Smart Rubric-based Systematic Model for Evaluating and Prioritizing Academic Practices to Enhance the Education Outcomes

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Abstract—Recently, the impact of free-market economy, globalization, and knowledge economy has become a challenging and focal to higher educational institutions, which resulted in radical change. Therefore, it became mandatory for the academic programs to prepare highly qualified graduates to meet the new challenges, through the implementation of well-defined academic standards. For this reason, the National Center for Academic Accreditation & Evaluation (NCAAA) in Kingdom of Saudi Arabia (KSA) defined a set of standards to ensure that quality of education in KSA is equivalent to the highest international standards. NCAAA standards contains of good criterions to guide the universities in evaluating their quality performance for improvement and obtain NCAAA accreditation. However, implementing NCAAA standards without supportive systems has been found to be a very complex task due to the existence of a large number of standard criterions, evaluation process occurs according to personal opinions, the lack of quality evaluation expertise, and manual calculation. This, in turn, leads to inaccurate evaluation, develops inaccurate improvement plans, and difficulty in obtaining NCAAA accreditation. Therefore, this paper introduces a systematic model that contain smart-rubrics that has been designed based on NCAAA quality performance evaluation elements supported with algorithms and mathematical models to reduce personal opinions, provide an accurate auto-evaluation, and auto-prioritization action plans for NCAAA standards. The proposed model will support academics and administrative by facilitating their NCAAA quality tasks with ease, an authenticate self-assessment, accurate action plans and simplifying accreditation tasks. Finally, the implementation of the model proved to have very efficient and effective results in supporting KSA education institution in accreditation tasks that will lead to enhance the quality of education and to obtain NCAAA accreditation.

Keywords—*Systematic Model; Smart Rubric; NCAAA Good Practices; quality of academic programs and universities; improvement action plan*

I. INTRODUCTION

The rapid growth of global the free-market economy, globalization, and knowledge economy has created a global competition in higher educational institutions [1-4]. Thus, educational institutions are participating in meeting the high demands of the market and keeping abreast of current technological developments. Therefore, those educational institutions are required to prepare highly qualified graduates who are competent with the needs of the global free-market economy, globalization, and knowledge economy. NCAAA

has defined academic standards in 2009 [5-6] and redefined these standards in December 2018 [7-9] to guarantee that Saudis universities and academic programs are qualified for the current challenges. NCAAA standards (both versions) contain good criterions/ practices to guide the academic programs and universities in assessing the competence and usefulness of the educational process, and to use this information to make decisions about how essential activities are enhanced, organized, and funded. Thus, implementation of NCAAA standards by KSA universities and academic programs will ensure good academic performance to meet the current education challenges. NCAAA standards cover different aspects of activities carried out by any academic entity. NCAAA standards are broken down into sub- standards dealing with requirements within each of the major areas. Each of the sub-standards consists of several good criterions/ practices. NCAAA 2009 standards practices at institutions level are more than four-hundred fifty, and at the program level is more than two hundred eighty. While, NCAAA 2018 standards practices at institutions level is one hundred fifty-six (156), at the program level is ninety-six (96), and at postgraduate program level is one-hundred fourteen (114). Currently, NCAAA accredited Saudis universities and academic programs using both (2009, 2018) version (for a specified period of time) leaving the option for universities and academic programs to use any version. NCAAA accepts the accreditation only when the institution has obtained a specific performance level in each standard. High performance level in the standards can only be achieved by accurate, valid and reliable evaluation of performance level and the creation of correct improvement action plans. Therefore, implementation, evaluation, prioritization and construction improvement action plans to achieve a good performance level in NCAAA standards criterion/ practices became a hard task without smart systematic aids and accurate evaluation tools. Hence, this paper will develop two evaluation rubrics (which is an evaluation tool that indicates success criteria to assess different kinds of academic works [10]) to evaluate both versions of NCAAA standards and criterion accurately. Moreover, this paper proposes mathematical equation that will be integrated in algorithm model to develop a smart rubric-based systematic model to auto-evaluate and auto-prioritize evaluate both versions of NCAAA criterions/ practices to support academics and administrative in their planning, self-review, and quality improvement strategies.

This paper is organized as follows: Section II gives an overview of current system for evaluating NCAAA standards, Section III describes the designing of smart rubric-based systematic model for evaluating and prioritizing academic practices to enhance the education outcomes, Section IV describes the practical implementation of the model, and Section V ends with conclusive remarks.

II. CURRENT SYSTEM FOR EVALUATING NCAAA STANDARDS

Currently, Saudi universities and academic programs use NCAAA standards as guidance for developing, managing, evaluating, and enhancing education programs. NCAAA has defined academic standards in 2009 and improved these standards in December 2018 leaving the option (for a specified period of time) for universities and academic programs to apply for NCAAA accreditation using either version to facilitate the accreditation process for the institutions who build their quality systems based on 2009 standards.

NCAAA 2009 standards consist of 11 broad standards that apply to both institutions and programs though there are differences in how they are applied for these different kinds of evaluations. NCAAA 2009 standards 11 standards are:

(1) Mission and Objectives, (2) Governance and Administration (3) Management of Quality Assurance and Improvement, (4) Learning and Teaching, (5) Student Administration and Support Services, (6) Learning Resources, (7) Facilities and Equipment, (8) Financial Planning and Management, (9) Faculty and Staff Employment Processes, (10) Research and (11) Relationship with the Community.

