Contents lists available at Science-Gate

International Journal of Advanced and Applied Sciences

Journal homepage: http://www.science-gate.com/IJAAS.html

Stakeholders' perceptions of the impact of accreditation of science curricula of higher education institutions

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ARTICLE INFO

Article history:
Received 23 December 2022
Received in revised form
23 April 2023
Accepted 9 May 2023

Keywords:
Accreditation
Accreditation impact
Higher education
Quality assurance
Science education

ABSTRACT

Despite being a relatively new process in higher education institutions (HEIs), accreditation has become an indispensable requirement for universities to remain competitive. Its significance lies in its crucial functions, such as evaluating the quality of academic or degree programs, fostering a culture of continuous improvement, establishing criteria for professional certification, and more. Nevertheless, the decision to seek accreditation remains voluntary for institutions, leading to a situation where not all of them pursue it due to various factors, including the perceptions of stakeholders. Therefore, this study aims to investigate stakeholders' perspectives on the impacts of accrediting science curricular programs in higher education institutions located in Central Visayas, Philippines. To achieve this goal, a mixed-methods research design was employed, and a survey was administered to stakeholders, including managers, faculty, alumni, and students, from four HEIs. The survey results were utilized to develop and validate a quantitative scale, revealing three distinct areas of impact associated with accreditation: Curricular, institutional, and societal. The outcomes of the survey indicated that stakeholders from the four HEIs perceived these impact areas positively, suggesting a willingness to pursue accreditation voluntarily if the need arises. Nonetheless, it is essential to emphasize that the recommendations arising from these accreditation processes should be diligently considered and adhered to. This study's findings may suggest that stakeholders developed positive perceptions regarding the impacts of program accreditation based on the level of compliance displayed by institutions with the recommendations made by accrediting bodies.

1. Introduction

The quality of science curricular degree programs offered in educational institutions plays a pivotal role in shaping the scientific and technological literacy of a nation's workforce. This, in turn, exerts a significant influence on the trajectory of the nation's economy (Drori, 2000). Moreover, scientific literacy, denoting the possession of knowledge and comprehension of scientific principles and processes, constitutes an essential prerequisite for informed decision-making and active engagement in matters pertaining to civic and cultural affairs (Dani, 2009). Currently, the significance of science education has gained heightened prominence. This was evident during the emergence of the COVID-19 pandemic, where a substantial portion of the public, who chose to disregard scientific expertise regarding the cruciality of vaccines, masks, and other health safety protocols in mitigating the spread of the virus, underscored the criticality of such education (Alberts, 2022). Their growing reactions denying the importance of scientific knowledge have served as a reminder of reactivating global commitment to improving scientific literacy by providing quality science education (Valladares, 2021). Contemporary societies need to appreciate the importance and draw upon scientific knowledge and practices in a broad range of personal, social, and socio-scientific issues, not just the pandemic but even with the proliferation of fake news concerning techno-scientific risks to which we are exposed to every day (Fortus et al., 2022).

Recognizing the importance of science curricular programs, the call for reform efforts in the discipline

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https://doi.org/10.21833/ijaas.2023.07.001
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has been ongoing to attract young individuals to pursue science-related careers and improve the quality of the discipline among nations. Among these efforts include implementing professional development programs in the context of science education reforms by developing teachers' practical knowledge or their knowledge and beliefs about their teaching practice (Van Driel et al., 2001). There is also the active participation of distinguished scientists, particularly those from academic research communities, in improving curricular standards (Atkin and Black, 2007). In the Philippines, an example of recent efforts to improve science curricular degree programs in the country is sending science teachers abroad to obtain full scholarships for postgraduate studies. Meanwhile, there are recommendations for (a) increasing educational attainment opportunities and access to resources, (b) improving student achievement in the discipline, (c) strengthening the preparation or training of pre- and in-service science teachers, and (d) expanding educational research and collaboration initiatives to improve science education (Faisal and Martin, 2019).

While all the aforementioned reforms efforts are tangible and recommendations are feasible in improving the quality of science curricular programs, accreditation of these programs is never put as premium consideration. Although accreditation is relatively new and a voluntary process in higher education institutions (HEIs), it has become a necessity among universities for them to stay in the game (Zhao and Ferran, 2016). It is a process of evaluating or reviewing whether an institution or a degree program meets the threshold standards and qualifies for certain status (Kis, 2005; Ryan, 2015; Seyfried and Pohlenz, 2018). The US Department of Education provides a comprehensive delineation of the objectives of accreditation, which encompass the following (Hegji, 2017):

- Evaluation of the quality of academic or degree programs at HEIs,
- Establishment of a culture of continuous or sustainable enhancement of academic excellence, thereby encouraging institutions of learning to elevate their standards,
- Facilitation of active engagement of faculty and staff in the process of institutional evaluation and strategic planning, and
- Formulation of criteria pertaining to professional certification, licensure, and the enhancement of course offerings.

There are two genres of accreditation according to scope: Institutional and specialized. Institutional accreditation assesses the educational capabilities of universities or colleges if they meet certain accreditation standards and rigorous evaluation criteria of educational quality (Ibrahim, 2014; Dashti-Kalantar et al., 2019). Obtaining and sustaining institutional accreditation are important as the basis of assurance to the sphere of the educational community, general public, and other organizations recruiting university graduates for the job position, encouraging institutional quality improvement, and creating a culture of excellence (Sywelem and Witte, 2009). Meanwhile, program accreditation assesses specific programs, departments, or schools that make up the institution. Its scope focuses on a narrower set of standards, particular to degree programs under consideration (e.g., medicine, laws, teacher education, and business) (Ibrahim, 2014).

