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Introducing "Student Staff Utilized Index" as a quantification index of education

Background: In this article "Student to Staff Index" was improved by implying student grades and staff academic ranks in every institute as a new "Standard Student to Staff Index". Also "Student from Staff Utilized Index" was introduced for controlling and ranking the private universities.

Methods: This index uses the numbers of classes and students attended in each class, and also the grade of the staff and their teaching hours during each semester or academic year, and are presented as a descriptive study.

Results: Data for calculation of these indexes were used from two universities of non-private and private using mostly wide range of specialist teachers as part-time or fee staff. The SSU Index of these two institutes for BSc students and assistant professors were respectively 1.14 and 1.33.

Conclusions: The results showed that the institutions can use more staff via invited part-time and hence select those with expert knowledge and more specialization. Utilizing Student (BSc.) to Staff (assist. Prof.) Index showed that it can be used for comparing and ranking of educational situation or qualifying the educational services in universities.

Keywords: Standard Student to Staff Index, Student/Staff Utilized Index, Student/ Staff allocation Index

تقديم "مؤشر ربح الطالب من الاستاذ" كمؤشر كمي لتقييم التعليم في مراكز التعليم العالي

الخلفية والهدف: في هذه الدراسة، أثناء تصحيح المؤشر العام "عدد الطلاب بالنسبة لأعضاء هيئة التدريس" من خلال النظر في المستويات التعليمية للطلاب والرتبة الأكاديمية لمعلميهم في كل مركز واستخدام المعيار القياسي "عدد الطالب بالنسبة لأعضاء هيئة التدريس" تم الاخذ والتعريف لمؤشر جديد و حقيقي لتقييم و ترتيب جودة التعليم للمؤسسات التعليمية تحت عنوان "مؤشر ربح الطالب من الاستاذ".

الأساليب: يستخدم هذا المؤشر عدد الفصول والطلاب الذين حضروا في كل فصل، وكذلك تم إدخال رتبة الموظفين خلال كل فصل دراسي أو عام دراسي والذي تم تقديمه كدراسة وصفية.

النتائج: بلغت نتائج جمع البيانات وحساب هذا المؤشر في مؤسستين تعليميتين حكوميتين وغير حكومية 1,14 في المركز العام و 1,33 في المركز غير الحكومي على التوالي.

الخلاصة: تشير هذه النتائج إلى أنه في حين استخدام أكثر وبالتالي أكثر تخصصاً من قوى الكلية، سواء كانوا يعملون ودعوا في شكل رسوم بدوام جزئي أو رسوم دراسية في المراكز التعليمية، يمكننا استخدام مؤشر ربح الطلاب في فترة معينة (كدرجة البكالوريوس) استخدام أعضاء هيئة التدريس برتبة معينة (أستاذ مساعد) للمقارنة والاستخدام في ترتيب الوضع التعليمي أو تقديم الخدمات التعليمية في المراكز التعليمية.

الكلمات الرئيسية: المعيار القياسي لعدد الطالب بالنسبة لأعضاء هيئة التدريس، مؤشر ربح الطالب من الاستاذ

معرفی "شاخص بهره مندی دانشجو از هیأت علمی" به عنوان شاخص کمی ارزیابی آموزش در مراکز آموزش عالی

زمینه و هدف: در این مطالعه ضمن اصلاح شاخص کلی "دانشجو به هیأت علمی" با لحاظ نمودن مقاطع تحصیلی دانشجویان و رتبه علمی مدرسین آنها در هر مرکز و نیز استفاده از "شاخص استاندارد دانشجو به هیأت علمی" نسبت به معرفی شاخص جدید و واقعی تری به منظور ارزیابی و رتبه بندی کیفیت آموزشی مؤسسات آموزشی با عنوان "شاخص بهره مندی دانشجو از هیأت علمی" اقدام گردیده است.

روش: این شاخص با لحاظ نمودن تعداد کلاس ها و دانشجویان حاضر در هر کلاس و نیز مرتبه اعضاء هیأت علمی اعم از تمام یا پاره وقت و ساعات تدریس آنها در هر ترم (یا سال تحصیلی) در هر مؤسسه، در قالب یک مطالعه توصیفی معرفی گردیده است.