NCAAA has prepared 2009 Self-Evaluation Scales (SES) document to help Saudi universities and academic programs to evaluate the NCAAA 2009 standards for quality level. SES support higher education institutions in enhancing their ability to meet the standards of quality assurance and to be used in NCAAA academic accreditation. SES is used by institutions in self-initial quality assessment, continues improvement plans, and prepares a self-study report to obtain NCAAA accreditation. Currently, SES standards evaluation is conducted manually by collecting the points of evaluation for all the related criteria according to their quality performance in elements of evaluation.

NCAAA has prepared two documents for NCAAA 2009 SES (sample is shown in Fig. 1) which is SES for higher education institution [11], and SES for higher education programs [12] (in MS-Word, and PDF format) to evaluate quality performance of NCAAA practices.

NCAAA 2009 SES has three elements of evaluation, which are: the extent and consistency with which processes are followed, the quality of the service or activity as assessed through systematic evaluations; and the effectiveness of what is done in achieving intended outcomes.

NCAAA 2009 SES evaluates the standards by categorizing the applicable practice quality performance into three performance level which are low, good, and high performance using zero to five stars evaluation system as shown in Fig. 2.

Fig. 1. Simple of NCAAA 2009 SES for Higher Education Programs Templates.

Fig. 2. Simple of NCAAA 2009 SES for Higher Education Programs Templates.

Higher educational institutions and programs use 2009 SES templates to calculate manually the quality performance level of each practice, using zero to five stars evaluation system based on the evaluation of the practice. Then, higher education institution and programs manually calculate the evaluation stars of each sub-standard by taking the average for all the practices in that sub-standard. Finally, higher education institution and programs calculate manually the evaluation stars of each standard by taking the average of for all sub-standards in that standards. Based on the evaluation of each standard, higher education institution and programs prepare an improvement plan to enhance the quality of the university/ program.

However, implementing the above-given evaluation system to evaluate and enhance NCAAA standards and practices is not an easy task due to the large number of practices, personal opinions-based evaluation process, lack of quality evaluation expertise, and the difficulty of manual calculation. Moreover, the absence of indicators for NCAAA practices priorities and importance leads to inaccurate improvement plans, which leaves the institution and/or the programs without an actual continuous improvement process.

Therefore, NCAAA has redefined NCAAA 2009 standards in December 2018 to facilitate its accreditation tasks and overcome some of NCAAA 2009 standards evaluation system with giving the option (for a specified period of time) for universities and academic programs to apply for accreditation using 2099 NCAAA standards.

By December 2018, NCAAA introduced an improved version of NCAAA standards to be eight standards at the institutions level, six standards at the program level, and seven standards for postgraduate programs. NCAAA 2018 institutional standards, which are:

(1) Mission, Goals and Strategic Planning, (2) Governance, Leadership and Management, (3) Teaching and Learning, (4) Students, (5) Faculty and Staff, (6) Institutional Resources, (7) Scientific Research and Innovation, and (8) Community Partnership while, NCAAA 2018 program standards [9] are: (1) Mission and goals, (2 Program management and quality assurance, (3) Teaching and Learning, (4) Students, (5) Faculty members, and (6) Learning resources, facilities, and equipment. Newly, NCAAA 2018 proposed a specific standard for postgraduate programs [10] which are: (1) Mission and goals, (2) Program management and quality assurance, (3) Teaching and Learning, (4) Students, (5) Faculty members, (6) Learning resources, facilities, and equipment, and (7) Research and Projects.

Also, NCAAA has prepared two documents for NCAAA 2018 SES (sample is shown in Fig. 3) which is SES for higher education institution [13], and SES for higher education programs [14] to evaluate quality performance of NCAAA improved criterions.

NCAAA 2018 SES has five elements of evaluation which are: extent of availability of elements and components of the criterion, quality level of application for each element, regularity of application and assessment, and availability of evidence, continuous improvement and level of results in the light of indicators and benchmarks, excellence and creativity in practices of the elements of the criterion. NCAAA 2018 SES improved a guidance rubric (not complete rubric for all NCAAA 2018 criterion) as shown in Fig. 4.

Levels of Evaluation / Elements of Evaluation	NA	Unsatisfactory Performance		Satisfactory Performance		
		Non-Compliance 1	Partial Compliance 2	Compliance 3	Perfect Compliance 4	Distinctive Compliance 5
Extent of availability of elements and components of the criterion		• There are no available elements of the criterion • Or there are few available elements	• Most of the elements of the criterion are available	• All of the elements of the criterion are available	• All of the elements of the criterion are available	• All of the elements of the criterion are available
Quality level of application for each element		• The elements of the criterion are not applied at all, (or) are applied at a very low level	• The elements of the criterion are applied at low level	• The elements of the criterion are applied at good level	• The elements of the criterion are applied at perfect level	• The elements of the criterion are applied at distinct level
Regularity of application and assessment, and availability of evidence		• Rarely applied	• Applied irregularly, • (or) there is no assessment, or it is there but is irregular, • (or) there is insufficient evidence	• Applied regularly, • There is a regular and effective assessment, • Sufficient evidence is available	• Applied regularly, • There is a regular and effective assessment, • Sufficient and varied evidence is available	• Applied on a regular basis, • There is a regular, effective, and excellent assessment, and • Various, comprehensive, and cumulative evidence is available,

Fig. 4.   Simple of NCAAA 2018 SES Guidance.

