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The Hong Kong Academy for Gifted Education

RESEARCH REPORT

Relationships amongst student expectations on HKAGE, actual benefits from HKAGE and life satisfaction

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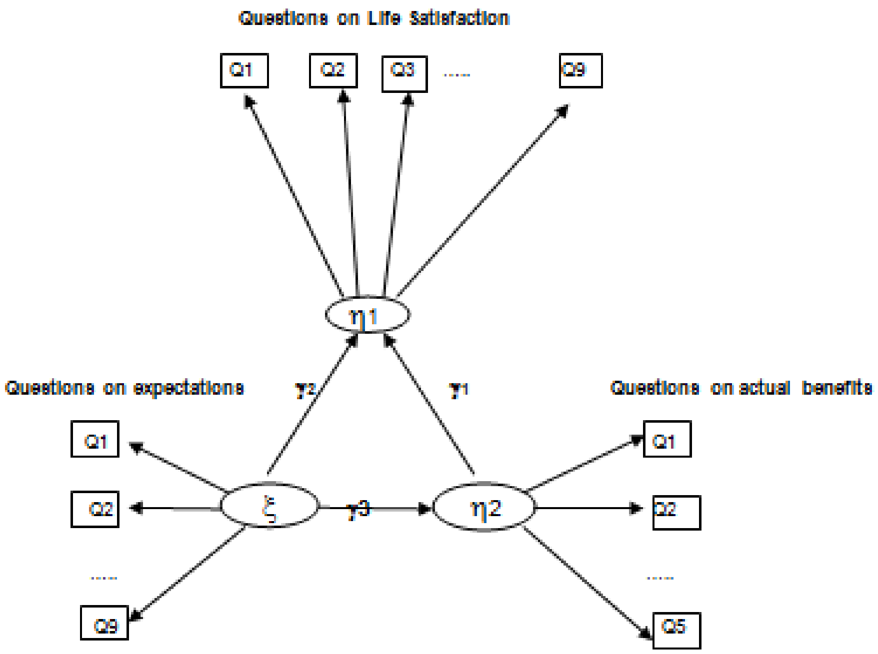
Background. In 2015 Student Tracking Study, 80 S3 and S6 secondary students have answered questions about the following aspects: (i) their expectations when enrolled in the HKAGE (totally 9 questions), (ii) benefits from the learning experiences offered by HKAGE (totally 5 questions), and (iii) life satisfactions (totally 9 questions). In this study, we suppose that one single latent factor governs each of these aspects and deploy Structural Equations Model (SEM) to explore the relationships amongst these latent factors.

Data analysis and Results.

Model building. The corresponding (simplified) path diagram depicting our initial model (M1) is shown below:



In the above diagram, eta1 (η1) is the latent variable that governs the responses on life satisfaction and eta2 (η2) is the latent variable that governs the responses on actual benefits obtained from the HKAGE. xi (ξ) is the latent variable that governs the responses on the expectations of HKAGE when enrolled in the HKAGE. Our main focus is the relationships amongst these latent variables which are represented by means of the following structural equations in the model language of **WINBUGS** (**B**ayesian Estimation **U**sing **G**ibbs **S**ampling**)**.

eta[i, 1]~dnorm(nu[i,1], psd[1])   eta[i,2]~dnorm(nu[i,2], psd[2])
nu[i, 1]<-gamma[1]*eta[i,2]+gamma[2]*xi[i]   nu[i, 2] <-gamma[3]*xi[i]

where i running from 1 to 80

Notes:

(i) The coefficient gamma[1](γ1) represents the impact from the latent variable eta2 (η2) to the latent variable eta1 (η1).