یافته ها: نتایج جمع آوری اطلاعات و محاسبه این شاخص در دو مؤسسه آموزشی دولتی و غیردولتی به ترتیب 1,14 در مرکز دولتی و 1,33 در مرکز غیردولتی بدست آمد. **نتیجه گیری:** این نتایج بیانگر آنست که ضمن استفاده از تعداد بیشتر و در نتیجه تخصصی تر از نیروهای هیأت علمی اعم از استخدامی و مدعو در قالب پاره وقت یا حق تدریسی در مراکز آموزشی، می توان از شاخص بهره مندی دانشجویان در مقطع مشخص (کارشناسی) از هیأت علمی با مرتبه معین (استادیار) برای مقایسه و استفاده در رتبه بندی وضعیت آموزشی و یا ارائه خدمات آموزشی در مراکز آموزشی استفاده نمود.

واژه های کلیدی: شاخص استاندارد دانشجو به استاد، شاخص بهره مندی دانشجو از هیأت علمی، شاخص سهم دانشجو از استاد

اکادمیک کونسل سے طلباء کا استفادہ کرنے کا معیار، اعلیٰ علمی مراکز میں تعلیمی کیفیت کے جانچنے کا معیار ہے۔

بیک گراؤنڈ: اس تحقیق میں اساتذہ سے حصول علم کی روشوں کی اصلاح کی گئی، اس امر کے لئے مدرسین کی علمی صلاحیتوں اور طلباء کے تعلیمی سال کا خیال رکھا گیا ہے۔ اساتذہ اور طلباء کے معیار کو بھی ایک نئے اور حقیقی معیار کی حیثیت سے متعارف کرایا گیا ہے۔ یہ روش تمام علمی مراکز میں اپنائی گئی ہے۔ اس روش کو اساتذہ کی صلاحیتوں سے طلباء کے بہرہ مند ہونے کا نام دیا گیا ہے۔

روش: اس تحقیق میں کلاسوں اور طلباء کی تعداد اور اکادمیک کونسل کے اراکین اور یہ کہ وہ کتنے گھنٹے تدریس کرتے ہیں، اس کا جائزہ لیا گیا، اس تحقیق میں تمام تعلیمی مراکز کو شامل کیا گیا ہے۔

نتیجے: سرکاری مراکز سے حاصل شدہ ڈیٹا کی نسبت ایک اعشاریہ ایک چار اور غیر سرکاری مراکز سے حاصل شدہ ڈیٹا کی نسبت ایک اعشاریہ تین تھی۔

سفارش: ان نتائج سے یہ معلوم ہوتا ہے کہ اعلیٰ تعلیمی مراکز مزید ماہر اساتذہ سے استفادہ کرسکتے ہیں یعنی تجربہ کار پروفیسروں کو تدریس کی دعوت دے کر یا پھر لکچروں کو ملازمت دے کر ان کی خدمات حاصل کرسکتے ہیں۔ بی ایس سی کے طلباء کے لئے اسٹنٹ پروفیسر کی خدمات حاصل کرکے تعلیمی معیارات کو جانچا جاسکتا ہے نیز یونیورسٹیوں میں صورتحال کا جائزہ لیا جاسکتا ہے۔

کلیدی الفاظ: تعلیمی معیار، پروفیسر، ملازمت، بی ایس سی

INTRODUCTION

Nowadays, educational quality improvement on higher education is undoubtedly one of the main apprehensions of the administrators, inspectors, and providers of these services in the universities and governmental or nonprofit-private higher education centers. It is also important for students to choose their field and select the institution for their studies.

The Student to Staff Ratio has been used for more than few decades by most of national and international statutory and regulatory bodies in terms of input quality for accrediting university courses as an indicator of investment in resources, rising tuition fees, and admission of potential students (1). There are several other quality and quantity indexes related to the student educational and welfare spaces, educational and laboratory equipment for assessing and grading higher education institutions. These indexes are concerned with the specifications such as education, research, art skills est., and academic discipline or supervision strategy, and are defined and stated by Higher Education Statistical Agencies (2).

