items A1 and A5, and the gap between items A17 and A11 could each be filled with a new item. This procedure of removing redundant items and filling gaps with items would improve the measurement function of the instrument without increasing the number of items on the instrument. Future versions of the STPLTS instrument could include new items to fill these gaps and in doing so increase the overall STPLTS's measurement precision. We suggest that future versions of the instrument contain such new items.

An interpretation of the ordering and spacing of items as a function of topic is also of great importance for Oman and science teacher training. At the bottom of the Wright Map, we see examples of knowledge of pedagogical learning theories that many Omani science teachers are most likely to indicate they are in agreement with. At the top of the map, we see similar examples that fewer Omani science teachers report agreeing to. For example, the Wright Map (Figure 2) shows that item A1 "I see learning and teaching theories as consisting of a set of concepts, facts, and principles organized within a valuable and meaningful structure" was located in a position that suggests most Omani science teachers found this item to be the one they were most likely to agree with. Item A5, "referring to a set of knowledge related closely to learners, teachers, community/society, and the environment," was the survey item which was the 2nd -most easy to agree with survey item.

In contrast, item 17, "Teachers' understanding them by reading and exploring the results of other educational research and studies," was found in a location (higher up the Wright map) that confirms the need to foster teachers' knowledge and experience on science literature and research in science education (Shahat et al.,

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2022b). This was an item that was one of the harder for the respondents to agree with in comparison with the other items. Item A11, "Their principles being based on the learner and his/her personal experience in building up knowledge and behaviours," was also located in a position suggesting it was harder for respondents to agree with. This suggests the need to enhance science teachers' awareness by providing training and considerable knowledge on the principles of these theories and its need to be practised with students (Zaidi & Nasir, 2015).

Discussion

The aim of the presented study was to develop and evaluate an instrument for assessing Arabic science teachers' views on a variety of pedagogical learning theories. Assessing science teachers' views toward these theories is important in that such views will influence instructional performance and hence student achievement. In Oman, one representative Arabic country, science education has undergone recent reforms as a result of unsatisfactory results of Omani students in large-scale international assessments. Those reforms have had an impact not only science instruction but also the professional development of science teachers. We decided that Omani efforts could be informed by evaluating teachers' professional competence – in particular, their views on pedagogical learning theories. A literature review revealed that existing instruments measuring teachers' views on PLT were not suitable for the specific context of science teaching in Oman. As a result, the STPLTS was developed. An online STPLTS was administered to 400 Omani science teachers. The average responses for all items were higher than 3.0 (Agree). This means that most respondents understand the importance of using pedagogical learning theories in their science classrooms. Of course, there is more to this than just an average, but it does provide a very broad overview of the teachers' typical attitudes. Therefore, it may seem that there is no relationship between the teacher's view of PLT and the actual student's achievement. A possible interpretation of this is that there may be a gap between teachers' view and understanding of PLT and their actual use of PLT in classes.

Rasch measurement techniques were used for evaluating the psychometric functioning of the instrument. Evaluation of fit, point biserials and Principal Component Analysis of Residuals all suggested a single dimension was measured by the scale. The values of these analyses all exceeded the suggested target values. The scale exhibited strong reliability and separation, with only item separation exhibiting a value just short of a suggested target value. The overall analysis of rating scale functioning, from the guidance of Linacre (2021), suggests very good rating scale functioning. In addition to these analyses, the independence of items was also evaluated. The results suggested item independence from the criteria provided by Fitzpatrick and Hill-Briggs (2015). Thus overall, from a broad array of measurement criteria, the scale was found to exhibit strong measurement properties. There are some aspects of the scale that should be monitored over time.

The considerations that we present below are a function of the sample, as is the case with any study. It will be important to use the instrument with other samples, as 9.2% of respondents have measures at the extremes of the scale. In future samples it will also be important to assess if respondents also are located at the top of the scale in a similar manner. If so, future versions of the instrument should have more added items, which are harder to "strongly agree" with. This would help decrease the chances of a respondent having a maximum measure. A related topic concerns the targeting of the instrument. A commonly used rule of thumb is that there should not be more than a 1.0 logit difference between the average person measure and the average item measure for an instrument. In part, because of the respondents clustering at the top of the scale, the difference between the average item measure and the average person measure was not less than 1.0 logits. With future use of the instrument, it will be important to assess this targeting of the STPLTS. As has been mentioned for the percentage of respondents at the top of the scale, future versions of the STPLTS might include 1–3 added items that are not easily answered with "strongly agree", even by the most confident teachers. This might result in a targeting of less than 1.0 logits. DIF (Differential Item Functioning) is often a common analysis conducted when evaluating the functioning of scales (Boone, & Staver, 2020), in essence a DIF analysis consists of a technique by which the measurement functioning of the scale can be compared as a function of a subgroup. When data can be collected from non-Omani settings, we plan to conduct a DIF analysis to compare the instrument functioning as a function of this Omani sample and a non-Omani sample.