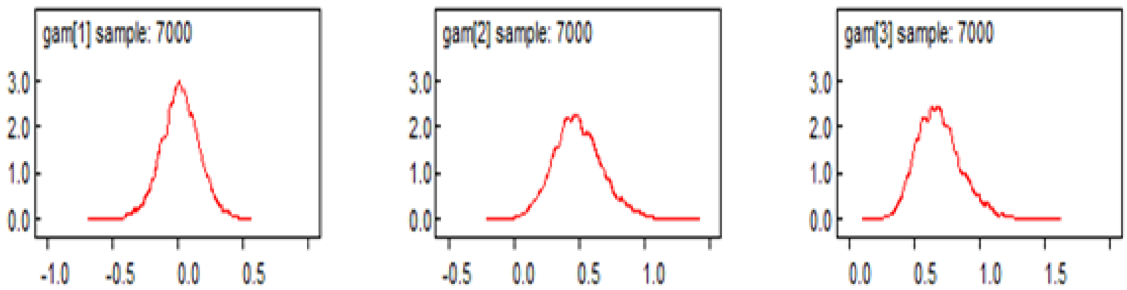
(ii) The coefficient gamma[2](γ2) represents the impact from the latent variable xi (ξ) to the latent variable eta1 (η1).

(iii) The coefficient gamma[3](γ3) represents the impact from the latent variable xi (ξ) to the latent variable eta2 (η2).

We adopt Bayesian approach[1] and the resultant estimations and their posterior densities of these coefficients obtained using the **MCMC** (**M**onte **C**arlo **M**arkov **C**hain) method are as follows:

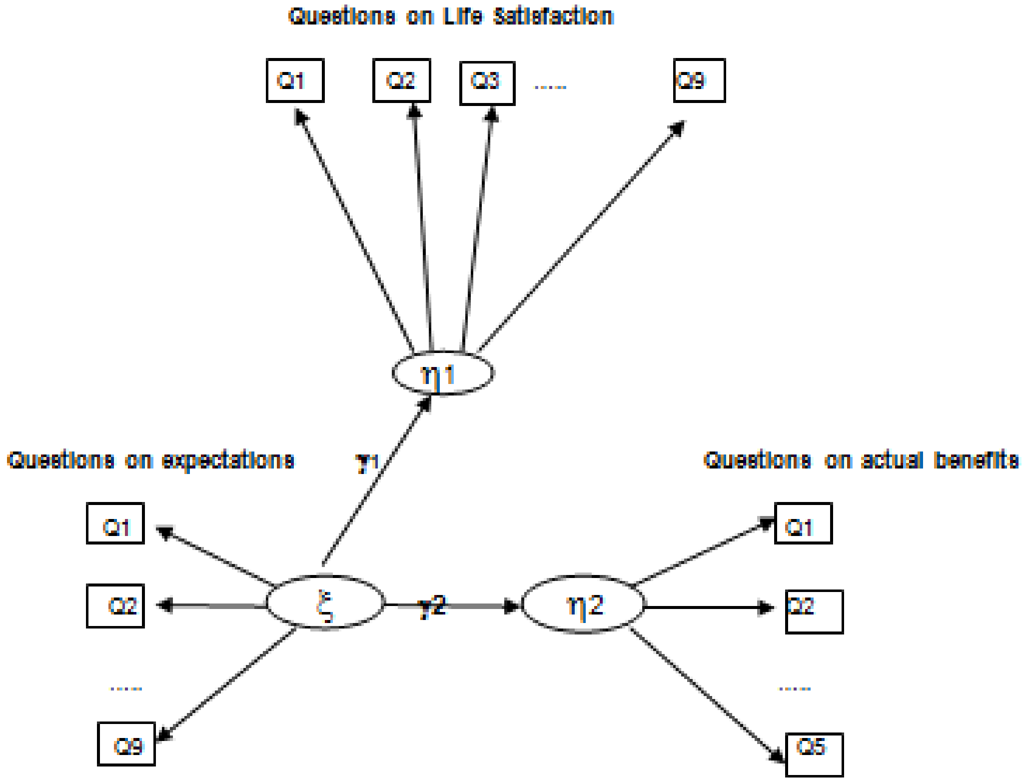
Table 1: Estimation results for the model M1

Node	Mean	SD	MC error	2.5%	Median	97.5%
gamma[1]	0.01753	0.1485	0.003956	-0.2854	0.01721	0.3137
gamma[2]	0.4965	0.1938	0.007265	0.1457	0.4842	0.9170
gamma[3]	0.6882	0.1766	0.008471	0.3906	0.6727	1.0820



[1] Sik-Yum Lee and Xin-Yuan Song. (2012) *Basic and Advanced Bayesian Structural Equation Modeling: With Applications in the Medical and Behavioral Sciences*, 1st edition, Wiley.