NCAAA 2018 SES evaluates the standards by categorizing the applicable criterion quality performance into two performance levels which are unsatisfactory performance, and satisfactory performance using a five-point evaluation scale (1 to 5) as shown in Fig. 5.

SES 2018 templates will be filled by evaluating each criterion performance level and giving a number manually, using a five-points scale. Then, each sub-standard performance level will be calculated manually by the average of its criterion' points (if the standard has sub-standards). Finally, each standard performance level will be calculated manually as the average of its sub-standards' points (if the standard has sub-standards) and as the average of its criterion' points (if the standard has no sub-standards). According to the evaluation of each standard, an improvement plan will be developed to enhance the standards.

1. MISSION AND GOALS

The program must have a clear and appropriate mission that is consistent with the mission statements of the institution and the college/department, and support its application. The mission must guide program planning and decision-making processes. The program goals and plans must be linked to it, and it must be periodically reviewed.

Levels of Evaluation / Elements of Evaluation	NA	Not Satisfactory		Satisfactory		
		Non-Compliance 1	Partial Compliance 2	Compliance 3	Perfect Compliance 4	Distinctive Compliance 5
1-0-1	The program has a clear, appropriate, approved and publicized widely mission that is consistent with the mission of the institution and the college/department; and is consistent with the needs of the society and the national trends.*					
1-0-2	The program goals are linked to its mission, consistent with the goals of the institution/college, and characterized by being clear, realistic and measurable.					
1-0-3	The program mission and goals guide all its operations and activities (e.g., planning, decision-making, resources allocation, curriculum development).					
1-0-4	The program goals and its implementation needs are linked to appropriate operational plans that are consistent with the institution/college plans.					

Fig. 3.   Simple of NCAAA 2018 SES for Higher Education Programs Templates.

Level	Description of Performance
(1) Non-Compliance	The program does not have teaching and learning strategies, and assessment methods to develop the students' ability to conduct scientific research, and to acquire higher thinking and self-learning skills, or they exist but are inappropriate or incompatible with the nature and level of the program, or that they are not fully applied or are applied rarely or at a very low level.
(2) Partial Compliance	The program has limited teaching and learning strategies and assessment methods to develop the students' ability to conduct scientific research, and to acquire higher thinking and self-learning skills, or only some of them are compatible with the nature and level of the program, or they are poorly or irregularly applied, or they are not subject to assessment or some of them are irregularly assessed, and there are limited procedures for their development.
(3) Compliance	The program has diverse teaching and learning strategies and assessment methods, compatible with its nature and level, all of which are applied at a good level on a regular basis, for enhancing the ability to conduct scientific research and ensuring students' acquisition of higher thinking and self-learning skills. There is sufficient evidence. Most of them are subject to periodic evaluation and development.
(4) Perfect Compliance	The program has diverse and developed teaching and learning strategies and assessment methods, all of which are of a high quality compatible with its nature and level, all of which are applied at a high level on a regular basis, enhancing the ability to conduct scientific research and ensuring students' acquisition of higher thinking and self-learning skills. There is ample and varied evidence. All are subject to periodic evaluation and development with the existence of high results for improvement.
(5) Distinctive Compliance	Any distinction and creativity in the practices of the elements of the criterion

Fig. 5.   NCAAA 2018 SES Performance Level Description.

The improved NCAAA 2018 standards SES have reduced the efforts of NCAAA accreditation tasks due to the smaller number of criterions compared to NCAAA 2009 standards practices. In addition, the guidance rubric will make the standard evaluation more accurate compared to NCAAA 2009 standards evaluation system. However, the proposed guidance rubric is not a complete rubric for all NCAAA 2018 criterion which will make the evaluation process still based on personal opinions. Moreover, implementing and evaluating NCAAA 2018 standards is still not an easy task due to the number of criterions, lack of complete quality evaluation guidance, the difficulty of manual calculation, and the absence of indicators for criterion priorities for improvement. Therefore, it will be difficult to develop accurate improvement plans.

Thus, there is a need for systematic model for facilitating NCAAA tasks to have more accurate results. Deanship of development and quality in King Saud University (KSU) has an electronic system to manage the process of development and quality, and NCAAA accreditation tasks at the university called ITQAN [15]. ITQAN support KSU academics and administrative with many services such as facilitating access to the data, automating large numbers of periodic reports, and disseminating and analyzing questionnaires. However, ITQAN cannot support in auto-evaluation, and auto-prioritizing the performance level of NCAAA criterion/practices.

Researches in King Abdelaziz University (KAU) propose a system [16] that automates Key Performance Indicators (KPIs) management process for higher educational institutions through balanced scorecard measuring tools. However, this proposed system will support NCAAA KPIs calculations without evaluating NCAAA criterion/practices.

NCAAA developed an electronic accreditation system called DAMAN [17] which will facilitate NCAAA accreditation processes through replacing the traditional paper-based accreditation processes to an integrated electronic accreditation process that saves time, effort and resources. However, DHMAN was developed to facilitate NCAAA accreditation processes not supporting educational institution and programs to evaluate their criterion/practices.