However, applications for accreditation are voluntary in some countries (Amourgis et al., 2009; Sywelem and Witte, 2009). In this regard, not all institutions submit for accreditation, or programs are applied for accreditation as influenced by an array of factors, including stakeholders' perceptions towards it. For many of them, the rapidity and impact of the process are perceived more as bureaucratic burdens and illegitimate interference from central management rather than opportunities. Thus, accreditation has encountered resistance (Seyfried and Pohlenz, 2018). It is also criticized for its highly demanding financial and human resources (Al-Eyadhy and Alenezi, 2021). In this regard, one method to ensure that when an institution or degree program applies for accreditation and stakeholders do not encounter resistance or criticisms among stakeholders is through examining their initial perceptions towards it. In other words, people involved in the process should have positive perceptions towards accreditation. Thus, to help improve the quality of science curricular undergraduate degree programs, these should undergo program accreditation but with the assurance that stakeholders who will participate in the process perceive it positively with regard to its impact. Toward this aim, this study aims to determine stakeholders' perceptions on the impacts of accreditation of science curricular degree programs of higher education institutions in Central Visayas, Philippines. Specifically, it seeks to address the following questions:

1. What instrument can be developed to assess stakeholders' perceptions regarding the impacts of accreditation of science degree programs?
2. What are the perceptions of stakeholders concerning the curricular, institutional, and societal impacts of accreditation?
3. Are there significant differences in stakeholders' perceptions of the impacts of accreditation when grouped according to HEI?

2. Methodology

This research looked into stakeholders' perceptions on the impacts of accreditation of science degree programs of four HEIs. Towards this aim, mixed-methods research designs were employed. Initially, a mixed-methods sequential exploratory design was employed to develop a valid and reliable scale that assesses perceptions of the impacts of accreditation. Subsequently, a mixed-methods sequential explanatory design was used to look into and compare the perceptions of stakeholders from four HEIs about the impacts of accreditation.

The participants of this study were 278 stakeholders from four selected HEIs in Central Visayas in the Philippines. However, only 222 of them disclosed the HEI with which they are affiliated, and the rest preferred to keep it confidential. Nonetheless, the responses of these stakeholders whose affiliations were not disclosed were still used for scale development but not when comparing perceived impacts on the accreditation of science degree programs of the four HEIs by the stakeholders who disclosed the HEI where they belong. These stakeholders were identified as alumni and students of any of the science curricular degree programs, science faculty, and university managers. Table 1 shows the distribution of these participants when grouped according to sex, age, type of stakeholder, and HEI of affiliation.

Table 1: Distribution of participants according to personal and professional profiles (n=278)

Variable	Category	Frequency (n)	Percentage (%)
Sex	Male	109	39.20
	Female	169	60.80
Age (years)	17 – 22	141	50.72
	23 – 28	51	18.35
	29 – 34	22	7.91
	35 – 40	15	5.40
	41 – 46	17	6.11
	47 – 52	17	6.11
	53 and above	15	5.40
Type of stakeholder	Student	145	43.17
	Alumni	43	20.86
	Faculty	62	25.90
	Managers	28	10.07
HEI	HEI 1	60	21.58
	HEI 2	34	12.23
	HEI 3	90	32.37
	HEI 4	38	13.67
	Prefer not to disclose	56	20.14

As reflected in Table 1, almost two-thirds of the participating stakeholders were females (60.80%). In the case of age distribution, 50.72% had ages ranging from 17 to 22 years old, while the least number of participants were with age ranges 35 to 40 and 53 years old and above (5.40%). These ranges of age are usually students and university managers. Hence, 43.17% account for student participants while the university managers are least represented, considering that this study was limited only to four HEIs. The HEIs with the greatest number of participating stakeholders is HEI3. All these HEIs are state universities with diverse science curricular degree program offerings.

The development and validation of the instrument to gather the data were based on Hinkin's (1998) recommendations, composed of the following steps: (1st) item generation, (2nd) questionnaire administration, (3rd) initial item reduction, (4th) confirmatory factor analysis, (5th) convergent/divergent validity, and (6th) replication. The last step is only performed when the developed instrument will be used in future studies that will need addition, deletion, or modification of items. In the present study, the first five steps were only performed.

Item generation: The items were generated through an inductive approach characterized by asking a sample of stakeholders with regard to their perceived impacts of accreditation of science curricular programs. The stakeholders were composed of two from each category: Top managers, middle managers, science faculty, science alumni, and science undergraduate students. Their responses were eventually developed into items resulting in 60 items and then classified by content analysis. The content analysis used keywords to group the items generated. While this study initially aimed to look into the impacts of program accreditations relating to science curricular programs, the content analysis of stakeholders' responses revealed that specialized accreditation impacts the curricula itself and also the institutions and society. In this regard, the constructs identified about the impacts of accreditation are on the curriculum itself, the institution, and society.

After the items were generated and categorized, these were subjected to content validity assessment to determine the items that needed to be retained, deleted, and modified on the basis of their Aiken Validity Index (AVI). The AVIs were obtained by asking three experts to rate each item in the instrument with respect to its relevance in the construct using the following scale: (1) irrelevant, (2) needs modification, (3) relevant, and (4) strongly relevant. Those items that met the heuristic guideline for AVI higher than 0.78 are classified as excellently representing the construct under examination (Terwee et al., 2007). Thus, these items are retained and are reflected in Table 2. Those items with AVIs lower than 0.78 are no longer reflected in Table 1. Subsequently, the items were assigned for scaling using a five-point Likert scale with 5 as strongly agree, 4 as agree, 3 as neutral, 2 as disagree, and 1 as strongly agree.

Questionnaire administration: In this stage, the instrument was administered purposively to a sample representative of the actual population of interest which were stakeholders mentioned in the research participants section. There were 278 of them affiliated with any of the four HEIs participated in the survey. The detailed process of this stage is reflected in the data-gathering section.

