



Article

Teachers' Innovative Work Behavior Scale: Psychometric Properties of the Greek Version and Measurement Invariance across Genders

Angelos Gkontelos ¹ , Julie Vaiopoulou ^{2,3} and Dimitrios Stamovlasis ^{1,*}

¹ Department of Philosophy and Education, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece; gkontelos@edlit.auth.gr

² Department of Education, University of Nicosia, Nicosia 2417, Cyprus; vaiopoulou.cp@unic.ac.cy

³ School of Psychology, Faculty of Philosophy, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece

* Correspondence: stadi@edlit.auth.gr

Abstract: Innovation refers to the implementation of creative ideas into practice. In that sense, innovative work behavior (IWB) is a type of behavior and a multidimensional construct that involves four factors: the generation, promotion, realization, and sustainability of new ideas for the whole organizations' benefit. Thus, the development of instruments for measuring and singling IWB is an interesting and necessary endeavor. The present study appraises the psychometric properties of the Greek version of the innovative work behavior scale (IWBS-G), a 44-item self-reported instrument, using data collected from two studies with in-service teachers. In the first study dataset ($N = 485$), exploratory factor analysis was applied, which, by implementing scree plot with parallel analysis, revealed the dimensionality of four factors, namely: *Idea Generation* (IG), *Idea Promotion* (IP), *Idea Realization* (IR), and *Idea Sustainability* (IS). The corresponding reliability measures using Cronbach's alpha and McDonald's omega ranged between 0.917 and 0.944. In the second study dataset ($N = 964$), confirmatory factor analysis validated a sufficient fit of the measurement model [$\chi^2 = 396.85$, $df = 203$, $p < 0.001$; $CFI = 0.995$; $TLI = 0.994$; $RMSEA = 0.031$], while the corresponding internal consistency measures ranged between 0.814 and 0.914. Furthermore, measurement invariance was conducted, which demonstrated insignificant differences between genders. Discussion on the significance of innovative work behavior and the potential implementation of the IWBS instrument in educational research is provided.

Keywords: psychometric properties; confirmatory factor analysis; innovative work behavior; measurement invariance; gender



Citation: Gkontelos, Angelos, Julie Vaiopoulou, and Dimitrios Stamovlasis. 2022. Teachers' Innovative Work Behavior Scale: Psychometric Properties of the Greek Version and Measurement Invariance across Genders. *Social Sciences* 11: 306. <https://doi.org/10.3390/socsci11070306>

Academic Editor: Nigel Parton

Received: 6 June 2022

Accepted: 11 July 2022

Published: 14 July 2022

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2022 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

In knowledge-based societies, where intense competition is prominent, innovation is a key prerequisite for the viability and success of any organization (Amabile and Pratt 2016). In this context, given the increasing demands for sustainability, innovative work actions typically need to go beyond prearranged job description duties. Innovative work behavior (IWB) is a differentiated form of creative behavior, since it includes not only the generation, but also the adoption and the implementation of novelty. The importance and the principal merit of IWB is reflected in the growing interest in the contemporary literature, which exhibits international and cross-cultural endeavors, studying the conditions and presuppositions of IWB development (Atatsi et al. 2022; Fan et al. 2021; Haque and Yamoah 2021; Işık et al. 2021).

IWB has been characterized as a repetitive, complex, and nonlinear activity (King and Anderson 2002; Messmann and Mulder 2011). As such, researchers face particular hitches in their attempts to understand the underlying process; thus, they tend to focus on the identification and description of successive stages that might be followed. These

stages include the *conception* of a new idea, the *discussion* about it among the members of the organization, its *implementation*, and the efforts to transfer and *disseminate* the novel concept in a broader context that goes beyond the framework of the organization. The above conjectures have spurred research interest in exploring IWB; however, the relative theory has not been fully developed and is constantly being updated (Lambriex-Schmitz et al. 2020). In this inquest, IWB and its psychological decedents are culturally dependent, and the measurement issues are of primary concern. To this end, the present endeavor contributes to the research field with the adaptation of the innovative work behavior scale in the Greek population.

1.1. IWB Dimensions

IWB is introduced in the literature with a variety of definitions. According to them, IWB refers to the intentional generation, introduction and implementation of new ideas within an organization in order to benefit the individual, the group and/or the organization as a whole (Janssen 2000). Moreover, IWB is thought to describe the contribution of employees to the development of the organization's innovation (Messmann and Mulder 2011; West and Farr 1990). IWB has been defined as an iterative multi-stage process, in which employees' behavior aims to deliberately create novel concepts after exploring different possibilities. It also includes the planning for the implementation and the execution itself, without neglecting to examine the sustainability of these ideas and the required actions, aiming to benefit the whole organization in the long run (Lambriex-Schmitz et al. 2020). Based on the above, IWB is a sequence of tasks in which employees' observed behavior changes dynamically, while, at the same time, the viability of organizations lies in the creation, promotion, and realization of new creative ideas.

Regarding the dimensions of IWB, early research (Kanter 1988; Scott and Bruce 1994) records three stages, which include the *generation* of new ideas, the *formation of a coalition* of members of the organization for the novel concept and its *implementation* in a broader context. Later, it was proposed (De Jong and Den Hartog 2010) that IWB consists of four stages. *Exploration of opportunities* was introduced as a fourth dimension of the IWB, because it consists of its own challenges, since it requires constant monitoring of work developments, changes in organizational structures, events in other organizations, as well as new individual ideas. In this context, the *generation of new ideas* stems from the critical examination of individual and collective beliefs and includes the treatment of work-related difficulties. The *promotion* aims at supporting creative environment, concerning both the colleagues and the negotiation of key factors, such as the available resources and the licenses for the dissemination of novel concepts inside and outside the organization. The *realization* marks the development of a functional and easy-to-use model, with the aim of each user being able to examine and avoid possible side effects, but also to plan its effective implementation in the work context.

The most recent approach for IWB is based on the model of Messmann and Mulder 2012. It contains statements that refer to the aforementioned dimensions, such as opportunities exploration, generation, promotion, and realization of innovative concepts. However, the *sustainability* of the new idea is examined for the first time, proposing a new five-dimensional model, which emphasizes the need for a *stabilization* or *continuation* phase as a critical stage for the completion of an innovative process (Lambriex-Schmitz et al. 2020). Sustainability reflects the optimization of the novel idea with the continuous distribution of information among the members and its deep integration in the system of the organization (Fullan 2007; Loh et al. 2013), as well as the dissemination of the concept on a larger scale outside the organization, where it has been developed by creating a channel for spreading vision, communication and results related to innovation (Loh et al. 2013).