It can be observed that the coefficient of gamma[1] ($\gamma 1$) is not significantly different from 0, as 0 is well covered by the 95% credible interval. For the model M1, the corresponding **Deviance Information Criterion** (**DIC**) is 3598.02. DIC is one of the commonly used model comparison statistics provided by WINBUGS that compromises between the goodness of fit and model complexity. It is compiled by summing up two measures. One of them measures the goodness of fit of the model concerned and the other is called the effective number of parameters measuring the model complexity. In practical applications, the model with the smaller DIC value should be selected. If the difference in DIC between two models is less than 5, it is deemed to be small. With regard to the estimation results shown above, we revise the model and obtain **M2** as follows.



The corresponding structural equations in the model language of WINBUGS are below.

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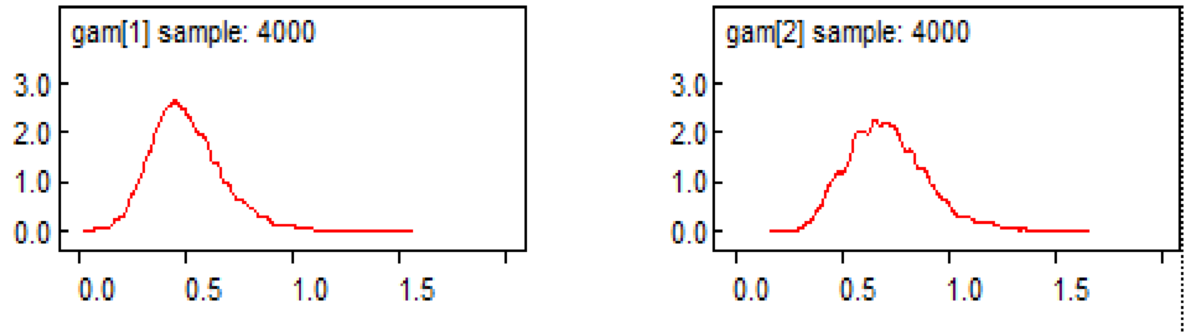
eta[i, 1]~dnorm(nu[i,1], psd[1])        eta[i,2]~dnorm(nu[i,2], psd[2])
nu[i, 1]<-gamma[1]*xi[i]                nu[i, 2] <-gamma[2]*xi[i]
```

where i running from 1 to 80

For M2, the value of DIC is 3590.44, which is smaller than that of M1 by about 8. Therefore M2 is adopted instead. The estimation results of gamma[1]($\gamma 1$) and gamma[2]($\gamma 2$) for M2 are shown below.

Table 2: Estimation results for the model M2

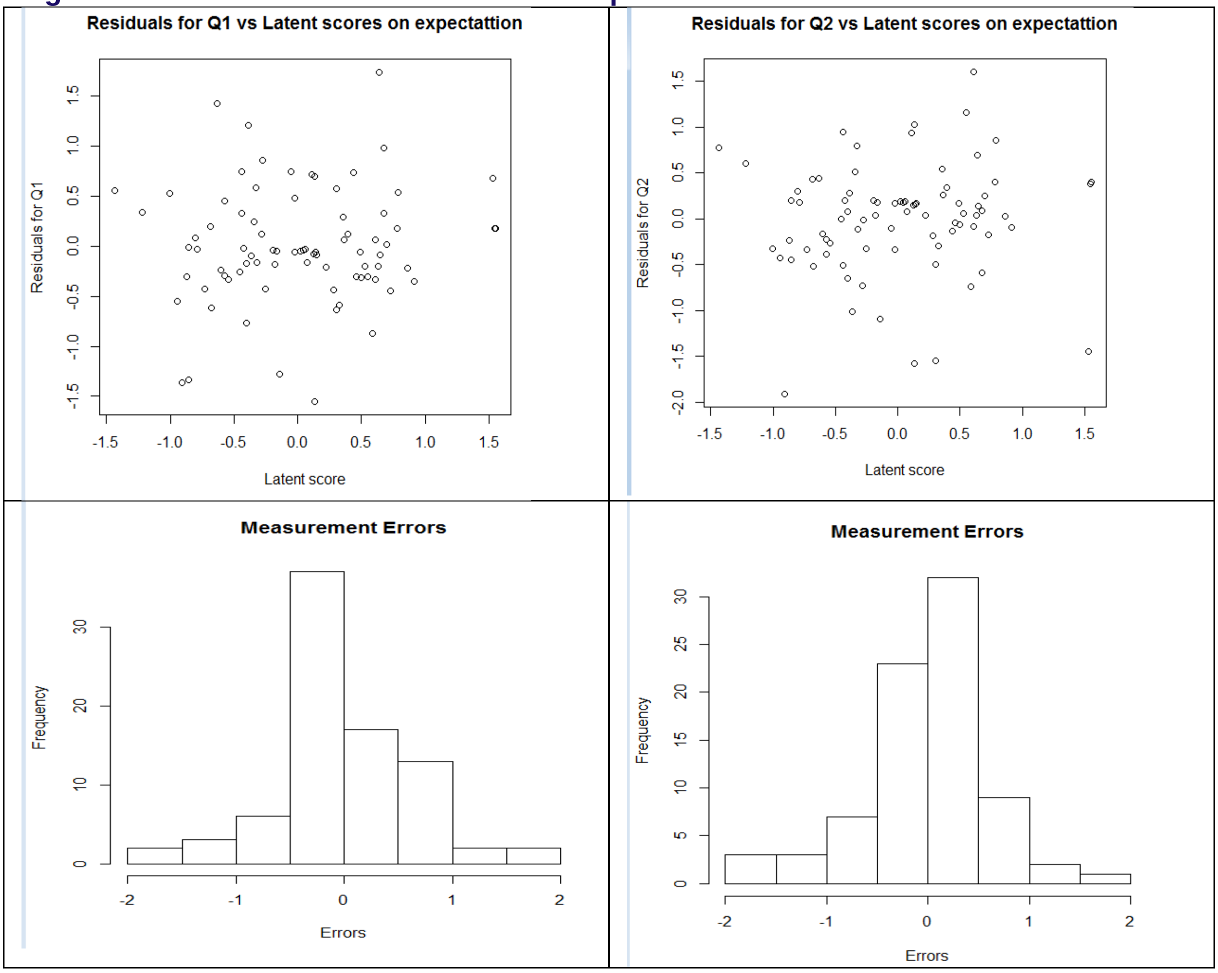
Node	Mean	SD	MC error	2.5%	Median	97.5%
gamma[1]	0.5047	0.174	0.0113	0.2209	0.4836	0.9062
gamma[2]	0.7163	0.1933	0.01188	0.3966	0.6996	1.1730