Initial item reduction: The data obtained from 278 stakeholders were used to perform exploratory factor analysis (EFA) as a means to reduce the number of items initially. EFA creates a more parsimonious representation of the original number of items and provides evidence of construct validity. In other words, it explores the structure of the underlying relationships between the items in the scale and determines whether subscales or factors could be created. However, EFA could not proceed if the sample size was not adequate. In this regard, two preliminary tests were performed: Bartlett's test of sphericity (BTS) and Kaiser–Meyer–Olkin (KMO) Measure of Sampling Adequacy. To justify factor analysis, the resulting BTS value should be significant ($p<0.05$), and the resulting KMO value should exceed 0.60 (Tabachnick and Fidell, 2019). Then, Principal Component Analysis (PCA) using Varimax rotation and scree plots was utilized to extract the factors. Only factors with Eigen values >1.0 and items with criterion loading >0.5 and communality values >0.6 were included based on the recommendation of Taherdoost et al. (2014). Next, the percentage of the total item variance that is explained is also examined, of which 60% served as the minimum target. Finally, Cronbach's alpha was determined as a measure of the internal consistency of the scale and its factors, of which 0.7 was the target (Tavakol and Dennick, 2011).

Confirmatory factor analysis (CFA): The CFA assessed the quality of the factor structure resulting from EFA by statistically testing the significance of the overall model and of item loadings on factors. This factor analysis began with examining the estimation results through the *t*-value and standardized factor loading (SFL) of each item, of which the acceptable values are respectively ≥1.96 and ≥0.7 (Hair et al., 2014; Kline, 2016). Once these values were achieved, the instrument was available for examining overall model data fit using several goodness of fit indices (GFIs) with their corresponding threshold values to have a good model data fit, namely: Comparative Fit Index (CFI) (>0.80) (Garson, 2006), Tucker–Lewis Index (TLI) or Non-Normed Fit Index (NNFI) (>0.85) (Sharma et al., 2005), Standardized Root Mean Squared Residual (SRMR) (≤0.08) (Hu and Bentler, 1999), Root Mean Square Error of Approximation (RMSEA) (<.08) (Kenny et al., 2015), and Chi-square/df Ratio <3.0 (Hair et al., 2009).

Convergent and divergent validation: The evidence for the convergent validity of the developed instrument was SFL and composite reliability (CR). The resulting values are considered good if ≥0.7 for both measures (Gefen et al., 2000). Meanwhile, the evidence for the discriminant validity of the instrument is the average variance extracted (AVE) which should be > 0.5 (Fornell and Larcker, 1981).

To begin with the data collection process, the researcher created a Google Form to do a web-based survey. Then, the link associated with the survey form was individually sent to the target stakeholders. The form was accepting responses from October–December 2021 to give ample amount of time for the participants to respond to the survey. Enclosed in the survey form was the preliminary portion stating that their participation in the study was entirely voluntary with no incentives, and they could withdraw without penalty or loss on their end. The survey had three parts: (a) directions, (b) demographic and professional profiling, and (c) perceived impacts of accreditation of science degree programs. It took approximately 15 minutes for each stakeholder to complete the survey.

Towards the end of the survey, they were assured about the confidentiality and anonymity of their responses. These responses were generated as an MS Excel spreadsheet, and there was no statistical correction made before analyzing the data. 278 responses were used to validate the instrument while 222 responses were used to examine perceptions about the impacts of accreditation because 56 preferred not to disclose the HEI where they are affiliated. Finally, four stakeholders per HEI were invited for focus group interviews to substantiate their quantitative survey responses. Table 2 shows the profiles of stakeholders involved in the FGD.

Table 2: Stakeholders involved in focus group discussion

HEI	Type of stakeholder	Sex	Participant code
HEI1	Student	Male	HEI1 – StudM
	Alumni	Female	HEI1 – AlumF
	Faculty	Female	HEI1 – FacF
	Manager	Male	HEI1 – ManM
HEI2	Student	Female	HEI2 – StudF
	Alumni	Female	HEI2 – AlumF
	Faculty	Male	HEI2 – FacM
	Manager	Female	HEI2 – ManF
HEI3	Student	Male	HEI3 – StudM
	Alumni	Female	HEI3 – AlumF
	Faculty	Female	HEI3 – FacF
	Manager	Female	HEI3 – ManF
HEI4	Student	Female	HEI4 – StudF
	Alumni	Female	HEI4 – AlumF
	Faculty	Female	HEI4 – FacF
	Manager	Female	HEI4 – ManF

This data analysis section is for the descriptive and inferential tests of 222 responses of stakeholders with their HEIs indicated in their responses. For descriptive tests, the mean and standard deviation per item was computed in each HEI to identify which perception area is low or high. On the other hand, Analysis of Variance (ANOVA) was performed for the inferential test to compare stakeholders' perceived impacts of accreditation from the four HEIs. Finally, the narrative accounts from FGDs were transcribed, coded, and thematized whether the curricular, institutional, or societal impact of accreditation. These were critically reviewed and analyzed to support the quantitative results.

3. Results and discussion

3.1. Assessing stakeholders' accreditation perceptions: Psychometric properties

Accreditation is identified as one of the measures in a quality assurance system that works to sustain and advance the quality of higher education institutions (Sywelem and Witte, 2009). In the same manner, one method of improving the quality of science curricular programs is through program accreditation. However, the success of accreditation rests on the perceived impacts of stakeholders as the process is voluntary and must be requested by educational institutions (Hegji, 2017). This means that stakeholders of a certain HEI need to have desirable perceptions with regard to the impacts of accreditation so that they may request to undergo the process.

However, there is one limitation to measuring stakeholders' perceptions of accreditation's impacts, particularly in science curricular degree programs. That is the lack of a unifying framework to do the process. There may be existing studies with the same objective (e.g., Aldoseri and Sharadgah (2021) and Perveen et al. (2021)), but their proposed scales are not specific to the accreditation of science curricular programs and these do not detail the development and validation steps. In this regard, the present study initially develops and validates a scale that examines stakeholders' perceptions on the impacts of accreditation to science curricular programs. While accreditation is categorized into two types: Program and institutional (Sywelem and Witte, 2009; Pham et al., 2020), these are exactly the same themes that stakeholders perceived as the impacts of accreditation. There is a novel impact area, however, which is not identified in the previous scales because of the emergence of societal impacts of accreditation from stakeholders' perspectives. This has led to the testing of the psychometric properties of a three-factor scale.