The members of the organization working for the realization of the new idea should focus on its implementation, both in the long run and in the short term, without forgetting that the sustainability of the said concept should be their primary goal. Finally, since a creative idea is not considered as innovation until it is implemented or institutionalized

(Van de Ven 1986), legislation constitutes a valid way of integrating novelty into the deeper structure of the organization (Gannaway et al. 2013).

1.2. IWB in the School Framework

The present work focuses on teachers' innovative work behavior (TIWB), which concerns the school practices through every educational context. In the school context, the constant knowledge acquisition, the interdisciplinarity, the multicultural character of the classrooms, but also the high societal expectations, point out the need for the development of innovative practices (Organisation for Economic Cooperation and Development 2005). In addition, the ensuing community demands from both students and teachers (Bransford et al. 2005), combined with the development and integration of new technologies in educational settings (Thurlings et al. 2015), as well as the role of school as a key factor of maintaining the competitiveness of society, and along with the development of innovative work behavior of citizens (Andiliou and Murphy 2010), indicate the need to strengthen TIWB.

TIWB has also been characterized as a type of behavior necessary for the development and sustainability of both the school and the entire educational system (Tuominen and Toivonen 2011). The development of innovation in learning institutions depends on the behavior of their members, as it can facilitate the employees themselves in their teaching by promoting, for example, communication between them, as well as the development of advanced problem-solving strategies. Creating a strong innovation network within the school unit may promote a vibrant and supportive work environment (Messmann et al. 2018).

The ethic development and theoretical construction of TIWB as a distinct latent construct leads to the issue of measurement. The most lately developed instrument is the *Innovative Work Behavior Scale* or IWBS (Lambriex-Schmitz et al. 2020), a self-reporting questionnaire, which assess the dimensions of the TIWB. The review of the literature on the factors that have an impact on IWB distinguishes them into demographic, individual, and organizational (Thurlings et al. 2015). TIWB has been examined in several past surveys along with goal orientation (Opfer et al. 2011), teachers' professional development (Messmann and Mulder 2015), personal incentives (Loogma et al. 2012), and school climate (Chang et al. 2011).

The IWBS includes five dimensions: (a) opportunity exploration, (b) idea generation, (c) idea promotion, (d) idea realization, and (e) idea sustainability, which have emerged after readjustments according to the development of the research about IWB (Carmeli et al. 2006; Janssen 2000; Lambriex-Schmitz et al. 2020; Messmann and Mulder 2012). Particularly, *opportunity exploration* is about how to ameliorate the resulting difficulties and/or consider them in alternative ways (De Jong and Den Hartog 2010). It starts with discovering an opportunity or recognizing a problem. In the school context, it refers to teachers' thoughts about their failures and successes, and the need for instant solutions to problems that arise from the attempt to distinguish between "how it is" and "how it should be" regarding a work situation. *Idea generation* is associated with the teachers' beliefs about problem-solving and performance improvement, as teachers have to reorganize and classify their new ideas and address them to work-related obstacles. This stage contains the deliberate generation of a novel concept and/or the revision of a previous one with the aim of solving any problems (Carmeli et al. 2006). *Idea promotion* is the next stage, where innovative ideas usually contrast with the prevailing perceptions within an organization. Reaching the stage of execution, new concepts must be properly assimilated for the purpose of developing a strong positive attitude toward change and strengthening innovation workflow. After all, the successful promotion and understanding of new ideas is considered necessary in order to develop teaching and learning leading to realizable and sustainable changes (Gannaway et al. 2013). The fourth dimension, *idea realization*, indicates teachers' perceptions about the implementation into practice. It requires the cultivation of members' attitudes adjusted to the innovative process results. For the successful implementation of the novelty in the school context, it is necessary to develop a careful planning and an innovation paradigm, aiming at familiarizing the participants with its details (Messmann and Mulder 2012).

Finally, the *idea sustainability* points out the teachers' thoughts on the integration of new ideas through the organization, as well as their dissemination on a larger scale outside of it. This stage is crucial as it aims to adapt novel concepts in order to contribute a positive impact on society. The sustainability of new ideas is a multifaceted development factor with long-term benefits for the school. As a result, the curriculum will be revamped, student engagement will improve, and research efforts by educators are expected to expand (Loh et al. 2013). Within this framework, the present study aimed to adopt and validate the Innovative Work Behavior Scale (Lambriex-Schmitz et al. 2020) for the Greek population.

2. Materials and Methods

2.1. Participants and Procedures

Two data sets were collected from in-service teachers. The first study ($N = 485$) included 67.84% women, ages 22 to 68 years old (*median* = 45, *mean* = 43.96, *SD* = 10.62), whose years of service varied from 1 to 35 (*median* = 18, *mean* = 17.68, *SD* = 9.86). Participants worked in public schools, 19.8% of which were located at a village, 18.1% at a town, and 62.1% at a city. A total of 38.6% of the teachers held a bachelor's degree, 5.8% a second bachelor's degree, 48.7% a master's degree, and 7% a PhD. This data set was used for exploratory factor analysis. The second study ($N = 964$) included 77.1% women, ages from 22 to 65 years old (*median* = 40, *mean* = 41.35, *SD* = 10.88), whose years of service varied from 1 to 35 (*median* = 14.5, *mean* = 15.12, *SD* = 10.63). Participants worked in public schools, 23.6% of which were located in a village, 16.3% in a town, and 60.3% in a city. A total of 35.9% of the teachers held a bachelor's degree, 7% a second bachelor's degree, 53.8% a master's degree, and 7% a PhD.

The two independent studies were carried out in a time lag of 8 months. The use of two different data sets facilitates the right protocol for exploratory/confirmatory procedures, which demands to be applied to different data sets. Alternative protocol is to split a sample into two random subsets and apply EFA to the first and CFA to the second, respectively (Wagenmakers et al. 2012). The data collection was achieved electronically via anonymous questionnaires and the call for participating was disseminated via school networks all over the country. Overlapping responders could not have been traced, but the fact is less likely to occur, given the widespread population and the time lag. However, a reply to a possible concern for overlapping responders is provided by an auxiliary application of the alternative protocol, that is, applied EFA and CFA to two random subsets in both studies, which led to the same structure and dimensionality.