As the student levels of education on different grades of BSc, MSc., and PhD. are entirely different, their lecturers whether they are tutors, assistants, associates or professors should be determined according to those degrees; therefore, using SSR in the centers with different students' grades and staff academic ranks cannot be the only and suitable index for evaluating educational services. Also in the private centers which have mostly no tendency to recruit academic staff and use part-time or fee staff, this index is not real and cannot be used as a reliable index for grading the institutions. This study tries to use "Standard Student to Staff Index" and also introduce a new index of "Student Staff Utilized Index" in a semester or a year which can be used as a quality criterion for assessing educational services and grading of the institutions. Also this study presents a comparison of their efficiency by calculating them in two educational centers with different specifications as governmental and nonprofit-private institutions.

METHODS

As the SSR index in a center cannot be the criterion for evaluation of providing educational services solely, "Standard Student to Staff Index" has been introduced in 2016 (3) by equation no. 3 using weighting factors of the student on different grades and staff with different academic ranks. Situation of different educational institutions can be ranked using values of this index with proposed Likert Scale Method (4). In state universities, which have mostly large numbers of students and recruited staff, this index can only show the general situation of the institute, without any hint to details such as the number of students attending at each class, student grades, and provided subject unites. However, this index cannot be suitable and valid in private and nongovernmental institutions which are mostly confronted with the shortage of full time academic staff, as they usually tend to use invited part-time or fee staff due to surplus financial expenses of recruiting them.

This study tries to modify the SSR index by using the

students' grades and staff academic ranks of the institute and the Standard Student to Staff Index, and also introduce a new and most real quantitative index named "Student Staff Utilized Index" for assessing and ranking the educational quality in the institutions. This index will consider the number of classes and attendee students, academic ranks of staff, and the number of their lectures on a semester (or academic year) in each institution.

To calculate these indexes, the Conversion Factor of Student (CFS) to each other based on Standard Students' number (SSni) of each class, and also Quality Factor of Staff (QFS) based on educational load or Compulsory Teaching Hours (CTHg) should be determined, these data are on the tables 1 and 2 below.

Table1. Standard Student number of each class in different grades (SSni)

Educational grades	Standard Student number
PhD.	4
MSc.	8
BSc.	20
Skill	25

Table2. Compulsory Teaching Hours of full-time staff at different academic ranks (CTHg) (5)

Academic rank	Compulsory Teaching Hours of staff
Professor	14
Associate prof.	16
Assistant prof.	18
Tutor	20

Conversion factors of defined students' grades to each other, e.g. to BSc. Degree, and quality factor of defined staff to other ranks e.g. assistant prof., can be calculated using data of above tables with equations of 1 and 2 below.

$$1) \text{ Conversion Factor of Students to BSc (CFS}_{BSc}) = \frac{\text{Standard Student number of BSc}}{\text{Standard Student number of defined section}} = \frac{20}{SSn_i}$$

and

$$2) \text{ Quality Factor of Staff to assist. Prof. QFS}_{(associate \text{ Prof.})} = \frac{\text{Compulsory Teaching Hours of assist. Prof.}}{\text{Compulsory Teaching Hours of defined staff}} = \frac{18}{CTH_{assist.Prof.}}$$

Values of these factors, using data of tables 1 and 2, are shown on tables 3 and 4.

Table3. Conversion factor of defined student to BSc. Degree (CFS _{BSc})	
Education grades	Conversion factor of defined student to BSc.
PhD.	5
MSc.	2.5
BSc.	1
Skill	0.8

Table 4. Quality factor of staff to assist. prof. (QFS _{assist.prof.})	
Academic rank	Quality Factors of Staff to assistant prof.
Professor	1.285
Associate prof.	1.125
Assistant prof.	1
Tutor	0.9

Assuming Ni and SSni as respectively the total number of student and standard student number of each class at section i, CFSBSc conversion factor of a defined student to BSc grade, Mg number of staff at rank g, and CTHg maximum compulsory teaching hours, the modified SSR and Standard student to staff indexes could be calculated with equations 3 and 4 below.

$$3) \text{ Student}_{(BSc)} \text{ to Staff}_{(assist.prof.)} \text{ Ratio} = \frac{\text{No. of student normalized to BSc.}}{\text{No. of staff normalized to assistant prof.}} = \frac{\sum_i N_i \times \frac{20}{SSn_i}}{\sum_g M_g \frac{18}{CTH_g}}$$

and

$$4) \text{ Standard Student}_{(BSc)} \text{ to Staff}_{(assist.prof.)} \text{ index} = \frac{\text{No. of student normalized to BSc./20}}{\text{No. of staff normalized to assistant Prof.}} = \frac{\sum_i N_i \times \text{CFS}_{BSc}/SSn_i}{\sum_g M_g \frac{18}{CTH_g}}$$

In this equation SSS index would be a unit, if the number of student and staff are exactly equal to the standards ones. An index value of less than unit indicates the shortage of students (or additional staff) and more than unit indicates that it is vice versa.