To begin evaluating the psychometric properties of the scale, all items were subjected to content validation. This process rejected nine items for the curricular impacts, eight items for institutional impacts, and 12 items for societal impacts of accreditation because these items failed to reach the heuristic guidelines proposed by Terwee et al. (2007). An item with excellent content validity should have an AVI of 0.78 to 1.00. Consequently, only 31 items were available for EFA after content validation. Subsequently, the sample size was evaluated whether adequate after the scale was administered to 278 stakeholders. The KMO statistic resulted in 0.970 while the BTS was significant (p<0.000). In this regard, both results suggest that the scale was available for EFA. Table 3 shows that the EFA of the 31-item scale retained all the items in its original assignment. The first factor or group of items are those assigned to the curricular impacts of accreditation which accounted for 27.741% of the total variance with an eigenvalue of 19.828 and loaded 11 items. The criterion loadings and communality values of items in this factor, respectively, range from 0.701 to 0.826 and from 0.684 to 0.818. The second factor or group of items are those assigned to societal impacts of accreditation which accounted for 25.751% of the total variance with an eigenvalue of 2.124 and loaded eight items. The criterion loadings and communality values of items in this factor, respectively, range from 0.704 to 0.758 and from 0.683 to 0.791.

Table 3: Content validity, construct validity, and reliability of the scale

Constructs	Item code	Aiken validity index	Communality values	Factor loading (EFA)		
				Factor 1	Factor 2	Factor 3
Curricular	Cur2	0.78	0.736	0.791		
	Cur3	0.89	0.744	0.801		
	Cur5	0.78	0.757	0.761		
	Cur8	0.78	0.818	0.826		
	Cur9	0.89	0.684	0.707		
	Cur12	0.78	0.748	0.756		
	Cur15	0.89	0.758	0.716		
	Cur16	0.89	0.741	0.736		
	Cur18	1.00	0.802	0.772		
	Cur19	0.78	0.770	0.701		
	Cur20	1.00	0.772	0.737		
Institutional	Ins1	0.78	0.710			0.565
	Ins2	0.89	0.686			0.580
	Ins3	1.00	0.683			0.567
	Ins4	0.89	0.741			0.730
	Ins5	1.00	0.791			0.686
	Ins6	0.89	0.782			0.640
	Ins7	0.78	0.677			0.534
	Ins13	1.00	0.711			0.572
	Ins14	0.78	0.685			0.542
	Ins15	0.89	0.726			0.578
	Ins16	0.78	0.733			0.548
	Ins17	1.00	0.760			0.634
Societal	Soc2	1.00	0.721		0.714	
	Soc3	0.78	0.705		0.715	
	Soc4	0.89	0.735		0.720	
	Soc6	1.00	0.729		0.717	
	Soc7	0.78	0.716		0.711	
	Soc10	0.78	0.718		0.704	
	Soc18	1.00	0.706		0.748	
	Soc19	0.89	0.731		0.758	
Total Eigenvalue				19.828	2.124	1.000
% of Variance Explained				27.741	25.751	19.977
Number of Items				11	8	12
Cronbach's Alpha				0.966	0.964	0.945

Overall α=.981, Kaiser-Meyer-Olkin measure of sampling adequacy=.970, Bartlett's test of sphericity=9,334.487, p<.000, df=465, Total variance=73.469%

Finally, the third factor or group of items are those assigned to institutional impacts of accreditation which accounted for 19.997% of the total variance with an eigenvalue of 1.000 and loaded 12 items. The criterion loadings and communality values of items in this factor, respectively, range from 0.534 to 0.730 and from 0.705 to 0.735. Overall, the total percentage of variance explained by these three factors is 73.469%. The scale reliability as determined by Cronbach's alpha ranges from 0.945 to 0.966 within subscales and 0.981 for the entire scale, indicating that the scale has ideal stability.

Subsequently, CFA was performed which results are shown in Table 4. The *t*-values and standardized factor loading (SFL) of each item were initially examined. The observed minimum *t*-value is 15.175 (Soc18) and the maximum is 21.689 (Cur18) while the recorded minimum SFL is 0.783 and the maximum is 0.891. In other words, there is no offending estimate observed in the factor load estimation results, and justifies the analysis of the overall model data fit of the scale. There were five GFIs evaluated to determine the overall model fit of the CFA results which resulting values are indicated beside CFI (0.916), TLI (0.909), SRMR (0.0338), RMSEA (0.081), and Chi-square/df ratio (2.810). These fit indices suggest an acceptable fit to the three-factor model.

Table 4: Convergent and discriminant validity of the scale

Constructs	Item code	Standardized factor loading (CFA)	Average variance extracted	Composite reliability
Curricular	Cur2	0.807	0.722346	0.966201
	Cur3	0.813		
	Cur5	0.852		
	Cur8	0.872		
	Cur9	0.806		
	Cur12	0.848		
	Cur15	0.855		
	Cur16	0.852		
	Cur18	0.891		
	Cur19	0.873		
	Cur20	0.875		
Institutional	Ins1	0.827	0.694101	0.964544
	Ins2	0.809		
	Ins3	0.813		
	Ins4	0.783		
	Ins5	0.863		
	Ins6	0.872		
	Ins7	0.816		
	Ins13	0.831		
	Ins14	0.822		
	Ins15	0.846		
	Ins16	0.853		
	Ins17	0.858		
Societal	Soc2	0.828	0.685158	0.94565
	Soc3	0.83		
	Soc4	0.852		
	Soc6	0.847		
	Soc7	0.83		
	Soc10	0.837		
	Soc18	0.784		
	Soc19	0.812		

Model Fit-indices (Cmin/df=2.810; TLI=0.909; CFI=0.916; RMSEA=0.081; SRMR=0.0338)

After the content validity, reliability, and construct validity of the scale were established, convergent and discriminant validity was determined. For convergent validity, it can be noted that the SFLs of all items are above 0.7 with 0.783 as the minimum. Another evidence of convergent validity is the resulting composite reliability values ranging from 0.94565 to 0.966201 which indicate higher inherent consistency of all items. For the discriminant validity, all AVEs are greater than 0.5 ranging from 0.685158 to 0.722346. In conclusion, the psychometric tests reveal that the scale developed is valid and reliable to assess stakeholders' perceived impacts of accreditation of science curricular degree programs.