This study looked major for DIF and not just sex. In future data collection it will be important to explore differential item functioning with regard to sex as well as exploring the impact of new items to fill in the Wright Map gaps.

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From the item-ordering on the Wright Map, it is clear that some items (A11, A17, A8) are surprisingly low—Omani teachers find these items among the more difficult to agree with in some manner. For example, the Wright Map results suggest that Omani science teachers need more attention to principles based on the learner and his/her personal experience in building up knowledge and behaviour during the preparation programmes (item 11). The study results suggest that Omani science teachers need to know more about educational research and studies related to teaching theories (item 17). The results indicate that Omani teachers also need to focus on the importance of personal experience and understanding the status of learners (item 8). Clearly, the results suggest that reform of current preservice courses and in-service courses regarding this knowledge and its related practices is required. As a first step, we are planning workshops and training programmes to refresh the Omani science teachers' knowledge and practices on the principles of teaching theories (Al Jabri et al., 2018). Naturally, it is planned to collect added survey data from teachers before and after such courses to measure changes in the science teachers' views.

Some survey items are surprisingly high (A1 "consisting of concepts, facts, and principles organized within a valuable and meaningful structure' & A5 "referring to a set of knowledge related closely to learners, teachers, community/society, and the environment"). These two items are most easy for respondents to agree with. This suggests that Omani teacher preparation and professional training programmes at the Ministry of Education provide teachers with a good opportunity to understand that learning and teaching theories consist of concepts, facts, and principles organized within a valuable, meaningful structure.

Some items (A3 "emerging from several factors such as learning desire (learning motivation), understanding the nature of learning" & A7 "relying on scientific evidence approved and attested by researchers in the field of education and psychology") are surprisingly high (harder to agree with than items below them). Their relative location suggests it is essential for Omani science teacher training to focus more on the evidence approved for teaching and learning theories by researchers. Omani science teachers also need to be provided with more examples about how to enhance motivation for learning.

We were surprised not to see items (A2 "expressed as a model to connect principles and ideas and explain how principles and ideas work" & A8 "partially focusing on the importance of personal experience and understanding the status of learners") near each other. Similarly, we did not see items (A4 "explaining how learning occurred" & A6 "forming a framework to interpret the learning of learners") near each other. We hypothesize that this is because a theoretical course in the cohort plan for Omani science teachers focuses on educational psychology. More specifically, on the principles and ideas of teaching theories and practical work on personal experience and understanding the status of learners. Since this non-practical course focuses only on theoretical frameworks, this could explain why items (A2) & A8 and items (A4) & A6 are near each other.

Conclusion and Implications

From the Rasch measurements, the STPLTS showed promising psychometric properties. Generally, the STPLTS scale functioned as expected and defined a single trait. The values of item reliability and item separation, as well as person reliability and person separation, were acceptable. Despite cases of clustering of items and gaps between items, the Wright Map showed that items were generally well-spaced across the STPLTS's construct. As a suggestion for future studies on the STPLTS, we recommend adding items with the goal of closing the gaps between items on the Wright Maps.

The issue of item order is vital because the order reflects the teachers' views toward applying pedagogical learning theories in the classroom. It will be important in Oman that interviews are conducted with teachers to understand further the patterns of the Wright Map. Such a next step would allow us to identify further needs of Omani science teachers' training and professional development programmes. It is also recommended to replicate the study and collect data from different educational regions in Oman (e.g., Muscat, Adh-Dhahirah, North Al-Batinah, South Al-Batinah, Al-Buraymi, Al-Wusta, North Al-Sharqiyah, South Al-Sharqiyah, Dhofar, Musandam, Muscat).

To optimize Omani science teacher education, teachers need more exposure to philosophical principles related to learners' internal or external factors during the preparation programmes. Science teachers' awareness needs to be fostered by providing training and considerable knowledge on the principles of these theories and their need to be practised with students. It is essential for Omani science teacher training to be more focused. Omani science teachers need to be provided with more examples of enhancing motivation for learning. Accord-

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ingly, reform of current preservice courses and in-service professional development programmes with regard to this knowledge and related practices is required.

One international contribution of this study is its demonstration of utilizing the Arabic version of the STPLTS in Oman. The study shows how instrument items can be successfully developed and applied for the Arab language and culture. The STPLTS could foster the assessment of pre-and in-service science teachers' competence in teaching science lessons by applying pedagogical learning theories in their science classrooms in elementary, lower, and upper secondary schools in Oman and possibly, in other countries. This survey will aid science education efforts in Oman as well as other Arab countries. An additional added value of this study is the detailed description of the instrument of STPLTS. The STPLTS can be used as a single diagnostic scale for education officials in Oman and other countries to identify further strengths and weaknesses in pre- and in-service science teacher training programmes regarding the application of pedagogical learning theories. This may help science teachers, or teachers in general, to meet their competence training needs and influence teacher training and help establish teachers' confidence to teach effectively by applying pedagogical learning theories. It could result in better practices when using STPLTS in science classroom teaching.

Declaration of Interest

Authors declare no competing interest.

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