The participants received an email via school networks and completed the self-completion questionnaire anonymously. It was uploaded on a web-based form via LimeSurvey. Before fulfilment, an associating cover letter clarified the voluntary participation, the purpose, and the confidentiality of the study, while the procedure followed the Ethics and Deontology Committee of Aristotle University of Thessaloniki guidelines.

2.2. Instrument

The innovative work behavior scale-Greek (IWBS-G) constitutes an adapted inventory from the original IWB scale (Lambriex-Schmitz et al. 2020), an instrument constructed for measuring teachers' innovative work behavior. The English-Greek translation and the suitable adaptation was guaranteed by involving three bilingual experts (Douglas and Craig 2006). The IWBS-G was used for data collection and the subsequent factor analyses. In the initial IWBS, five dimensions were proposed, namely: *Opportunity Exploration* (OE), *Idea Generation* (IG), *Idea Promotion* (IP), *Idea Realization* (IR), and *Idea Sustainability* (IS). The scale consisted of 44 items classified as follows: opportunity exploration {1, 2, 3, 4}, idea generation {5, 6, 7, 8, 9, 10, 11}, idea promotion {12, 13, 14, 15, 16, 17, 18}, idea realization {19, 20, 21, 22, 23, 24, 25, 26, 27}, idea sustainability {28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44}. The IWBS-G items were measured in a 5-point Likert scale. The IWBS appears in the Appendix A. Besides the IWBS-G items, the questionnaire included variables corresponding to individual differences, such as gender and age, along with some

demographic data, e.g., type of school, region of school, years of teaching experience, and educational level of the participants. In the present study, only gender was evaluated for the measurement invariance.

2.3. Analyses

To determine the dimensionality and the structure of IWBS-G, exploratory factor analysis via principal axis factoring (PAF) was applied, and successively a confirmatory factor analysis (CFA) was carried out using the second data set to evaluate the measurement model. Based on the literature, multiple fit indices were used, such as the chi-squared (χ^2), the comparative fit index (CFI), and the root mean square error of approximation (RMSEA), with the usual acceptable value [$CFI \geq 0.95$, $TLI \geq 0.95$ and $RMSEA \leq 0.05$] (Geiser 2013). In addition, for internal consistency of the scales, Cronbach's alpha and McDonald's omega coefficients were calculated.

The measurement invariance which followed CFA is a procedure with four steps. The first step evaluates the *configural invariance*, that is, the least restrictive model, employed as the base line. The analysis proceeds with more restricted models, and in each step, a comparison of the current model with the previous one is made. Briefly, the next model, namely the *metric invariance*, concerns the values of factor loadings in every group, that is, the meaning of the construct is the same across groups and the factor variances and covariances are also similar for the two groups. The *scalar invariance*, which follows, examines if the item intercepts are equivalent across groups. If the invariance of the intercepts does not hold, then a bias effect might operate, denoting essential difference between groups in perceiving the essence of the construct under investigation. Finally, the *strict invariance* appraises the residual errors and tests whether they are equal across the two gender-groups. Some details about measurement invariance applications could be found in previous studies (e.g., Gkontelos et al. 2021), while comparison between invariance model is based on the χ^2 difference test, along with some indicative values of $\Delta CFI < 0.01$ and $\Delta RMSEA < 0.015$ for non-rejecting the null hypothesis of invariance (Chen 2007; Cheung and Rensvold 2002).

3. Results

3.1. Exploratory Factor Analysis (EFA)

In a data set from the first study ($N = 485$), EFA was applied by using PAF with oblique/promax rotation to reveal the number of the underlying dimensions. Bartlett's test of sphericity ($\chi^2 = 9821.266$, $p < 0.0001$) and the Kaiser–Meyer–Olkin index (0.946) suggested adequate variance for applying factor analysis. Parallel analysis (Figure 1), along with the Kaiser's Criterion and the corresponding scree plot, suggested a four-factor structure. Note that the initially proposed structure is five-dimensional, and the final refined structure includes the items (with loading greater to 0.40) showed in the Table 1, where reliability measures are also presented.

The four factors correspond to *idea realization* (IR), *idea sustainability* (IS), *idea generation* (IG) and *idea promotion* (IP), with eigenvalues 5.217, 4.188, 3.708, and 2.398, respectively, while the corresponding portions of variance explained were 23.70%, 19.00%, 16.90%, and 10.90%, respectively, while the total variance explained was 70.50% (Table 2).

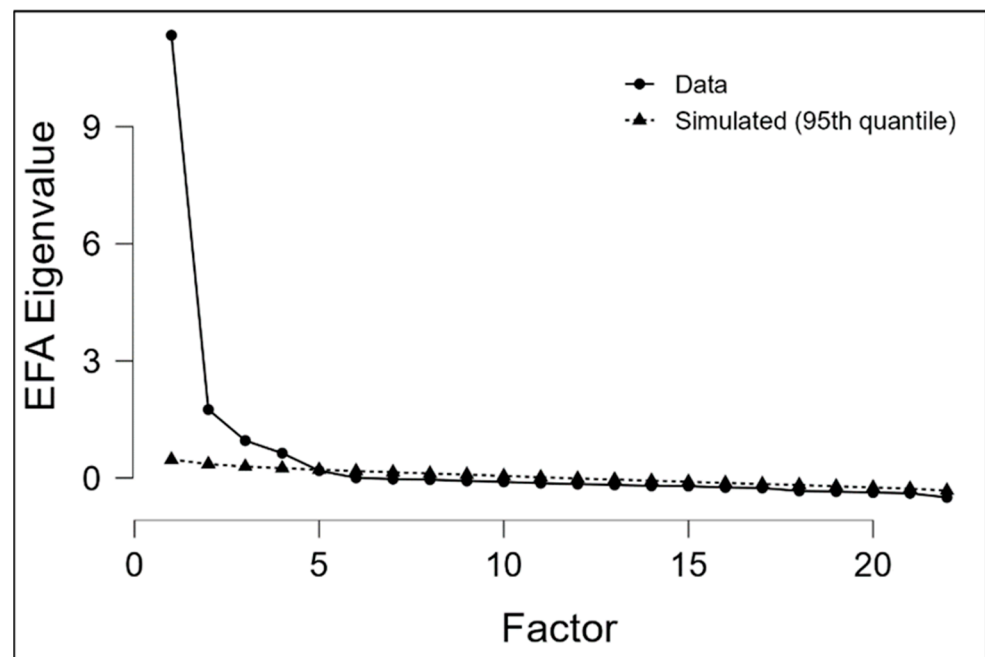


Figure 1. Parallel analysis with scree plot suggesting four-factor structure (First study).