3.2. Stakeholders' perceptions of science curriculum accreditation

The levels of perceptions among stakeholders from four HEIS on the curricular, institutional, and societal impacts of the accreditation of science curricular degree programs are reflected in Table 5. Generally, stakeholders across four HEIs have between agree and strongly agree responses of the items under curricular impacts of accreditation. There is a strong consensus, as evidenced by means above 4.20, among these stakeholders from all HEIs that accreditation of science degree programs does the following: (a) identifies curricular areas needing revision and (b) improves the quality of instruction. The strong agreement of stakeholders on these curricular impacts indicates the consistency of results from previous studies (e.g., Garfolo and L'Huillier (2015) and Kumar et al. (2020)) that one of the outcomes of accreditation, regardless of program, is reporting the strengths of it or areas needing improvement and, in turn, recommending improvement of students' learning process.

Three HEIs from among the four perceived the following impacts of accreditation with a strongly agree adjectival rating, meaning one from any of them has a rating below this. These curricular impacts pertained are (a) gaining a better understanding of the science curriculum, (b) prompting improvements to classroom practice, (c) promoting systemic and regular evaluation of the science curriculum, (d) raising academic expectations for students, and (e) indicating that the science curricular programs meet the quality set by the accreditation organization.

Table 5: Perceived curricular, institutional, and societal impacts of the accreditation of science degree programs by the participants when grouped according to the higher education institution (n=222)

Item code	Item statement	Mean±SD			
		HEI 1 (n=60)	HEI 2 (n=34)	HEI 3 (n=90)	HEI 4 (n=38)
	Curricular impacts				
Cur2	Gains a better deeper understanding of the science curriculum	4.45 ± 0.70	4.18 ± 1.27	4.34 ± 0.98	4.24 ± 0.94
Cur3	Identifies science curricular areas needing revision	4.38 ± 0.74	4.29 ± 1.14	4.24 ± 0.89	4.34 ± 0.94
Cur5	Leads to the use of student data in informing teaching-learning practices	4.35 ± 0.71	4.12 ± 1.15	4.17 ± 0.89	4.16 ± 0.97
Cur8	Prompts improvements to classroom teaching practices	4.35 ± 0.71	4.18 ± 1.14	4.27 ± 0.95	4.34 ± 0.94
Cur9	Addresses the learning differences among students	4.12 ± 0.78	4.03 ± 1.03	4.07 ± 0.91	4.08 ± 0.91
Cur12	Promotes a systemic and regular evaluation of the science curriculum	4.27 ± 0.73	4.32 ± 1.15	4.31 ± 0.86	4.19 ± 0.94
Cur15	Raises academic expectations for students	4.27 ± 0.73	4.35 ± 1.01	4.33 ± 0.82	4.16 ± 0.89
Cur16	Ensures faculty to use highly effective science teaching techniques	4.25 ± 0.84	4.35 ± 0.98	4.22 ± 0.88	4.16 ± 0.95
Cur18	Sustains in improving knowledge-based science education	4.19 ± 0.68	4.18 ± 1.14	4.24 ± 0.85	4.34 ± 0.94
Cur19	Indicates that the science curricular programs meet the quality set by the accreditation organization	4.22 ± 0.72	4.44 ± 0.99	4.23 ± 0.89	4.18 ± 0.93
Cur20	Improves the quality of science instruction	4.32 ± 0.77	4.32 ± 1.01	4.21 ± 0.87	4.29 ± 0.93
	Mean±SD	4.29 ± 0.59	4.45 ± 1.00	4.24 ± 0.78	4.23 ± 0.86
	Institutional impacts				
Ins1	Provides institutional growth through continuing self and peer evaluation	4.20 ± 0.83	4.44 ± 0.79	4.14 ± 0.84	4.24 ± 0.75
Ins2	Identifies weaknesses in school resources	4.23 ± 0.89	4.44 ± 0.82	4.24 ± 0.85	4.21 ± 0.78
Ins3	Improves school management	4.33 ± 0.80	4.41 ± 0.82	4.29 ± 0.88	4.18 ± 0.83
Ins4	Affects school improvement in the long-term planning of the school	4.12 ± 0.83	4.44 ± 0.86	4.17 ± 0.91	4.03 ± 0.90
Ins5	Provides continuous intensification of actions that Project quality in its educational products and services	4.15 ± 0.76	4.41 ± 0.86	4.19 ± 0.83	4.11 ± 0.81
Ins6	Leads to the school's organizational effectiveness	4.25 ± 0.73	4.36 ± 0.86	4.17 ± 0.86	4.16 ± 0.76
Ins7	Leads to improvements in school leadership	4.33 ± 0.71	4.29 ± 0.87	4.22 ± 0.85	4.21 ± 0.81
Ins13	Provides valid and thorough recommendations for crafting a school improvement plan	4.18 ± 0.75	4.26 ± 0.83	4.11 ± 0.89	4.24 ± 0.86
Ins14	Improves the quality of student services	4.27 ± 0.73	4.12 ± 0.84	4.26 ± 0.86	4.26 ± 0.76
Ins15	Motivates personnel in an institution to develop teamwork and collaboration	4.30 ± 0.79	4.29 ± 0.87	4.31 ± 0.88	4.24 ± 0.82
Ins16	Provides opportunities for institutional growth through self-evaluation and self-regulation	4.27 ± 0.71	4.29 ± 0.91	4.24 ± 0.87	4.24 ± 0.82
Ins17	Enables the institution to responsive implementation of changes	4.28 ± 0.69	4.41 ± 0.82	4.27 ± 0.83	4.32 ± 0.81
	Mean±SD	4.24 ± 0.63	4.35 ± 0.76	4.22 ± 0.76	4.20 ± 0.70
	Societal impacts				
Soc2	Helps science degree graduates to land better employment opportunities	4.18 ± 0.77	4.36 ± 0.82	4.17 ± 0.88	4.26 ± 0.79
Soc3	Enhances the institution's image with an internationally accepted standard	4.22 ± 0.83	4.62 ± 0.78	4.27 ± 0.86	4.24 ± 0.71
Soc4	Prepares the school in response to the need for world-class standards in higher education	4.35 ± 0.73	4.59 ± 0.78	4.29 ± 0.89	4.37 ± 0.67
Soc6	Is important for the mutual recognition of credentials to allow institutional, regional, national, and international mobility among students	4.33 ± 0.75	4.62 ± 0.78	4.27 ± 0.88	4.30 ± 0.57
Soc7	Increases community support for school initiatives	4.27 ± 0.76	4.38 ± 0.85	4.20 ± 0.90	4.32 ± 0.62
Soc10	Provides the foundation for a total quality management program to reduce stakeholder complaints	4.08 ± 0.79	4.33 ± 0.99	4.13 ± 0.85	4.24 ± 0.59
Soc18	Gives the community a better understanding of what the school is all about	4.30 ± 0.77	4.45 ± 0.87	4.13 ± 0.93	4.34 ± 0.67
Soc19	Allows the community to take an unbiased look at the strengths and weaknesses to improve the school	4.30 ± 0.70	4.41 ± 0.87	4.18 ± 0.89	4.16 ± 0.64
	Mean±SD	4.25 ± 0.62	4.47 ± 0.74	4.20 ± 0.80	4.27 ± 0.58