In private-nonprofit institutions which are mostly faced with the shortage of full time academic recruited staff and tend, as far as possible, to provide their staff via inviting part-time or fee staff, the number of staff at each grade (Mg) in the equations should be sum of recruited full time staff and invited or fee staff as a full-time equivalent (FTE) staff. The full-time equivalent (FTE) staff at rank g can be calculated with the equation 5 below.

$$5) \text{ No. of full time equivalent staff with grade g} = \frac{\text{No. of unite lectured by invited staff with grade g}}{\text{Compulsory Teaching Hours of staff with grade g}}$$

The number of students in each class, due to the difficulties on the admission process in nonprofit-private institutions, are very often more or less than the standard one; however, changing number of student in a class would change their contributions, and accessing to the staff, therefore, is defined as a new index which quantitatively shows educational situation of higher education institutions as a "Student Staff Utilized Index". This index, through using the standard number of student to attended ones at a class (SSn_i/n_i) and quality factor of staff to a certain rank (QFS_g), can be calculated with equation 6 for different grades of undergraduate and post graduate students.

$$6) \text{ Student Staff Utilized Index} = \frac{\sum_{BSc\&lower} (\frac{SSn_i}{n_i} \times QFS_{assist.Prof.}) + \sum_{MSc,PhD} (\frac{SSn_i}{n_i} \times QFS_{associa.prof.})}{\text{Total no. of lectures in a semester or a year}}$$

As the Higher education developmental committee, the Ministry of science, research and technology [5] necessitate presence of at least one staff with the rank of assistant prof. for establishing the undergraduate academic grades, and a staff with the grade of associate prof. for post graduate grades, therefore, in this equation for calculation SSU Index, the quality factor of staff were defined with respect to assistant prof. and associate prof. respectively for under and postgraduate classes.

RESULTS

In this study the Student _(BSc) to Staff _(assistant prof.) Ratio, Standard Student_(BSc) to Staff _(assistant prof.) Index, and Utilized Student to Staff Index were calculated from a state university and a private-nonprofit institution in the first semester of 2019-2020, using equations of 3, 4 and 6 above.

A) In the private-nonprofit institution 560 different unit lessons were presented on 251 classes for 755 undergraduate students of human science, by 111 staff with the grad of tutors (87), assistant prof. (24) as shown in table 5 and 6 below. In the state university 658 different unit lessons were presented on 336 classes for 810 BSc, 80 MSc and 9 PhD students of paramedical science, by 155 staff with the grade of tutors (60), assistant prof. (77), associate prof. (11) and professor (7) as shown in table 5 and 6 below.

The number of lecture classes versus different attended student in nonprofit institution is shown with a Bar graph in figure 1. In this institution the Standard Student (BSc) to Staff (assist prof) Index, Standard Student (BSc) to Staff (assist prof) Index, and Student Staff Utilized Index are respectively 28.2, 1.41 and 1.33 based on equation 3, 4 and 6. In these calculations the classes with one and two students, as an unwind class, were not included.

These numbers indicate that first for presenting 560 lecture units, with the same staff rank and their compulsory teaching hours, one need to use 20.1 and 8.7 staff with the rank of tutor and assist. Prof. respectively, which was practically done by 87 tutors, (4 recruited) and 24 assist. Professors (2 recruited). These numbers show that the institutions used more staff via invited part-time; hence they select those with expert knowledge as more specialized staff.