Thus, this paper introduces a smart-rubrics systematic model that is designed to support educational institutions and programs to evaluate their NCAAA criterion/practices, facilitate their NCAAA quality tasks, provide self-assessment, guide in development of accurate quality implementation action plans and simplifying accreditation tasks.

III. Designing of Smart Rubric-Based Systematic Model for Evaluating and Prioritizing Academic Practices to Enhance the Education Outcomes

The proposed smart rubric-based systematic model for evaluating and prioritizing academic practices consists of two evaluation rubrics that are designed to accurately evaluate both versions of NCAAA standards, and an algorithm model that contains mathematical model to auto-evaluate, auto-prioritize, and auto-calculate the performance level of NCAAA standards.

A. Designing the Rubrics

Two rubrics are designed to assess and evaluate academic criterion/practice, one is according to NCAAA 2009 Standards practice, the other one according to NCAAA 2018 Standards criterion.

1) NCAAA 2009 standards rubrics: To evaluate NCAAA 2009 standards practice accurately , a rubric is designed based on three performance criteria: the extent and consistency with which processes are followed, the quality of the service or activity as assessed through systematic evaluations; and the effectiveness of what is done in achieving intended outcomes which are according to NCAAA 2009 standard practice guideline [12, 13]. Each of those performance criteria has its own descriptor aligned with the performance level in the rubric.

Table I shows the rubric that is designed to illuminate the performance criteria, performance descriptor, performance level, the variable's name is ECF, with its possible values (which will be used in the mathematical equations) to evaluate the practices according to the extent and consistency with which processes are followed.

Table II shows the rubric that is designed to illuminate the performance criteria, performance descriptor, performance level, the variable's name is QSA, with its possible values (which will be used in the mathematical equations) to evaluate the practices according to the quality of the service or activity as assessed through systematic evaluations.

Table III shows the rubric that is designed to illuminate the performance criteria, performance descriptor, performance level, the variable's name is EFF, with its possible values (which will be used in the mathematical equations) to evaluate the practices according to the effectiveness of what is done in achieving intended outcomes.

TABLE. I. Rubric Elements to Evaluate the Practices According to the Extent and Consistency with which Processes are Followed

Practice Number and Description	The extent and consistency with which Processes are Followed				
	All the time	*Consistently*	*Most of the Time*	*Usually*	*Occasional*
Practice Number and Description	Practice Followed All the time	Practice Followed Consistently	Practice Followed Most of the Time	Practice Followed Usually	Practice Followed Occasionally
ECF	5	4	3	2	1

TABLE. II. Rubric Elements to Evaluate the Practices According to the Quality of the Service or Activity as Assessed through Systematic Evaluations

Practice Number and Description	The quality of the service or activity as assessed through systematic evaluations				
	Superior Quality	*High Quality*	*Satisfactory*	*Less than satisfactory*	*Poor*
Practice Number and Description	Practice Quality is Superior Quality	Practice Quality is High Quality	Practice Quality is Satisfactory	Practice Quality is Less than satisfactory	Practice Quality is Poor
QSA	5	4	3	2	1

TABLE. III.   RUBRIC ELEMENTS TO EVALUATE THE PRACTICES ACCORDING TO THE EFFECTIVENESS OF WHAT IS DONE IN ACHIEVING INTENDED OUTCOMES

Practice Number and Description	The effectiveness of what is done in achieving intended outcomes				
	Excellent	*Very Good*	*Good*	*Satisfactory*	*Poor*
Practice Number and Description	Practice Effectiveness is Excellent	Practice Effectiveness is Very Good	Practice Effectiveness is Good	Practice Effectiveness is Satisfactory	Practice Effectiveness is Poor
EFF	5	4	3	2	1

2) NCAAA 2018 standards rubrics: The NCAAA 2018 Standards criterion rubric is designed based on five performance criteria: extent of availability of elements and components of the criterion, quality level of application for each element, regularity of application and assessment, and availability of evidence, continuous improvement and level of results in the light of indicators and benchmarks, and excellence and creativity in practices of the elements of the criterion according to NCAAA 2018 Standard criterion guideline [14, 15]. Each of those performance criteria has its own descriptor aligned with the performance level in the rubric. Table IV shows the rubric that is designed to illuminate the performance criteria, performance descriptor, performance level, the variable's name is EV, with its possible values (which will be used in the mathematical equations) to evaluate the criterion according to the extent of availability of elements and components of the criterion.

Table V shows the rubric that is designed to illuminate the performance criteria, performance descriptor, performance level, the variable's name is AQ, with its possible values (which will be used in the mathematical equations) to evaluate the criterion according to the quality level of application for each element.

Table VI shows the rubric that is designed to illuminate the performance criteria, performance descriptor, performance level, the variable's name is RA, with its possible values (which will be used in the mathematical equations) to evaluate the criterion according to the regularity of application and assessment, and availability of evidence.