Table 1. Exploratory factor analysis: factor loadings of four-dimensional structure and reliability measures using Cronbach's alpha and McDonald's omega. First study.

	Idea Realization	Idea Sustainability	Idea Generation	Idea Promotion	Uniqueness
IR22	0.886				0.192
IR21	0.856				0.178
IR23	0.800				0.268
IR20	0.787				0.258
IR25	0.783				0.270
IR26	0.764				0.286
IS31		0.973			0.168
IS30		0.927			0.176
IS29		0.782			0.373
IS32		0.774			0.295
IS33		0.750			0.307
IG7			0.841		0.296
IG9			0.785		0.315
IG6			0.698		0.361
IG8			0.652		0.320
IG5			0.629		0.572
IP14				0.578	0.341
IP15				0.545	0.202
IP13				0.491	0.360
IP12				0.483	0.401
IP17				0.438	0.260
IP16				0.420	0.290
alpha	0.944	0.928	0.917	0.927	
omega	0.942	0.929	0.918	0.927	

Note. Applied rotation method is oblimin.

Table 2. Factor eigenvalues and variance explained (First study).

	SumSq. Loadings	Proportion var.	Cumulative
Factor 1 Idea Realization	5.217	0.237	0.237
Factor 2 Idea Sustainability	4.188	0.190	0.428
Factor 3 Idea Generation	3.708	0.169	0.596
Factor 4 Idea Promotion	2.398	0.109	0.705

3.2. Confirmatory Factor Analysis (CFA)—The Measurement Model

In a follow up study, which included a larger sample ($N = 964$) of participants, CFA was applied to IWBS-G, in order to validate the four latent variable structure underlying the set of observed variables. CFA results (Table 3) for the single-factor model were: $\chi^2 = 2990.135$, $df = 209$, $p < 0.001$, $CFI = 0.824$, $TLI = 0.805$, $RMSEA = 0.117$, $SRMR = 0.062$, $NFI = 0.813$. The four-factor model fitted satisfactorily to the empirical data possessing the following fit measure indices: $\chi^2 = 396.85$, $df = 203$, $p < 0.001$; $CFI = 0.995$; $TLI = 0.994$; $RMSEA = 0.031$; $90\% \text{ CI of RMSEA} = [0.027; 0.036]$; $SRMR = 0.051$; $NFI = 0.990$; $GFI = 0.992$. Comparison of the two models by means of a χ^2 test revealed that the four-factor model was substantially improved over the single-factor model ($\Delta\chi^2 = 2593.42$, $df = 3$, $p < 0.001$). Thus, the hypothesis of the unidimensional structure of IWBS-G in the present data set was rejected. In addition, by inspecting the standardized residual covariances matrix, which had values smaller than two, the absence of possible model misspecifications was assured (Arbuckle 2006). The calculations were carried out in R (via JASP).

Table 3. CFA measurement model: factors, estimates of factor loadings, standards errors, lower and upper 95% CI and statistical significance.

Factor	Indicator	Symbol	Factor Loadings				95% Confidence Interval	
			Estimate	Std. Error	z-Value	p	Lower	Upper
Factor 1	IG8	λ_{11}	0.709	0.015	48.377	<0.001	0.680	0.738
	IG9	λ_{12}	0.566	0.013	42.234	<0.001	0.540	0.592
	IG6	λ_{13}	0.811	0.016	50.907	<0.001	0.780	0.842
	IG7	λ_{14}	0.597	0.014	44.182	<0.001	0.570	0.623
	IG5	λ_{15}	0.581	0.014	42.840	<0.001	0.554	0.608
Factor 2	IP13	λ_{21}	0.710	0.013	56.118	<0.001	0.685	0.735
	IP14	λ_{22}	0.787	0.015	54.295	<0.001	0.759	0.816
	IP15	λ_{23}	0.858	0.014	59.777	<0.001	0.830	0.886
	IP16	λ_{24}	0.782	0.013	58.458	<0.001	0.756	0.808
	IP17	λ_{25}	0.764	0.013	56.886	<0.001	0.737	0.790
	IP12	λ_{26}	0.838	0.015	56.145	<0.001	0.808	0.867
Factor 3	IR22	λ_{31}	0.793	0.014	56.166	<0.001	0.765	0.820
	IR23	λ_{32}	0.816	0.015	56.232	<0.001	0.788	0.845
	IR21	λ_{33}	0.784	0.014	57.198	<0.001	0.757	0.810
	IR26	λ_{34}	0.716	0.013	53.762	<0.001	0.690	0.742
	IR20	λ_{35}	0.813	0.014	56.725	<0.001	0.785	0.841
	IR25	λ_{36}	0.491	0.011	43.771	<0.001	0.469	0.513
Factor 4	IS29	λ_{41}	0.711	0.016	45.530	<0.001	0.680	0.742
	IS30	λ_{42}	1.024	0.017	61.080	<0.001	0.991	1.057
	IS31	λ_{43}	0.974	0.017	58.261	<0.001	0.941	1.006
	IS33	λ_{44}	0.805	0.015	54.070	<0.001	0.776	0.834
	IS32	λ_{45}	0.869	0.016	54.133	<0.001	0.838	0.900

3.3. Reliability Analysis

Reliability measures of the four GTIB's factors were computed using Cronbach's alpha (α) and McDonald's omega (ω): **idea generation** ($\alpha = 0.825/\omega = 0.824$), **idea promotion** ($\alpha = 0.891/\omega = 0.891$), **idea realization** ($\alpha = 0.911/\omega = 0.914$), and **idea sustainability**

($\alpha = 0.854/\omega = 0.857$). The overall internal reliability of the G-IWBS is $\alpha = 0.957/\omega = 0.957$. These reliability indices suggest that the present measurements with the G-IWBS sub-scales have a satisfactory degree of internal consistency (Table 4).

