

Effect of integrating research skills with basic sciences in an interdisciplinary integrated endocrine module on students' satisfaction and performance

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ABSTRACT

Background: A system-based integrated curriculum has been implemented at Faculty of Medicine, King Abdulaziz University since the academic year 2006/2007. There were many calls to increase the integration level and to integrate the scientific research skills into the medical curriculum. **Objectives:** This study aimed to document the steps taken to establish a higher level of integration of basic sciences along with the scientific research skills and to assess the effect of such changes on student satisfaction and performance. **Methods:** The integration level among the endocrine basic sciences was increased from the temporal co-ordination to the interdisciplinary level. Students' assessment methods were modified accordingly. Scientific research skills were incorporated into the module. Students' satisfaction and performance were compared before and after implementation of these changes. **Results:** A significant increase in students' satisfaction with the module organization was recorded. A significant increase in students' self-reported motivation to study the endocrine subject matter as well as improvement of their research skills was also reported compared to that of the students studied the module before the reform. The percentage of students got grade an after modular reform was significantly higher compared to those who studied the traditional module while the overall success rate showed non-significant increase. **Conclusion:** This interdisciplinary integrated endocrine module provides framework and tips for module construction that would improve critical thinking skills, research skill and prepare the students to be life-long learners.

Key words: System- based, Module, Integration, Research, Satisfaction, Performance.

INTRODUCTION

Medical education is showing a trend towards inculcating critical thinking and reasoning skills and developing a positive attitude among students towards scientific research from the start of their medical career.¹ Performing undergraduate research has been shown to support students' attitudes towards research later in their careers and increase the possibility of a career in academic medicine.² The specific competencies that could be enhanced through medical students' involvement in research that include improving their long term career prospect and broad knowledge base, boosting their career profile, evolving their critical appraisal and thinking,

increasing their information literacy as well as helping shape the medical students by cultivating their critical judgment.^{3,4} Taking into consideration all these benefits in addition to the impact of having published researches on the acceptance of Saudi medical students in international schools that was observed, Faculty of Medicine (FOM), King Abdul aziz University (KAU) as well as many other Saudi medical Schools are taking steps to integrate research into the undergraduate medical school curriculum.

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Recognizing the importance of integration in medical curriculum that became prevailing trend around the world, the FOM at KAU developed its curriculum from traditional discipline-based to integrated system-based curriculum in the academic year of 2006/2007. The developed curriculum included pre-clinical and clinical phases. During the preclinical phase, some core courses of basic sciences and system-based modules are taught while in the clinical phase the major clinical clerkships as well as sub-specialties are taught.⁵ The endocrine system module is one of the system-based modules taught during the third year of the curriculum. It included the study of the structure and function of the endocrine organs including the pituitary, thyroid, parathyroid, adrenal glands and pancreas in relation to health and disease states. It was designed to be in the temporarily coordinated level of the integration ladder.⁶ Several teaching modalities such as lectures, problem-based learning (PBL), practical sessions, clinical presentations and student directed learning (SDL) were used in this module.

Despite the efforts spent to establish integration between module content, students satisfaction assessed at the end of the last two academic years showed incomplete satisfaction with the integration within the modules. In response to that, as well as the recommendations to integrate research skills into the curriculum, the committee responsible for the endocrine module in collaboration with the medical education department (MED) worked to increase the level of the integration of the module in order to heighten students' understanding of the basic science of the endocrine system as well as improve student's critical thinking and help them to apply the scientific research skills taught to them in the previous module in the context of the endocrine health problem.

This paper aimed to document the steps taken to establish a higher level of integration of basic sciences along with the scientific research skills and to assess the effect of such changes on student satisfaction and performance. It will serve as a useful model for other medical schools aiming to improve integration levels in their curriculum.

MATERIALS AND METHODS

An ethical approval of this research article has been obtained from the biomedical research ethics committee, Faculty of Medicine, King Abdul aziz University.

The module reform was done by the module committee in collaboration with the medical education department in the light of the results of the module evaluation surveys filled by both students and faculty members

during the last two years as well as the recommendation of the curriculum committee to integrate scientific research skills into the modules in order to enhance undergraduate students participation in research.