TABLE. IV.   RUBRIC ELEMENTS TO EVALUATE THE CRITERION ACCORDING TO THE EXTENT OF AVAILABILITY OF ELEMENTS AND COMPONENTS OF THE CRITERION

Criterion Number and Description	Extent of availability of elements and components of the criterion			
	All Elements Available	*Most of the Elements Available*	*Few Available Elements*	*No Available Elements*
Criterion Number and Description	All of Criterion Elements Available	Most of Criterion Elements Available	Few Available Criterion Elements	Criterion Elements Not Available
EV	4	3	2	1

TABLE. V.   RUBRIC ELEMENTS TO EVALUATE THE CRITERION ACCORDING TO THE QUALITY LEVEL OF APPLICATION FOR EACH ELEMENT

Criterion Number and Description	Quality level of application for each element				
	Applied at Distinct Level	*Applied at Perfect Level*	*Applied at Good Level*	*Applied at Low Level*	*Not Applied at all Very Low Level*
Criterion Number and Description	Criterion Elements are Applied at Distinct Level	Criterion Elements are Applied at Perfect Level	Criterion Elements are Applied at Good Level	Criterion Elements are Applied at Low Level	Criterion Elements Not Applied at all or Applied at a Very Low Level
AQ	5	4	3	2	1

TABLE. VI.   RUBRIC ELEMENTS TO EVALUATE THE CRITERION ACCORDING TO THE REGULARITY OF APPLICATION AND ASSESSMENT AND AVAILABILITY OF EVIDENCE

Criterion Number and Description	Regularity of application and assessment, and availability of evidence				
	Applied Regularly / Regular Effective, Excellent Assessment / Comprehensive, Cumulative Evidences	*Applied Regularly / Regular and Effective Assessment / Sufficient and Varied Evidences*	*Applied Regularly / Regular and Effective Assessment / Sufficient Evidences*	*Applied Irregularly / (No Assessment (or) Irregular Assessment) / Insufficient Evidences*	*Rarely Applied*
Criterion Number and Description	Criterion Applied Regularly / Regular Effective, Excellent Assessment / Comprehensive, Cumulative Evidences	Criterion Applied Regularly / Regular and Effective Assessment / Sufficient Evidences	Criterion Applied Regularly / Regular and Effective Assessment / Sufficient Evidences	Criterion Applied Regularly / Regular and Effective Assessment / Sufficient Evidences	Criterion Rarely Applied
RA	5	4	3	2	1

Table VII shows the rubric that is designed to illuminate the performance criteria, performance descriptor, performance level, the variable's name is CI, with its possible values (which will be used in the mathematical equations) to evaluate the criterion according to the continuous improvement and level of results in the light of indicators and benchmarks.

TABLE. VII.   RUBRIC ELEMENTS TO EVALUATE THE CRITERION ACCORDING TO THE CONTINUOUS IMPROVEMENT AND LEVEL OF RESULTS IN THE LIGHT OF INDICATORS AND BENCHMARKS

Criterion Number and Description	Continuous improvement and level of results in the light of indicators and benchmarks			
	Regular Improvement Procedures and Distinct Results Compared To Other Institutions	*Regular Improvement Procedures and Higher Results Compared to Previous Results.*	*Regular Improvement Procedures and Good Results*	*Limited Improvement Procedures*
Criterion Number and Description	Regular Improvement Procedures Applied on the Criterion with Distinct Results Compared To Other Institutions	Regular Improvement Procedures Applied on the Criterion with Higher Results Compared to Previous Results	Regular Improvement Procedures Applied on the Criterion with Good Results	Limited Improvement Procedures Applied on the Criterion
CI	4	3	2	1

TABLE. VIII. RUBRIC ELEMENTS TO EVALUATE THE CRITERION ACCORDING TO THE EXCELLENCE AND CREATIVITY IN PRACTICES OF THE ELEMENTS OF THE CRITERION

Criterion Number and Description	Excellence and creativity in practices of the elements of the criterion
	Creativity in the Practices of the Elements of the Criterion.
Criterion Number and Description	There is a Creativity in the Practices of the Elements of the Criterion
EC	5

Table VIII shows the rubric that is designed to illuminate the performance criteria, performance descriptor, performance level, the variable's name is EC, with its possible values (which will be used in the mathematical equations) to evaluate the criterion according to the excellence and creativity in practices of the elements of the criterion.

B. Designing the Algorithm Model

An algorithm model is integrated in the rubric to build a smart rubric-based systematic model for evaluating and prioritizing academic practices to enhance the educational outcomes. Fig. 6 shows the algorithm model flowchart. The algorithm model steps can be summarized in the following points:

- The algorithm model will check which type of standards (institutional or program) the user will use. If its institutional standards, the algorithm model will use the mathematical equations of the institutional standards rubrics. Otherwise, the algorithm model will use the mathematical equations of program standards rubrics.

- In both cases in the previous step, the algorithm model will check which version of standards (2018 or 2009) the user will use. If its 2018 standards, the algorithm

model will use NCAAA 2018 improved standards rubrics and according to the type of standards (institutional or program) was selected in the previous step. Otherwise, NCAAA 2009 standards rubrics will use according to the type of standards (institutional or program) which was selected in the previous step.

- The algorithm model will use the smart rubric to evaluate criterion/practice according to the selection in the previous steps,

- The algorithm model will use a mathematical equation that is formulated to calculate the criterion/ practice performance evaluation in NP_PerEv according to the selection in the previous steps.