Table 4. Factor correlation matrix, means, standard deviations, and internal consistency measures, Cronbach's alpha, and McDonald's omega.

Variable	Idea Generation	Idea Promotion	Idea Realization	Idea Sustainability
1. Idea Generation	1			
2. Idea Promotion	0.815 ***	1		
3. Idea Realization	0.796 ***	0.808 ***	1	
4. Idea Sustainability	0.689 ***	0.776 ***	0.683 ***	1
Mean	3.801	3.483	3.781	3.059
Std. Deviation	0.724	0.838	0.770	0.958
Alpha, α	0.825	0.891	0.911	0.854
Omega, ω	0.824	0.891	0.914	0.857

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 4 shows the correlation matrix of the four dimensions, along with the means and the standard deviations of each factor. Idea generation correlated with idea promotion ($r = 0.817$, $p < 0.001$) with idea realization ($r = 0.796$, $p < 0.001$) and with idea sustainability ($r = 0.689$, $p < 0.001$). Idea promotion correlates with idea realization ($r = 0.801$, $p < 0.001$) and with idea sustainability ($r = 0.778$, $p < 0.001$), while idea realization is correlated with idea sustainability ($r = 0.687$, $p < 0.001$).

3.4. Measurement Invariance for Gender

Having completed CFA, measurement invariance was carried out for the two genders, according to the description presented in a proceeded section. The measurement invariance is a general concern in psychometrics, and, within the gender difference psychology, it has always been a potential research question. The present study, embracing both areas, tested this hypothesis, which has not been, so far, reported, and it comprises an additional innovative element of this endeavor. Table 5 summarizes measurement invariance for gender. The chi-squared difference ($\Delta\chi^2$) test, when comparing each of the invariance models (i.e., configural, metric, scalar, and strict invariance model) with its predecessor, showed that p -values are statistically insignificant. Thus, it is concluded that the measurement invariance holds for gender, that is, there are not differences in the parameters of the factor model measuring the *teachers' innovative work behavior* (Lambriex-Schmitz et al. 2020) for the Greek population.

Table 5. Measurement Invariance for Gender.

Invariance Model	χ^2	df	CFI	TLT	RMSEA	SRMR	$\Delta\chi^2$	Δdf	p -Value
	0	0							
Configural	47,934	402	0.995	0.994	0.031	0.051	47,934	402	
Metric	496,966	424	0.998	0.998	0.019	0.056	17,626	22	0.728
Scalar	519,301	442	0.998	0.998	0.019	0.054	22,335	18	0.217
Strict	529,706	464	0.960	0.961	0.017	0.055	10,405	22	0.982

4. Discussion

4.1. Discussion and Interpretation of the Findings

The implementation of innovative processes is a prerequisite for the development of an organization. Employees play an important role in shaping the innovation culture and, thus, the study of their beliefs and perceptions regarding the cultivation of innovative work behavior (IWB) is essential. The international literature has highlighted IWB as an indispensable component for the successful realization of novelties in the workplace. To

this end, research should focus on how IWB emerges and contributes to both internal and external development. The first prerequisite in this task is to ensure valid measurements.

Scholars have argued that IWB has to involve the entire work process (De Jong 2007; Kleysen and Street 2001), because innovations are products of human activity, that could be achieved merely by systematic endeavor, where the process of IWB can be substantially subjected to immediate evaluation, taking into account the environment and the context in which the desirable behaviors are observed (Janssen 2005; Scott and Bruce 1994). A related aspect of IWB to focus on is the dynamic relationships between the members of the organization (Messmann and Mulder 2011). Thus, in pursuing to understand IWB, the collaborative activities should be examined and, in measurement procedures, all IWB dimensions should be identified and included to ensure validity issues. In this context, the current theoretical perspective suggests viewing the operation of the IWB as a process (Messmann and Mulder 2012), and rather as a complex dynamic one, since, at a collective level, it cannot be predicted merely by individual intentions of the interacting employees.

The present study assessed the psychometric properties of the Greek version of the *Innovative Work Behavior Scale* (IWBS-G) for teachers. Exploratory and confirmatory analyses disclosed the four-factor structure and supported its validity, showing that idea generation, idea promotion, idea realization and idea sustainability were the four dimensions. The absence of the fifth dimension (opportunity exploration) that was included in the initially proposed model (Lambriex-Schmitz et al. 2020) can be explained by considering cultural differences and idiocrasies of the population under study. The exploratory procedure showed that the dimensions of opportunity exploration and idea generation coincide to some extent, and this could be partially explained by closely scrutinizing the underlying processes. The exploration of opportunities ascends from the unexpected individual and collective failures and the need to immediately solve the emergent problems. The process of searching for alternative ways of working leads to idea generation, possibly making the two hypothetical dimensions indistinguishable. Regarding measurement, in the psychometric language, they share similar empirical indices, which are perceived likewise by the participants. A differentiated scale with a missing dimension is not an unusual or a problematic finding, when researchers adopt instruments from the international literature (Vaipoulou et al. 2019), since it just signifies that the measurement issues are culturally specific in social sciences, primarily when the research concerns latent variables.

The conducted analysis of measurement invariance demonstrated insignificant differences among genders, a finding that is in line with previous studies (Carmeli et al. 2006). This work adds to the IWB literature by addressing validity and measurement issues that are fundamental and a prerequisite for the future investigations and theory building.

It is pertinent to emphasize, here, that the differentiated scale does not comprise any drawbacks for the theoretical perspective. The results support the conceptual framework that has been proposed by the IWBs founders, confirming that the empirical indices implemented are associated with theoretical concepts, instigating further inquiries for establishing firm relationships between the innovative work behavior dimensions and predictive covariates and/or achievement outcomes.