1.0–1.8: Strongly disagree; 1.81–2.6: Disagree; 2.61–3.4: Neutral; 3.41–4.2: Agree; 4.21–5.0 Strongly agree

Overall, the mean scores of four HEIs under items evaluating curricular impacts of science programs accreditation range between 4.23 to 4.45. Below are sample interview transcripts providing justifications of stakeholders' ratings with regard to the curricular impacts of accreditation of science programs.

- Progress in the university must always take place. From what I observed before the accreditation is that the university is not that well upgraded but after the accreditation, we see faculties sent for continuing education as part of accreditors' recommendations. In effect, the pedagogies and strategies of these faculty improve and are responsive to students' needs (HEI2–ManF).
- Accreditation engenders or creates positive change by prompting more "hands-on learning" and attention to science programs (HEI3–FacF).

- I believe accreditation is truly helpful in leveraging the services, facilities, competencies, learning outcomes, and teaching processes. Because there are provisions that we have to meet, along the way we become practitioners and providers of quality and excellent training and product-our learners (HEI1–FacF).

A number of studies (e.g., Perveen et al. (2021), Acevedo-De-los-Ríos and Rondinel-Oviedo (2022), and Nguyen et al., 2021) reported that program accreditation has institutional impacts by creating a culture of excellence in the institution. In the present study, it can be noted that the stakeholders strongly agreed with the listed curricular impacts of the accreditation of science curricular programs. Hence, stakeholders viewed also the institutional impacts of the program accreditation. As evidence, five items were rated strongly agree by stakeholders from all four HEIs. These institutional impacts are (a) identifying weaknesses in school resources, (b) improving school leadership, (c) developing teamwork and collaboration among stakeholders, (d) providing opportunities for institutional growth, and (e) enabling the institution to respond to the implementation of changes. The mean scores of four HEIs range between 4.20 to 4.35 under this impact area suggesting strong agreement. The following interview transcripts support these scores:

- Accreditation promotes unity and camaraderie among students, teaching, and non-teaching staff (HEI1–ManM).
- As students, we are tasked to help organize and maintain the cleanliness of the Science and Technology building, where we usually spend our time for our major or content classes. My classmates and I do it wholeheartedly because if we pass the accreditation, we would also take pride in the accomplishment (HEI4–StudF).
- Some of our concerns as students are addressed through accreditation (HEI3–StudM).
- It helps the university in advancing more in regard to its facilities like the libraries and science laboratories (HEI4–ManF).
- It creates a set of quality standards for all education institutions and programs (HEI4–ManF).
- It creates goals for institutional self-improvement (HEI1–FacF).
- There were improvements in the facilities, additional programs offered, and projects done for the science curricular programs (HEI1–ManM).

Finally, the societal impacts of accreditation also recorded desirable perceptions from stakeholders. Although previous reports from Frank et al. (2020) and Acevedo-De-los-Ríos and Rondinel-Oviedo (2022) indicated that these are the expected impacts of program accreditation on society, the present study further validates these findings. In particular, items on (a) enhancing institutional image through internationally accepted standards, (b) preparing the school for world-class standards in higher education, (c) recognizing students' credentials to allow institutional, regional, national, and international mobility, and (d) increasing community support for school initiatives have mean scores above 4.20 or an adjectival rating of strongly agree. As to the overall mean scores of four HEIs under this impact area, these range between 4.20 to 4.47, suggesting strong agreement. Here are sample narratives explaining the high scores.

- Through accreditation, the school can prepare and develop lifelong learners that are globally competitive (HEI1–AlumF).
- It helps produce students who are research–oriented and technologically driven (HEI2–FacM).
- Students are best ready for their future endeavors as employers often require evidence that applicants have received a degree from an accredited school or program (HEI3–AlumF).
- The accreditation status reflects the kind of institution that we are and, in the process, it tells society and the entire academic community the quality of training and services that we can offer and the competence of the faculty and staff behind the institution. It results to trust and confidence among stakeholders, fund-granting agencies, and members of the society at large (HEI3–FacF).