- If the user selects to use NCAAA 2018 improved standards, the following mathematical equations will be used to calculate the criterion points in CP(x) where x is equal to the criterion number:

$$IF\big((EV < 3)\ OR\ (AQ \leq 2)\big)\ then\ CP(x) = 1 \tag{1}$$

$$IF\big((EV = 3)\ OR\ (AQ = 2)\ OR\ (RA = 2)\ OR\ (CI = 1)\big)$$
$$then\ CP(x) = 2 \tag{2}$$

$$IF((EV=4)\ OR\ (AQ=3)\ OR\ (RA=3)\ OR\ (CI=2))$$
$$then\ CP(x)=3 \tag{3}$$

$$IF((EV=4)\ OR\ (AQ=4)\ OR\ (RA=4)\ OR\ (CI=3))$$
$$then\ CP(x)=4 \tag{4}$$

$$IF((EV=4)\ OR\ (AQ=5)\ OR\ (RA=5)\ OR\ (CI=5)\ OR\ (EC=5))$$
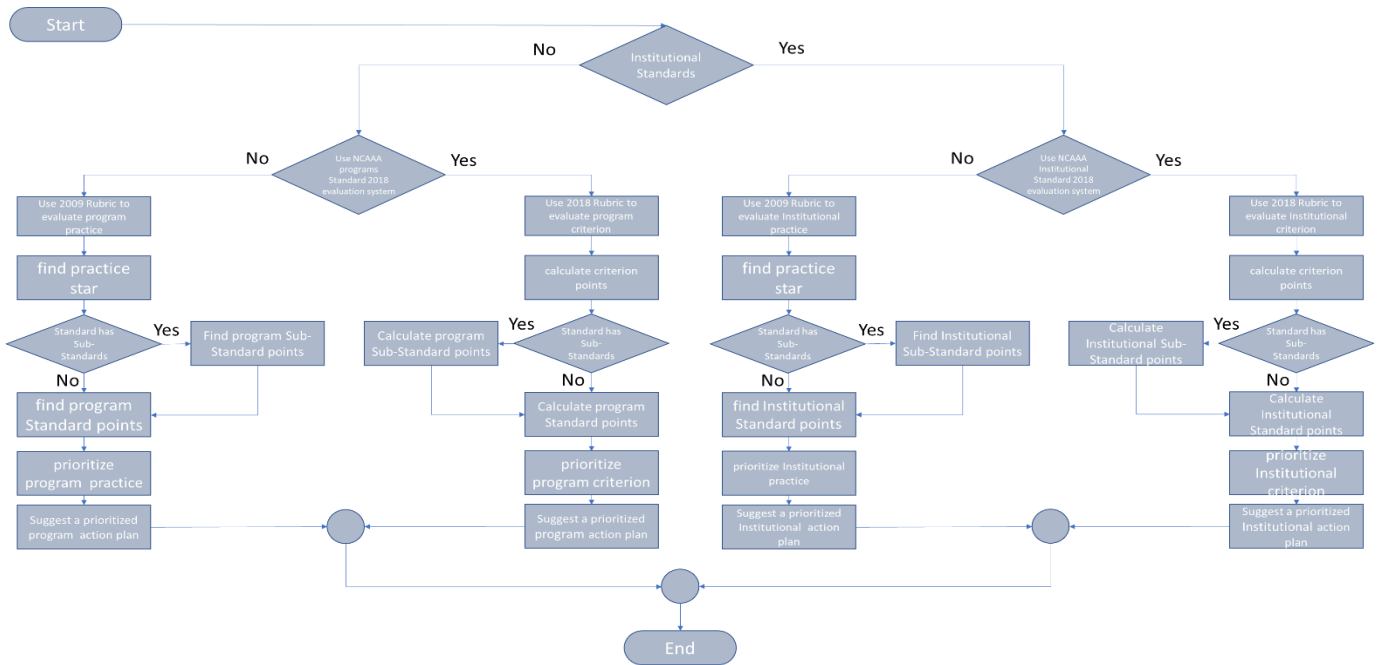$$then\ CP(x)=5 \tag{5}$$

Fig. 6. Smart Rubric-based Systematic Model for Evaluating and Prioritizing Academic Practices Algorithm Model Flowchart.

- If the user selects to use NCAAA 2009 standards, the following mathematical equations will be used to find the practice star in PP(x) where x is equal to the practice number:

IF(ECF = 1) then PP(x)=1   (6)

IF((ECF=2) AND (QSA=2) AND (EFF=1)

then PP(x)=2   (7)

IF((ECF=3) AND (QSA=3) AND (EFF=2))

then PP(x)=3   (8)

IF((ECF$\geqslant$4) AND (QSA=4) AND (EFF=3)

then PP(x)=4   (9)

IF((ECF=5) AND (QSA=5) AND (EFF>3)

then PP(x)=5   (10)

- The algorithm model will check if the evaluated standard has sub-standards, If it does, the algorithm model calculates the sub-standard performance evaluation in SSP(x) according to the selection in the previous steps. Otherwise, the algorithm model moves to calculate the standard performance evaluation.