Finally, some critical annotations are provided that might aid theory development in the field. As it was mentioned in previous sections, the theory is being constantly updated. An in-depth consideration of the revealed and validated dimensions and the nature of these latent constructs could suggest a conjectural orientation, that might be followed, contributing so to the ongoing discussion. One issue that plays an important role in this negotiating process is the identification of the valid empirical indices that connect the multidimensional theoretical concepts with the observed level. This is preserved by the valid TIWBS. However, it is pertinent to emphasize that TIWBS, as every tool, is a necessary but not a sufficient condition for theory development. The latter is attained via the appropriate epistemological framework and by positing the right research questions on the role and the relationships between measured constructs. Regarding the kind of dimensions under study, as latent variables, philosophically, they adhere to *dispositionalism*

rather than to *representationalism* (Schwitzgebel 2022), that is, a dynamical nature is implied. Besides, it has been explicitly stated and acknowledged that they represent sub-processes of the overall anticipated behavior. Scrutinizing each of them closely, for example the *idea generation*, one identifies that the outcome is an emergent phenomenon through the dynamic interaction of multiple, individual, and environmental components. This makes the process complex and nonlinear, requiring the proper framework to be described and understood. Analogous views can be considered for the corresponding processes of idea promotion, idea realization, and idea sustainability. To this end, *Complexity and nonlinear Dynamical System theory* (CDS) is proposed as the pertinent framework to embrace TIWB endeavors. CDS has already been introduced in social sciences (Guastello 2002; Vallacher and Nowak 2007), and particularly in workplace research (Rebelo et al. 2016; Xanthopoulos and Stamovlasis 2020), in education (Koopmans and Stamovlasis 2016; Vaiopoulou et al. 2021), as well as in innovative behavior research (Jacobsen and Guastello 2007, 2011).

The implications of the CDS consideration are that the processes operationalized by the dimensions of TIWBS should not be expected to occur sequentially, but be diffused within a network of actions, and, in addition, changes within them should be anticipated to occur also with a nonlinear fashion, posing new challenges for introducing and evaluating innovations in educational contexts.

4.2. Limitations

The limitations of the present study should also be mentioned. Specifically, the opportunity sampling and the heterogeneity of the sample as far as the unbalance size regarding the two genders, suggests that the measurement invariance results should be considered with caution. Since it is the first report for the Greek population, replications of the study need to be conducted in order to further establish the ensued structure of the four-dimensional model and the measurement invariance, while additional individual factors could also be considered, such as age, school type, and education level.

4.3. Future Research

Conclusively, a valid instrument, such as IWBS-G, can initiate and endorse new investigations, driven by research hypotheses on potential predictors of innovative work behavior. The vital role of teachers' IWB in the school framework could be explored in conjunction with other individual differences that regulate work performance, such as burnout, self-efficacy, irrational thinking, and creativity. IWB is a significant determinant of growth and development in any organization, particularly in schools, leading to a great interest in inspiring further investigations.

Author Contributions: Conceptualization, A.G., J.V. and D.S.; methodology, A.G., J.V. and D.S.; software, A.G., J.V. and D.S.; validation, A.G., J.V. and D.S.; formal analysis, A.G., J.V. and D.S.; investigation, A.G., J.V. and D.S.; resources, A.G., J.V. and D.S.; data curation, A.G., J.V. and D.S.; writing—original draft preparation, A.G., J.V. and D.S.; writing—review and editing, A.G., J.V. and D.S.; visualization, A.G., J.V. and D.S.; supervision, D.S.; project administration, D.S.; funding acquisition, A.G., J.V. and D.S. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki. It has been approved to following the protocol of the Ethics and Deontology Committee of Aristotle University (No. 39714/2022).

Informed Consent Statement: The research involved adults participating anonymously in an online survey. Before completion, an accompanying cover letter explained the confidentiality and purpose of the study, the potential objectives, and the voluntary participation. No financial incentives were provided for participating in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

The IWBS Instrument (Items with ** Retained)

- OE1. Questioning the current concepts, work processes and results with the goal to improve them.
 OE2. Discussing the possible leeway for change with colleagues.
 OE3. Questioning the effectiveness of the current way of working.
 OE4. Exchanging thoughts on recent developments or problems at work with colleagues.
 **IG5. Asking critical questions about current situations at work.
 **IG6. Suggesting improvements on expressed ideas.
 **IG7. Exchanging ideas on concrete changes at work with one's colleagues.
 **IG8. Specifying which elementary improvements can be implemented at work.
 **IG9. Discuss personal ideas for improvements with one's colleagues.
 IG10. Expressing a personal opinion of underlying problems in the workplace.
 IG11. Suggesting new ideas to solve problems in the current work situation.
 **IP12. Suggesting the new idea to key persons who are authorized to allocate resources for this new idea.
 **IP13. Convincing others of the importance of a newly developed idea or solution.
 **IP14. Promoting new ideas to the supervisor in order to gain his/her active support.
 **IP15. Promoting new ideas to colleagues in order to gain their active support.
 **IP16. Promoting the application of a new solution within one's work context.
 **IP17. Getting colleagues acquainted with the utilization of the new idea or solution.
 IP18. Making it clear to others, how a new idea can be stepwise put into practice.
 IR19. Defining criteria of success for the realization of the idea.
 **IR20. Monitoring the progress during the process of putting ideas in practice.
 **IR21. Analyzing the solutions that are found on undesired effects, when putting ideas into practice.
 **IR22. Testing solutions for unexpected problems that emerge, when putting ideas into practice.
 **IR23. Obtaining information from people who have already put the idea into practice, about possible bottlenecks during the implementation process.
 IR24. Designing operational strategies for future, comparable situations.
 **IR25. Reflecting critically on the actions you execute when putting the idea into practice.
 **IR26. Reflecting systematically on your experiences when putting the new idea into practice.
 IR27. Keeping colleagues posted about the progress of the realization of the idea.
 IS28. Discussing broader applications of the implemented idea with colleagues outside your team.
 **IS29. Participating in networks that have the innovation or new idea as a theme.
 **IS30. Initiating collaboration with other groups in the organization to apply the idea in other contexts also.
 **IS31. Initiating collaboration with other groups outside of the organization to apply the idea in other contexts also.
 **IS32. Communicating explicitly the returns of the implemented idea outside the team.
 **IS33. Visualizing the output of the implemented ideas to a broader audience.
 IS34. Exchanging information about bottlenecks with people who have already implemented the idea.
 IS35. Comparing the results of the implemented idea with the predetermined, original goals.
 IS36. Initiating quality assurance systems that support the implemented idea.
 IS37. Being aware of the steps that can be made to make a success of the implementation process.
 IS38. Communicating explicitly the returns of the implemented idea, in the team.
 IS39. Executing improvement activities to optimize the implemented solutions.
 IS40. Organizing activities for professional development for yourself and your colleagues, to continue the development of the idea.
 IS41. Actively gathering results of the implemented ideas or solutions.
 IS42. Showing initiative to anchor the new idea in existing procedures or structures of the organization.
 IS43. Discussing with colleagues how implemented ideas can be embedded more firmly in the system of the organization.
 IS44. Substantiating the implemented ideas with figures.