All of these two coefficients are significantly different from 0, as their 95% credible intervals exclude the value 0. It implies that the impacts from expectation when admitted to the HKAGE respectively to the actual benefits obtained from the HKAGE and to life satisfaction are both significant.

Model Checking: Examinations of Residuals. An advantage of the sampling-based Bayesian approach for SEM is that we can obtain the estimates of the latent variables through the posterior simulation so that reliable estimates of the residuals in the measurement equation and structural equation can be obtained. As a step of model checking, we visually inspect the residuals for some questions and plot these residuals against the individual latent scores of expectation on the HKAGE. Two of them are shown in the diagrams below. From the diagrams, it can be seen that they are quite close to white noises and approx. follow a normal distribution.

Figure1: Examination of residuals of two questions



Discussions. It may be a surprise to find that student members' expectations (of the HKAGE) had a clear positive influence on the actual benefits they gained (from the HKAGE) and their life satisfaction. On the contrary, no significant impact from the actual benefits the student members gained (from the HKAGE) to their life satisfaction was found. It means the more positive their expectations of the HKAGE were, the more actual benefits they could gain (from the HKAGE) and the higher the life satisfaction was. On the other hand, the actual benefit may not be the driving factor behind life satisfaction. The findings support the importance of a positive attitude in personal success and failure.

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