Steps of module reform:

1. Extensive revision of the module intended learning outcomes, contents and assessment methods were conducted by the module committee.
2. Implementing the steps of upgrading the integration level in the cardiovascular system module that was previously described by [Ayuob et al.](#)⁷ in order to reach the interdisciplinary level described by Malik and Malik.⁸ The clinical themes set for the endocrine module included diabetes mellitus, pituitary disorders, Grave's disease and Cushing's disease. They were chosen with the consultation of the relevant clinicians and according to the commonality across the module objectives as well as the commonality of the community.
3. Joint session between histology, physiology and clinical biochemistry instructors were conducted to explain the pathophysiological aspect of thyroid disorders and diabetes mellitus instead of discrete lectures. This was aiming to get rid of redundancy and ensure horizontal integration between these basic sciences.
4. The study guide of the students was revised and supplied with self-assessment tools like multiple choice questions (MCQs), clinical scenarios- based questions as well as research assignments.
5. When it came to students' research skills, one of the valid students' comments is that they have some theoretical knowledge about scientific research from their study in a previous course but they did not know how to apply this knowledge to start conducting research. So, in this module the emphasis was on how students be enabled to start thinking about the endocrine research area after have been exposed to it. They were encouraged to think about research question, test its novelty, then refine it and formulate specific research hypothesis and objectives. They were encouraged also to start writing a research proposal for their research ideas and have it discussed with the tutor. A protected 2 hours for research was allotted in the timetables.
6. The time allotted for the student directed learning (SDL) was increased to reach 6 hours/week.
7. Regarding the assessment of the research skills; the students were requested to submit their research proposals which were assessed by the tutor using a rubric.

8. On assessing the critical thinking of the students, case-based structure essay questions were introduced as an assessment tool in this module. A group of case scenarios with a series of questions covering different aspect of the case were written by the instructors and were revised by the relevant clinicians. The students were trained on this type of question during the tutorials as well as the formative assessment. Some of these questions were included also in the study guide.

In order to assess the effectiveness of the changes implemented in the endocrine module students' satisfaction was measured via a module evaluation questionnaire that was constructed by the medical education department in collaboration with the module committee members. The questionnaire was distributed to the 3rd year students in 2013-2014 who finished the reformed endocrine module as well as the 4th year students who finished the module on 2012-2013 (before reform). Students' response was classified according to five Likert scale; into extremely satisfied, highly satisfied, fairly satisfied, poor satisfaction, unsatisfied and cannot judge.⁹ The reliability of the questionnaire was calculated according to Cronbach and it was 0.83.¹⁰ The students assessment results, in the form of success rate and the percentage of students' grades in the module in the two consecutive years 2012/2013 and 2013/2014 was compared.

Statistical analysis was done using a statistical package of social science (SPSS) software, version 16 (2005). Kolmogrov-Smirnov test was used to check the normal distribution of data. The qualitative data were presented in the form of number and percentage while the quantitative was expressed as mean and standard deviation. Student *t*-test was used to compare the students' perception at different years.

A chi-square test, with linear trends, was used for ordinal qualitative data.

RESULTS

Regarding the changes that have been done in the instruction methods used in the endocrine module, it was observed that the percentage of the contact hours allotted to the didactic lectures was decreased (46.8 versus 37.5) while the percentage of the SDL contact hours was increased (6.3 versus 9.3) in year (2012-2013) compared to the year (2013-2014) (Table 1).

When comparing between the students assessment results using chi-square with linear trend in the year (2012-2013) to that of the (2013-2014), there was no statistical significance ($p=0.84$) in the overall success. The percentage of students who got grade A and B in (2013/2014) was significantly higher ($p=0.02$ and $p=0.04$) compared to that of (2012-2013). About 6% of the contact hours became allotted to the joint sessions that were conducted by many instructors of different specialties (Table 2).