3.3. Stakeholders' accreditation impact perceptions by HEI groups

One-way ANOVA was performed thrice to determine potential differences in stakeholders' perceptions from four HEIs concerning the curricular, institutional, and societal impacts of accreditation of science curricular programs. The results shown in Table 6 revealed no significant difference in their perceived curricular [$F(3, 218)=0.059$, $p=0.981$], institutional [$F(3, 218)=0.324$, $p=0.808$], and societal impacts [$F(3, 218)=1.143$, $p=0.332$] of accreditation of science curricular programs. As shown in Table 4, the means recorded in all perception areas across four HEIs are above at least 4.20 and are not distant from one another, suggesting that they positively perceived the impact of accreditation at the curricular, institutional, or societal level. In other words, they may not resist but may voluntarily apply for accreditation.

4. Conclusion

This study makes a valuable contribution by introducing a valid and reliable scale to assess stakeholders' perceptions regarding the impacts of accrediting science curricular programs. The scale identifies three distinct impact areas associated with program accreditation: Curricular, institutional, and societal. The findings of this study indicate that stakeholders from the four HEIs in the Central Visayan region of the Philippines have positively perceived these impact areas. Consequently, it is suggested that there is a favorable disposition among these stakeholders towards pursuing program accreditation, and thus, minimal resistance may be expected should these HEIs choose to apply for accreditation.

Table 6: ANOVA results

Impact areas	Source of variation	SS	df	MS	F	*P*-value	Decision
Curricular	Between groups	0.111	3	0.037	0.059	0.981	Non-significant
	Within groups	135.925	218	0.624			
	Total	136.036	221				
Institutional	Between groups	0.500	3	0.167	0.324	0.808	Non-significant
	Within groups	112.082	218	0.514			
	Total	112.582	221				
Societal	Between groups	1.740	3	0.580	1.143	0.332	Non-significant
	Within groups	110.560	218	0.507			
	Total	112.3	221				

Based on the study's results, several recommendations are proposed. Firstly, the newly developed scale could be employed to evaluate stakeholders' perceptions of program accreditation impacts in other HEIs. Secondly, in the event that these institutions decide to seek accreditation, it is crucial to carefully consider and comply with the recommendations put forth by accrediting bodies. The study suggests that stakeholders have drawn their positive perceptions of program accreditation impacts from observing institutions' adherence to accreditors' recommendations. In essence, stakeholders have observed that complying with these recommendations leads to improvements in both the curriculum and the institution as a whole. Consequently, it is imperative to sustain these positive perceptions among stakeholders, as they play vital roles in the accreditation process. Failure to maintain such positive perceptions may jeopardize future accreditation endeavors for these institutions.

Lastly, it is recommended that future studies explore the possibility of employing structural equation modeling to determine whether these identified impact areas can serve as predictors of intention to pursue program accreditation, particularly in the context of science degree programs. Such investigations could provide further insights into the underlying factors influencing institutions' decisions to seek accreditation and potentially enhance our understanding of the accreditation process's dynamics in science education.

Compliance with ethical standards

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

References

Acevedo-De-los-Ríos A and Rondinel-Oviedo DR (2022). Impact, added value and relevance of an accreditation process on quality assurance in architectural higher education. Quality in Higher Education, 28(2): 186-204. https://doi.org/10.1080/13538322.2021.1977482

Alberts B (2022). Why science education is more important than most scientists think. FEBS Letters, 596(2): 149-159. https://doi.org/10.1002/1873-3468.14272 **PMid:35006607**

Aldoseri M and Sharadgah TA (2021). Assessing the impact of accreditation standards on quality assurance and risk management in higher education institutions: Faculty members' perceptions. Journal of Legal, Ethical and Regulatory Issues, 24(1): 1-17.

Al-Eyadhy A and Alenezi S (2021). The impact of external academic accreditation of undergraduate medical program on students' satisfaction. BMC Medical Education, 21: 565. https://doi.org/10.1186/s12909-021-03003-0 **PMid:34753457 PMCid:PMC8576880**

Amourgis S, Costes N, Froestad W, Frykholm CU, Harris N, Hopbach A, and Wahlén S (2009). Programme-oriented and institutional-oriented approaches to quality assurance: New developments and mixed approaches. ENQA Workshop Report 9, European Association for Quality Assurance in Higher Education, Helsinki, Finland.

Atkin JM and Black P (2007). History of science curriculum reform in the United States and United Kingdom. In: Abell SK and Lederman NG (Eds.), Handbook of research on science education: 781-806. Taylor and Francis, Oxfordshire, UK.

Dani D (2009). Scientific literacy and purposes for teaching science: A case study of Lebanese private school teachers. International Journal of Environmental and Science Education, 4(3): 289-299.

Dashti-Kalantar R, Rassouli M, Elahi N, and Asadizaker M (2019). Programmatic accreditation or institutional accreditation?-The development of accreditation in nursing schools. Annals of Medical and Health Sciences Research, 9(5): 664-671.