- The algorithm model will use a mathematical equation that is formulated to calculate the sub-standard points in SSP(x) where x is equal to the sub-standard number and NoP is the number of the criterion in the sub-standard:

$$SSP(x) = \frac{\sum_{n=1}^{NoP} CP(n)}{NoP} \qquad (11)$$

- The algorithm model will use a mathematical equation that is formulated to calculate the standard performance evaluation points in SP(x) (where x is equal to the standard number and NoS is the number of the of sub-standard) according to the selection in the previous steps:

IF SSP(x)>0 then

$$SP(x) = \frac{\sum_{n=1}^{NoS} SSP(n)}{NoS}$$

else

$$SP(x) = \frac{\sum_{n=1}^{NoP} SSP(n)}{NoP} \qquad (12)$$

- The algorithm model will use the following mathematical equation to auto-prioritize criterion/ practice based on its performance evaluation in PriIM . The algorithm model use the variable ILP to get the importance level of criterion/ practice, if its essential practice, then ILP=1, else ILP=0:

$IF\big((NP_{PerEv} < 3) \ AND \ (ILP = 1)\big) \ then \ PriIM = 5$ (13)

$IF\big((NP_{PerEv} < 3) \ AND \ (ILP = 0)\big) \ then \ PriIM = 4$ (14)

$IF\big((NP_{PerEv} = 3) \ AND \ (ILP = 1)\big) \ then \ PriIM = 3$ (15)

$IF\big((NP_{PerEv} = 3) \ AND \ (ILP = 0)\big) \ then \ PriIM = 2$ (16)

$IF\big((NP_{PerEv} > 3 \ )\big) \ then \ PriIM = \ 1$ (17)

Where the value 5 means very high priority for improvement, 4 means high priority for improvement, 3 means medium priority for improvement, 2 means normal priority for improvement, and 1 means low priority for improvement.

- The algorithm model will suggest a prioritized action plan according to the selection in the previous steps. The prioritized action plan will contain the criterion/ practice that needs very high priority for improvement, or high priority for improvement according to the selection in the previous steps by implementing the following mathematical equation:

$IF \ PriIM = \ 5 \ then$

$add \ to \ the \ top \ list \ of \ the \ prioritized \ action \ plan$

$else \ IF \ PriIM = \ 4 \ then$

$add \ to \ the \ bottom \ list \ of \ the \ prioritized \ action \ plan$ (18)

IV. IMPLEMENTATION

The implementation of the smart rubric-based systematic model showed very efficient and effective result in supporting institution and programs in auto-evaluating, auto-prioritizing, and auto-calculating the performance level of NCAAA standards. The proposed model provides a visual and easy selection rubric to support the users to evaluate the criterion/ practice according to the designed rubric in the previous section. When the user selects the performance level of each evaluation element, the smart rubric (as shown in Fig. 7 for NCAAA 2009 standards, and Fig. 8 for NCAAA 2018 standards) can auto-evaluate criterion/ practice, auto-calculate the star/ point, and auto-prioritize and suggest priority for improvement of criterion/ practice.

The smart rubric can support and facilitate academics and administrative workers by suggesting a prioritized accurate action plan according to the criterion/ practice performance evaluation as shown in Fig. 9. The accurate action plan will lead to enhance the university's/ program's quality of education and facilitate the tasks of obtaining NCAAA accreditation.

The smart rubric can provide a comparison of the standards performance evaluation (as shown in Fig. 10 for NCAAA 2009 standards, and Fig. 11 for NCAAA 2018 standards) which will support the institutions to easily take decisions for improvement.

Fig. 7. Smart Rubric-based Screenshot for Evaluating and Prioritizing Academic Practices NCAAA 2009 Standards.

Fig. 8.   Smart rubric-based Screenshot for Evaluating and Prioritizing Academic Practices NCAAA 2018 Standards.

Fig. 9.   Suggested Prioritized Action Plan According to the Criterion/ Practice Performance Evaluation.
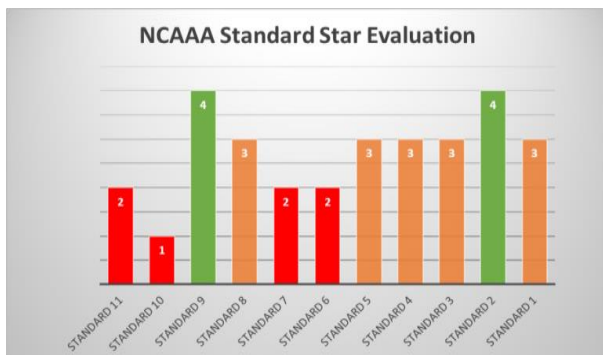

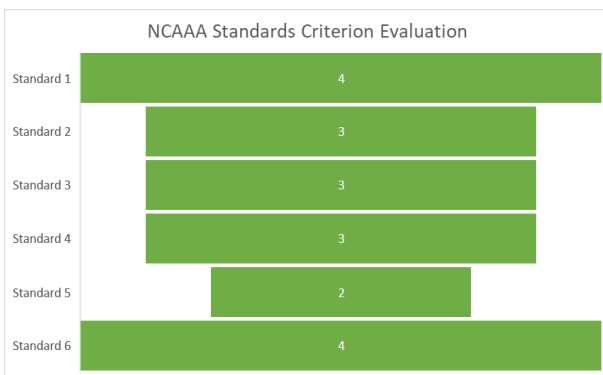Fig. 10. A Comparison of the NCAAA 2009 Standards Performance Evaluation.

Fig. 11. A Comparison of the NCAAA 2018 Standards Performance Evaluation.