When the students satisfaction with the module was compared and it showed that students in 2013-2014 were significantly more satisfied than those in 2012-2013 regarding incorporation of clinically relevant material ($p=0.01$), reasonable distribution of academic workload ($p=0.01$), gaining benefit from the study guide ($p<0.001$) and effectiveness of tutorial session in application of knowledge ($p<0.001$). The students in 2013-2014 were significantly more satisfied with the module organization ($p<0.001$) and the overall quality of the module ($p=0.03$) (Table 3).

When asked about the critical thinking and the scientific research skills, the students in 2013-2014 reported a higher significant self-reported learning ($p<0.001$) in these skills compared to those in 2012-2013. They also reported a higher motivation to study the subject matter of the module ($p<0.001$) and they gained benefit from

Table 1: Comparison between teaching and learning modalities and contact hours of the endocrine module in the year (2012-2013) and year (2013-2014)

Method of instruction	(2012-2013)		(2013-2014)	
	N	(%)	N	(%)
Lectures	30	46.8	24	37.5
Tutorials	7	10.9	7	11
Practical	7	10.9	7	11
SDL	4	6.3	6	9.3
Clinical Presentation	8	12.5	8	12.5
PBL	8	12.5	8	12.5
Joint sessions	0	0	4	6.3
Total	64	100	64	100

Table 2: Comparison between the students assessment results in the years (2012-2013) and (2013-2014)

		(2012-2013)		(2013-2014)		P value*
		N	(%)	N	(%)	
Overall success rate		321	97.9	403	97.8	0.84
Grade	A	40	12.2	75	18.2	0.02
	B	133	40.5	137	33.3	0.04
	C	101	30.8	119	28.9	0.63
	D	47	14.3	72	17.5	0.29
	F	7	2.1	9	2.2	0.84

*Significant is considered at $p < 0.05$.

Table 3: Comparison between year (2012-2013) and year (2013-2014) regarding student satisfaction with the module design

	(2012-2013) Mean \pm SD	(2013-2014) Mean \pm SD	P value*
Clarity and appropriate use of objectives	3.08 \pm 1.61	3.37 \pm 1.43	0.34
General module organization	2.82 \pm 1.24	3.81 \pm 1.4	<0.001
Quality of teaching	3.02 \pm 1.31	3.56 \pm 1.09	0.022
Academic workload/ demands on student time	2.4 \pm 1.61	3.16 \pm 1.26	0.009
Incorporation of clinically relevant material	2.54 \pm 1.51	3.25 \pm 1.24	0.01
I get benefit from the study guide	1.74 \pm 1.64	3.32 \pm 1.49	<0.001
The tutorial sessions helped me to understand and apply the knowledge.	1.88 \pm 1.65	4.02 \pm 1.18	<0.001
The formative test prepared me for summative assessment	2.05 \pm 1.47	3.38 \pm 1.33	<0.001
Fairness of exams and grading	2.51 \pm 1.63	2.61 \pm 1.55	0.740
Overall module quality	2.68 \pm 1.32	3.12 \pm 1.05	0.031

*Significant is considered at $p < 0.05$.

Table 4: Comparison between year (2012-2013) and year (2013-2014) regarding students self-reported learning during the module

	(2012-2013) Mean \pm SD	(2013-2014) Mean \pm SD	P value*
This module improved my critical thinking	1.85 \pm 1.43	2.86 \pm 1.46	<0.001
This module improved my skill in internet research	2.05 \pm 1.4	3.41 \pm 1.24	<0.001
This module improved my scientific research skills	1.65 \pm 1.47	2.8 \pm 1.65	<0.001
This module motivate me to learn the subject matter	2.22 \pm 1.37	3.25 \pm 1.33	<0.001
In this module, I received feedback about my progress in learning	2.25 \pm 1.61	3.02 \pm 1.63	0.016
This module prepared me for clerkships	3.17 \pm 1.65	3.72 \pm 1.05	0.027

*Significant is considered at $p < 0.05$.

the feedback they received ($p=0.016$) compared to those in in 2012-2013 (Table 4).