Table 5. Data of staff and presented units in a state and a nonprofit-private university

Staff rank	Nonprofit-private university			State university								
	Tutor	Assistant prof.	Total	Tutor		Assistant prof.		Associate prof.		Professor		Total
	U.G	U.G		U.G	P.G	U.G	P.G	U.G	P.G	U.G	P.G	
No. of presented units	403	157	560	250.5	2	234	89	41.5	2	29	10	658
Full-time equivalent staff	20.1	8.7	28.8	12.5	0.1	13.0	4.9	2.6	0.1	2.1	0.7	36
No. of recruit staff	4	2	6	2		22		2		5		31
No. of invited staff	83	22	105	58		55		9		2		124

P.G=Post Graduate students, U.G=Under Graduate students

Table 6. Data of students and educational qualified indexes in a state and a nonprofit-private university

Educational data	Nonprofit-private institution		State university	
	Student grade		U.G	P.G
No. of students			755	810
No. of students normalized to BSc.			755	1055
No. of departments			9	8
% of recruited staff			20.8 %	80.5 %
No. of staff normalized to assist. prof.			26.8	35.9
Student _(BSc) to Staff _(assist prof) Ratio Index			28.2	29.4
Standard Student _(BSc) to Staff _(assist prof) Index			1.41	1.47
Student Staff Utilized Index			1.33	1.14

The number of lecture classes versus different attended student in nonprofit institution is shown with a Bar graph in figure 1. In this institution the Standard Student (BSc) to Staff (assist prof) Index, Standard Student (BSc) to Staff (assist prof) Index, and Student Staff Utilized Index are respectively 28.2, 1.41 and 1.33 based on equation 3, 4 and 6. In these calculations the classes with one and two students, as an unwind class, were not included.

These numbers indicate that first for presenting 560 lecture units, with the same staff rank and their compulsory teaching hours, one need to use 20.1 and 8.7 staff with the rank of tutor and assist. Prof. respectively, which was practically done by 87 tutors, (4 recruited) and 24 assist. Professors (2 recruited). These numbers show that the institutions used more staff via invited part-time; hence they select those with expert knowledge as more specialized staff.

Increasing the Standard Student (BSc) to Staff (assist prof) Index to 1.41 could be due to attending more students than standard capacity in some classes or using staff with lower ranks such as tutors or lecturers. Nevertheless, based on the data shown in figure 1 and Student Staff Utilized Index of more than unit (1.33), it first means that the number of students were often less than standard in classes and hence there is better allocation from staff with assistant. prof. rank, and secondly one can conclude that increasing SSS index is mainly due to the use of more staff with academic ranks of tutors or lecturers.

B) In the state university 103 and 555 different unit lessons were presented respectively on 55 and 283 classes of post and undergraduate students of paramedical science, by 155 staff as shown on table 5. In this university the Standard Student (BSc) to Staff (assist prof) Index, Standard Student (BSc) to Staff (assist prof) Index, and Student Staff Utilized Index are respectively 29.4, 1.47 and 1.14 based on equation 3, 4 and 6, (the SSU indexes are 0.99 and 1.75 for under and postgraduate students respectively). In these calculations the classes with one and two students, as an unwind class, were not included.

These numbers show that first for presenting those lectures, with the same staff rank and compulsory teaching hours, one need to use 12.6 tutors, 17.9 assistant Prof., 2.7 associate Prof. and 2.8 professors, for students on BSc. and postgraduate grades, but they were practically done by 60 tutors, (2 recruited) and 77 assistant Prof. (22 recruited), 11 associate Prof. (2 recruited), and 7 professors (5 recruited) which means the university used more staff via invited part-time and hence it selected those with expert knowledge and more specializations. Secondly, although staff of some BSc classes were tutors who cause to increase the SSS index to 1.47, but SSU index of 0.99 for BSc student and 1.14 for total students, showed the optimal use of staff ranks. The increase of this index to 1.75 for postgraduate students is also due to the students' shortages and use of staff with higher ranks, with respect to standards in these classes.