Moreover, the smart rubric can provide analysis of the improvement priority for the standards as shown in Fig. 12 which will support the institutions to focus more in the improvement actions on the standards that need more priority for improvement.

The smart rubric can also provide a comparison of the performance evaluation at the criterion/ practice level as shown in Fig. 13. Thus, an action plan can be implemented at the criterion/ practice level.

Moreover, the smart rubric can provide analysis of the institution / program total quality performance status based on the criterion/ practice improvement priority as shown in Fig. 14.
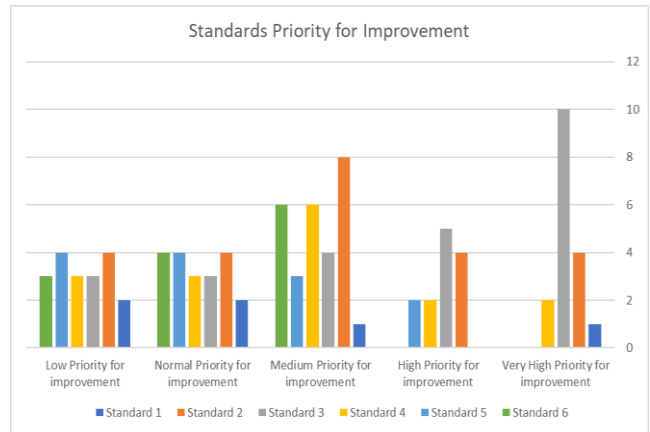

Fig. 12. An Analysis of the Improvement Priority for the Standards.
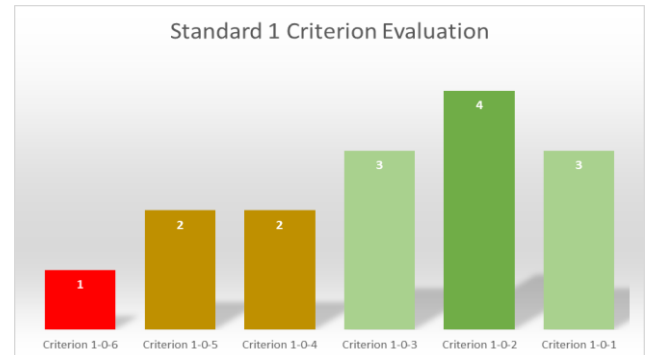

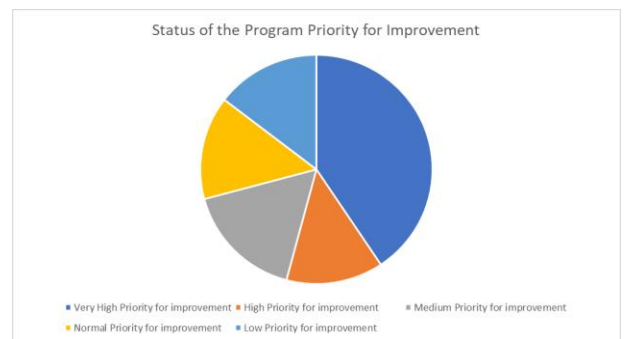Fig. 13. A Comparison of the NCAAA 2018 Criterion Performance Evaluation.

Fig. 14. An Analysis of the Institution / Program Total Quality Performance Status based on the Criterion/ Practice Improvement Priority.

Thus, if the analysis shows that many criterion/ practices needs very high or high priority for improvement, it means the institution / program total quality performance is low. On the other hand, if the analysis shows that many criterion/ practices needs normal or low priority for improvement, that means the institution /program total quality performance is high. Based on that, the smart rubric can provide a specific percentage about the institution's / program's total quality performance status as shown in Fig. 15.

In addition, the smart rubric can provide comparison of standards performance improvement compared to previous self-assessments shown in Fig. 16 to help institution / program to analyze the enhancement actions trend across different assessment cycles.

Fig. 15. A Specific Percentage about Institution / Program Total Quality Performance Status.

Fig. 16. A Comparison of Standards Performance Improvement Compared to Previous Self-Assessment Cycle.

V. CONCLUSION

NCAAA standards in Kingdom of Saudi Arabia aim to prepare highly qualified graduates to meet the new challenges causes by the impact of free-market economy, globalization, and knowledge economy. However, implementing NCAAA standards without supportive systems has been found to be a very complex task. In this paper, we have described the development of a very sustainable and efficient smart rubric-based systematic model for evaluating and prioritizing NCAAA criterions/ practices and developing an accurate quality action plans based on the criterions/practices evaluation. The implementation of the proposed smart rubric-based systematic model demonstrates a high degree of validity, usefulness, accuracy for developing an implementation action plan. Moreover, reduces the time and efforts for evaluating NCAAA criterions/ practices by auto-evaluating, auto-calculating the star/ point, and auto-prioritizing and suggesting priority for improvement of criterion/

practice. Furthermore, the proposed smart rubric-based systematic model supports the academic institution's/ program's decision making by providing analysis of the standards improvement priority, analysis of the performance evaluation at the criterion/ practice level, analysis of the total quality performance status, analysis of standards performance improvement compared to different assessment cycles, and provides a specific percentage of the total quality performance status. Therefore, Saudi higher educational institution and programs can implement accurate action plans that will lead to enhance the quality of education and to obtain NCAAA accreditation.

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