Drori G (2000). Science education and economic development: trends, relationships, and research agenda. Studies in Science Education, 35(1): 27-57. https://doi.org/10.1080/03057260008560154

Faisal and Martin SN (2019). Science education in Indonesia: Past, present, and future. Asia-Pacific Science Education, 5: 4. https://doi.org/10.1186/s41029-019-0032-0

Fornell C and Larcker DF (1981). Structural equation models with unobservable variables and measurement error: Algebra and statistics. Journal of Marketing Research, 18(3): 382-388. https://doi.org/10.1177/002224378101800313

Fortus D, Lin J, Neumann K, and Sadler TD (2022). The role of affect in science literacy for all. International Journal of Science Education, 44(4): 535-555. https://doi.org/10.1080/09500693.2022.2036384

Frank JR, Taber S, van Zanten M, Scheele F, and Blouin D (2020). The role of accreditation in 21st century health professions education: Report of an international consensus group. BMC Medical Education, 20: 305. https://doi.org/10.1186/s12909-020-02121-5 **PMid:32981519 PMCid:PMC7520947**

Garfolo BT and L'Huillier B (2015). Demystifying assessment: The road to accreditation. Journal of College Teaching and

Learning, 12(3): 151-170. https://doi.org/10.19030/tlc.v12i3.9303

Garson GD (2006). Structural equation modeling. G. David Garson and Statistical Associates Publishing, Raleigh, USA.

Gefen D, Straub D, and Boudreau MC (2000). Structural equation modeling and regression: Guidelines for research practice. Communications of the Association for Information Systems, 4: 7. https://doi.org/10.17705/1CAIS.00407

Hair JF, Black WC, Babin BJ, and Anderson RE (2009). Multivariate data analysis. Prentice Hall, Upper Saddle River, USA.

Hair JF, Black WC, Babin BJ, and Anderson RE (2014). Multivariate data analysis. Pearson Education, Harlow, UK.

Hegji A (2017). An overview of accreditation of higher education in the United States. CRS Report R43826, Congressional Research Service, Washington, USA.

Hinkin TR (1998). A brief tutorial on the development of measures for use in survey questionnaires. Organizational Research Methods, 1(1): 104-121. https://doi.org/10.1177/109442819800100106

Hu LT and Bentler PM (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. Structural Equation Modeling: A Multidisciplinary Journal, 6(1): 1-55. https://doi.org/10.1080/10705519909540118

Ibrahim HAH (2014). Quality assurance and accreditation in education. Open Journal of Education, 2(2): 106-110. https://doi.org/10.12966/oje.06.06.2014

Kenny DA, Kaniskan B, and McCoach DB (2015). The performance of RMSEA in models with small degrees of freedom. Sociological Methods and Research, 44(3): 486-507. https://doi.org/10.1177/0049124114543236

Kis V (2005). Quality assurance in tertiary education: Current practices in OECD countries and a literature review on potential effects. OECD Thematic Review, Organisation for Economic Co-operation and Development, Paris, France.

Kline R (2016). Principles and practice of structural equation modeling. Guilford Press, New York, USA.

Kumar P, Shukla B, and Passey D (2020). Impact of accreditation on quality and excellence of higher education institutions. Revista Investigacion Operacional, 41(2): 151-167.

Nguyen TBN, Le HT, and Pham TTH (2021). The effect of accreditation on the perception of leaders and lecturers about quality training. In Proceedings of 1st Hanoi Forum on Pedagogical and Educational Sciences, Vietnam National University Press, Hanoi, Vietnam: 362-373.

Perveen U, Idris M, and Zaman A (2021). Impact of accreditation on improvement of the teacher education programs/institutions in Pakistan. Journal of Education and Educational Development, 8(1): 194-217. https://doi.org/10.22555/joeed.v8i1.518

Pham PT, Duong TB, Phan TTT, Nguyen TH, Nguyen MT, Nguyen MT, and Nguyen TT (2020). Impact of the self-assessment process on quality enhancement of higher education institutions: A case study of Vietnam. International Journal of Education and Practice, 8(3): 536-546. https://doi.org/10.18488/journal.61.2020.83.536.546

Ryan T (2015). Quality assurance in higher education: A review of literature. Higher Learning Research Communications, 5: 4. https://doi.org/10.18870/hlrc.v5i4.257

Seyfried M and Pohlenz P (2018). Assessing quality assurance in higher education: Quality managers' perceptions of effectiveness. European Journal of Higher Education, 8(3): 258-271. https://doi.org/10.1080/21568235.2018.1474777

Sharma S, Mukherjee S, Kumar A, and Dillon WR (2005). A simulation study to investigate the use of cutoff values for assessing model fit in covariance structure models. Journal of Business Research, 58(7): 935-943. https://doi.org/10.1016/j.jbusres.2003.10.007

Sywelem MM and Witte JE (2009). Higher education accreditation in view of international contemporary attitudes. Online Submission, 2(2): 41-54.

Tabachnick BG and Fidell LS (2019). Using multivariate statistics. Pearson, Boston, USA.

Taherdoost H, Sahibuddin S, and Jalaliyoon N (2014). Exploratory factor analysis: Concepts and theory. Advances in Applied and Pure Mathematics, 27: 375-382.

Tavakol M and Dennick R (2011). Making sense of Cronbach's alpha. International Journal of Medical Education, 2: 53-55. https://doi.org/10.5116/ijme.4dfb.8dfd **PMid:28029643 PMCid:PMC4205511**

Terwee CB, Bot SD, de Boer MR, van der Windt DA, Knol DL, Dekker J, and de Vet HC (2007). Quality criteria were proposed for measurement properties of health status questionnaires. Journal of Clinical Epidemiology, 60(1): 34-42. https://doi.org/10.1016/j.jclinepi.2006.03.012 **PMid:17161752**

Valladares L (2021). Scientific literacy and social transformation: Critical perspectives about science participation and emancipation. Science and Education, 30(3): 557-587. https://doi.org/10.1007/s11191-021-00205-2 **PMid:33867683 PMCid:PMC8035063**

Van Driel JH, Beijaard D, and Verloop N (2001). Professional development and reform in science education: The role of teachers' practical knowledge. Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching, 38(2): 137-158. https://doi.org/10.1002/1098-2736(200102)38:2<137::AID-TEA1001>3.0.CO;2-U

Zhao J and Ferran C (2016). Business school accreditation in the changing global marketplace: A comparative study of the agencies and their competitive strategies. Journal of International Education in Business, 9(1): 52-69. https://doi.org/10.1108/JIEB-02-2016-0001