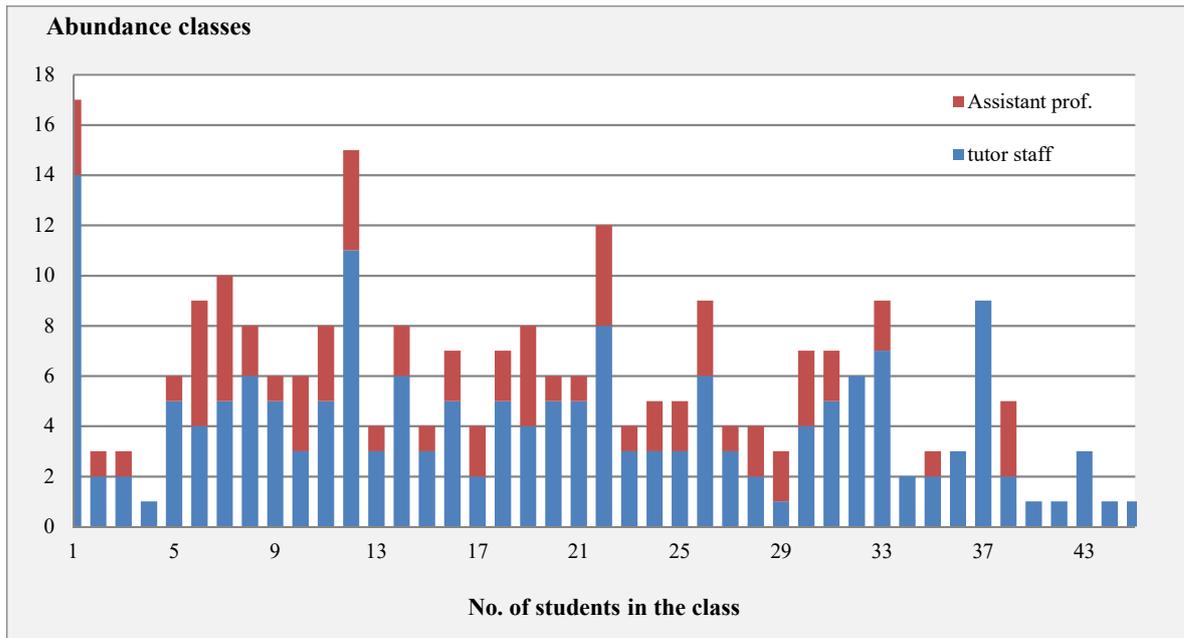


Figure 1. Bar graph of abundance of the lesson classes according to number of students in nonprofit institution

Finally, the SSU indexes with small differences between state university (1.14) and nonprofit-private institution (1.33), and increase of this index for postgraduate students (1.75), results showed that the governmental educational centers spend most of their academic potentials for postgraduate grades of MSc. and PhD.

DISCUSSION

The Standard Student_(BSc) to Staff_(assist prof) Index at paramedical faculty in 2012 (3), was reported 4.8, while in this study it improved to 1.47. The reason of this reduction is due to different standard capacity of the classes according to the ministry of science, research, and technology and the ministry of health and medical education, and other parts due to continuous developments of educational quality through increasing number and ranks of academic staff. In this study the indexes were calculated with standards of the ministry of science, research and technology.

The studies showed that using and comparing these indexes for grading institutions should have an attention that these indexes cannot be used solely and are mostly dependent on time of study and nature of educational fields, such as medical basic science, engineering, managements, arts, social science etc. which have different educational strategy planning e.g. theoretical, practical or skills, and some of them uses academic aids for refining and quickening education (1).

In the SSR index, the time of study and nature of educational fields would depend on lots of other different factors such as number of optional and special units in the educational programs, research, and also to the field and grades of students. This index has been recently reported from 10.3 up to 22.3 between 10 top universities in the U.K (6).

Nevertheless, if calculated as a student (with defined grade) to staff (with defined grade) index, similar fields and plans could be used as suitable criteria for only comparing the quality of academic staff usage on state universities with high percent of recruited staff.

The student (with defined grades) to staff (with defined grade) index with USS index, on basic and human sciences, whether or not in state or nonprofit-private centers which tends to use part-time or fee staff can be used for assessing, comparing and ranking the educations situations on presenting academic services with suitable precision.

In two centers in this study, it was shown that besides using more staff via invited part-time or fee staff and hence selecting the expert knowledgeable and more specialized staff, one could use the SSU index of 1.14 and 1.33 on similar centers such as state and nonprofit-private academic centers for ranking educational situations.

Ethical consideration: Ethical issue (including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the author.

ACKNOWLEDGEMENT

We would like to thank our expert colleagues in the education offices of the universities for their cooperation on data collections.

Financial support: There was no financial support.

Conflict of interest: There was no conflict of interest.

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