References

- Amabile, Teresa M., and Michael G. Pratt. 2016. The dynamic componential model of creativity and innovation in organizations: Making progress, making meaning. *Research in Organizational Behavior* 36: 157–83. [\[CrossRef\]](#)
- Andiliou, Andria, and Pricilla Karen Murphy. 2010. Examining variations among researchers' and teachers' conceptualizations of creativity: A review and synthesis of contemporary research. *Educational Research Review* 5: 201–19. [\[CrossRef\]](#)
- Arbuckle, James L. 2006. *Amos 7.0 Users' Guide*. Spring House: Amos Development Corporation.
- Atatsi, Eli Ayawo, Petru L. Curşeu, Jol Stoffers, and Ad Kil. 2022. Learn in Order to Innovate: An Exploration of Individual and Team Learning as Antecedents of Innovative Work Behaviours in Ghanaian Technical Universities. *Sustainability* 14: 4012. [\[CrossRef\]](#)
- Bransford, John, Sharon Derry, David Berliner, Karen Hammerness, and Kelly Lyn Beckett. 2005. Theories of learning and their role in teaching. In *Preparing Teachers for a Changing World*. Edited by Linda Darling-Hammond and John Bransford. San Francisco: Jossey-Bass, pp. 40–87.
- Carmeli, Abraham, Ravit Meitar, and Jacob Weisberg. 2006. Self-leadership skills and innovative behavior at work. *International Journal of Manpower* 27: 75–90. [\[CrossRef\]](#)
- Chang, Cheng-Ping, Hao-Wan Chuang, and Lynne Bennington. 2011. Organizational climate for innovation and creative teaching in urban and rural schools. *Quality and Quantity* 45: 935–51. [\[CrossRef\]](#)
- Chen, Fang Fang. 2007. Sensitivity of goodness of fit indexes to lack of measurement invariance. *Structural Equation Modeling* 14: 464–504. [\[CrossRef\]](#)
- Cheung, Gordon W., and Roger B. Rensvold. 2002. Structural Equation Modeling: A Evaluating Goodness-of-Fit Indexes for Testing Measurement Invariance. *Structural Equation Modeling: A Multidisciplinary Journal* 9: 233–55. [\[CrossRef\]](#)
- De Jong, Jeroen P. J. 2007. Individual Innovation: The Connection between Leadership and Employees' Innovative Work Behavior. Ph.D. thesis, EIM, Zoetermeer, The Netherlands.
- De Jong, Jeroen, and Deanne Den Hartog. 2010. Measuring innovative work behaviour. *Creativity and Innovation Management* 19: 23–36. [\[CrossRef\]](#)
- Douglas, Susan P., and C. Samuel Craig. 2006. Collaborative and Iterative Translation: An Alternative Approach to Instrument Translation. *SSRN Electronic Journal* 15: 30–43. [\[CrossRef\]](#)
- Fan, Chuanhao, Mingyue Hu, Ziheng Shanguan, Chunlan Ye, Shuting Yan, and Mark Yaolin Wang. 2021. The Drivers of Employees' Active Innovative Behaviour in Chinese High-Tech Enterprises. *Sustainability* 13: 6032. [\[CrossRef\]](#)
- Fullan, Michael. 2007. *The New Meaning of Educational Change*, 4th ed. New York: Teachers College Press.
- Gannaway, Deanne, Tilly Hinton, Bianca Berry, and Kaitlin Moore. 2013. Cultivating change: Disseminating innovation in higher education teaching and learning. *Innovations in Education and Teaching International* 50: 410–21. [\[CrossRef\]](#)
- Geiser, Christian. 2013. *Data Analysis with Mplus*. New York: Guilford Press.
- Gkontelos, Angelos, Julie Vaiopoulou, and Dimitrios Stamovlasis. 2021. Teachers' Irrational Belief Scale: Psychometric Properties of the Greek Version and Measurement Invariance across Genders. *Behavioral Sciences* 11: 160. [\[CrossRef\]](#) [\[PubMed\]](#)
- Guastello, Stephen J. 2002. *Managing Emergent Phenomena: Nonlinear Dynamics in Work Organizations*. New York: Psychology Press.
- Haqae, Adnan ul, and Fred A. Yamoah. 2021. The Role of Ethical Leadership in Managing Occupational Stress to Promote Innovative Work Behaviour: A Cross-Cultural Management Perspective. *Sustainability* 13: 9608. [\[CrossRef\]](#)
- Işık, Cem, Ekrem Aydın, Tarik Dogru, Abdul Rehman, Rafael Alvarado, Munir Ahmad, and Muhammad Irfan. 2021. The Nexus between Team Culture, Innovative Work Behaviour and Tacit Knowledge Sharing: Theory and Evidence. *Sustainability* 13: 4333. [\[CrossRef\]](#)
- Jacobsen, Joseph J., and Stephen J. Guastello. 2007. Nonlinear models for the adoption and diffusion of innovations for industrial energy conservation. *Nonlinear Dynamics, Psychology, and Life Sciences* 11: 499–520. [\[PubMed\]](#)
- Jacobsen, Joseph J., and Stephen J. Guastello. 2011. Diffusion models for innovation: S-curves, networks, power laws, catastrophes, and entropy. *Nonlinear Dynamics, Psychology, and Life Sciences* 15: 307–33.
- Janssen, Onne. 2000. Job demands, perceptions of effort-reward fairness and innovative work behavior. *Journal of Occupational and Organizational Psychology* 73: 287–302. [\[CrossRef\]](#)
- Janssen, Onne. 2005. The joint impact of perceived influence and supervisor supportiveness on employee innovative behaviour. *Journal of Occupational and Organizational Psychology* 78: 573–79. [\[CrossRef\]](#)
- Kanter, Rosabeth Moss. 1988. When a thousand flowers bloom: Structural, collective, and social conditions for innovation in organizations. In *Research in Organizational Behavior*. Edited by Barry M. Staw and Larry L. Cummings. Greenwich: JAI Press, pp. 169–211.
- King, Nigel, and Neil Anderson. 2002. *Managing Innovation and Change: A Critical Guide for Organizations*. London: Thomson.
- Kleysen, Robert F., and Christopher T. Street. 2001. Toward a multi-dimensional measure of individual innovative behavior. *Journal of Intellectual Capital* 2: 284–96. [\[CrossRef\]](#)
- Koopmans, Matthijs, and Dimitrios Stamovlasis. 2016. Introduction to education as a complex dynamical system. In *Complex Dynamical Systems in Education: Concepts, Methods and Applications*. Cham: Springer International Publishing, pp. 1–7.
- Lambriex-Schmitz, Peggy, Marcel R. Van der Klink, Simon Beusaert, Monique Bijker, and Mien Segers. 2020. Towards successful innovations in education: Development and validation of a multi-dimensional Innovative Work Behaviour Instrument. *Vocations and Learning* 13: 313–40. [\[CrossRef\]](#)