DISCUSSION

The ability of medical students to integrate knowledge acquired from basic sciences including biochemistry, physiology and pathology to the clinical venue lies in the core of medical practice and requisite for medical

profession has been previously raised.¹¹ Demonstrating this experience of upgrading the integration level within the pre-clerkship curriculum and documenting its effectiveness could be helpful for medical schools that are willing to enhance integration levels in their curriculum. It could also prove useful to those who intend to integrate their conventional discipline-based curriculum in order to help their students to cross-link and tie information to clinical applications and recall it after the tran-

sition to clinical clerkships.⁷ The present study aimed to explore satisfaction of medical students regarding their experience with endocrine module following its reform and compare it to those who study the traditional module. During module reform, the endocrine module committee with the medical education department promoted integration through setting combined lectures and joint sessions between different disciplines to eliminate irrelevant details that lack clinical relevance. In addition case scenarios were discussed in the lectures, tutorials and clinical sessions together with examples in the student study guide. This offered students the opportunity of a learning environment that enhance thinking and analyzing capabilities and this was evidenced by students who reported they have their critical thinking improved after study this module. The present findings agree with that of Tsinopoulos *et al.* who observed significant increase in 5th year medical students' satisfaction after implementation of integrated ophthalmology course.¹² Even the mean of their final grade was significantly higher compared to those taught with the conventional system. This was also evident in the present work as the students who scored "A" and "B" grade were significantly higher following implementation of the reformed endocrine module compared with those of the preceding year. Improved student and faculty satisfaction was earlier observed as a result of change from non-integrated to integrated medical curricula in the study of Rehman *et al.*¹³ The present results together with previous findings point to the effectiveness of implementing integrated curricula and its acceptance and preference by students. Following module reform, students were highly significant satisfied regarding the benefit they got from the study guide and how tutorials and formative assessment helped them get prepared for the summative one. This might reflect the real improvement in module content and formative assessment even the unstructured formative assessment offered in tutorial classes.

Importance of including research skills within undergraduate medical curriculum has been previously addressed by Collins *et al.*¹⁴ Students' motivation towards scientific research was stated as an essential element of modern undergraduate medical education curricula and the medical school graduates should be able to use research skills to develop better understanding and to affect their practice.^{15,16} Integrating the research further into the curriculum was among the recommendations concluded from previous studies conducted at the FOM, KAU.^{17,18} In response to that, the curriculum committee at the FOM encouraged integration of research skills into the course and modules. One interesting finding in the present work is the students' satisfaction regarding the

newly introduced module objectives related to the scientific research skills. While setting these objectives, we were inspired by research learning outcomes of GMC, but considering students' capabilities and their academic workload.¹⁹ Student satisfaction observed in the present work agrees with the insightful Students' feedback that demonstrated perceived attainment of research competencies in the study of Riley *et al.*²⁰ Students reported that the reformed module significantly improve their internet search as well as scientific research skills. In Charite' University Medical Centre Berlin, Germany, Students from the problem based medical curriculum showed greater participation in research production and felt more confident in their scientific competencies than other students.²¹ This is supported in this study as the PBL is one of the learning modalities in the endocrine module.

Limitations of the study: Qualitative analysis of the students learning and experience of the reformed endocrine module through focus group was not conducted although it could add to the understanding of the increased satisfaction of the students.

In conclusion, endorsement of both horizontal and vertical integration of basic sciences and incorporation of clinically relevant topics as well as scientific research skills in the endocrine module resulted in significant improvement of the students' satisfaction and acquisition of learning outcomes. This interdisciplinary integrated endocrine module provides framework and tips for module construction that would improve critical thinking skills, research skill and prepare the students to be life-long learners.

CONCLUSION

This interdisciplinary integrated endocrine module provides framework and tips for module construction that would improve critical thinking skills, research skill and prepare the students to be life-long learners.

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CONFLICT OF INTEREST

Authors declare no conflict of interest

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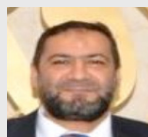
SUMMARY

- Increased level of integration as well as integrating scientific research skills resulted in a significant increase in students' satisfaction with the endocrine module organization.
- A significant increase in students' motivation to study the endocrine subject matter as well as improvement of their research skills was also reported after the module reorganization.

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