- Loh, Lawrence C., Stacey R. Friedman, and William P. Burdick. 2013. Factors promoting sustainability of education innovations: A comparison of faculty perceptions and existing frameworks. *Education for Health* 26: 32–38. [\[CrossRef\]](#) [\[PubMed\]](#)
- Loogma, Krista, Jüri Kruusvall, and Meril Ümarik. 2012. E-learning as innovation: Exploring innovativeness of the VET teachers' community in Estonia. *Computers and Education* 58: 808–17. [\[CrossRef\]](#)
- Messmann, Gerhard, and Regina H. Mulder. 2011. Innovative Work Behaviour in Vocational Colleges: Understanding How and Why Innovations Are Developed. *Vocations and Learning* 4: 63–84. [\[CrossRef\]](#)
- Messmann, Gerhard, and Regina H. Mulder. 2012. Development of a measurement instrument for innovative work behaviour as a dynamic and context-bound construct. *Human Resource Development International* 15: 43–59. [\[CrossRef\]](#)
- Messmann, Gerhard, and Regina H. Mulder. 2015. Reflection as a facilitator of teachers' innovative work behaviour. *International Journal of Training and Development* 19: 125–37. [\[CrossRef\]](#)
- Messmann, Gerhard, Regina H. Mulder, and Tuire Palonen. 2018. Vocational education teachers' personal network at school as a resource for innovative work behaviour. *Journal of Workplace Learning* 30: 174–85. [\[CrossRef\]](#)
- Opfer, V. Darleen, David G. Pedder, and Zsolt Lavicza. 2011. The role of teachers' orientation to learning in professional development and change: A national study of teachers in England. *Teaching and Teacher Education* 27: 443–53. [\[CrossRef\]](#)
- Organisation for Economic Cooperation and Development. 2005. *Teachers Matter: Attracting, Developing, and Retaining Effective Teachers*. Paris: Organisation for Economic Cooperation and Development.
- Rebelo, Teresa, Dimitrios Stamovlasis, Paulo Renato Lourenço, Isabel Dimas, and Margarida Pinheiro. 2016. A cusp catastrophe model for team learning, team potency and team culture. *Nonlinear Dynamics, Psychology and Life Sciences* 20: 537–63.
- Schwitzgebel, Eric. 2022. The Nature of Belief from a Philosophical Perspective, with Theoretical and Methodological Implications for Psychology and Cognitive Science. *Frontiers in Psychology*, 4146. [\[CrossRef\]](#)
- Scott, Susanne G., and Reginald A. Bruce. 1994. Determinants of innovative behavior: A path model of individual innovation in the workplace. *Academy of Management Journal* 37: 580–607. [\[CrossRef\]](#)
- Thurlings, Marieke, Arnoud T. Evers, and Marjan Vermeulen. 2015. Toward a Model of Explaining Teachers' Innovative Behavior: A Literature Review. *Review of Educational Research* 85: 430–71. [\[CrossRef\]](#)
- Tuominen, Tiina, and Marja Toivonen. 2011. Studying innovation and change activities in KIBS through the lens of innovative behaviour. *International Journal of Innovation Management* 15: 393–422. [\[CrossRef\]](#)
- Vaiopoulou, Julie, Ioanna Papavassiliou, and Dimitrios Stamovlasis. 2019. Career decision-making difficulties and decision statuses among Greek student teachers. *Hellenic Journal of Psychology* 16: 74–94.
- Vaiopoulou, Julie, Themistocles Tsikalas, Dimitrios Stamovlasis, and George Papageorgiou. 2021. Nonlinear dynamic effects of convergent and divergent thinking in conceptual change process: Empirical evidence from primary education. *Nonlinear Dynamics, Psychology, and Life Sciences* 25: 335–55.
- Vallacher, Robin R., and Andrzej Nowak. 2007. Dynamical social psychology: On complexity and coordination in interpersonal relations. In *Complexity and Leadership, Volume 1: Conceptual Foundations*. Edited by Mary Uhl-Bien and Russ Marion. Charlotte: Information Age Publishers, pp. 49–81.
- Van de Ven, Andrew H. 1986. Central Problems in the Management of Innovation. *Management Science* 32: 590–607. [\[CrossRef\]](#)
- Wagenmakers, Eric-Jan, Ruud Wetzels, Denny Borsboom, Han L. J. van der Maas, and Rogier A. Kievit. 2012. An Agenda for Purely Confirmatory Research. *Perspectives on Psychological Science* 7: 632–38. [\[CrossRef\]](#)
- West, Michael A., and James L. Farr. 1990. *Innovation and Creativity at Work: Psychological and Organizational Strategies*. Chichester: Wiley.
- Xanthopoulou, Despoina, and Dimitrios Stamovlasis. 2020. Job Crafting and Work Engagement: Probing Non-linear Effects with Catastrophe Theory Models. *Nonlinear Dynamics, Psychology, and Life Sciences* 23: 305–26.