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# Medical students' preclinical service-learning experience and its effects on empathy in clinical training

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## Abstract

**Background:** Service learning (SL) is an educational methodology presumed to help medical students be more empathetic and compassionate. We longitudinally investigated the level of empathy in medical students and how preclinical SL experience was related to their level of empathy in their clinical clerkships.

**Methods:** Our cohort comprised fifth-year medical students engaged in clerkships as part of a 7-year medical programme at one medical school in Taiwan. Surveys were conducted at the beginning of the clerkship in September 2015 (T1) to collect data on the medical students' preclinical SL experience in curriculum-based service teams (CBSTs) and extracurricular service teams (ECSTs) and their SL self-efficacy, demographic characteristics, and empathy level. Subsequently, three follow-up surveys were conducted once every 3 months to determine the empathy level of the students during their clinical clerkships (T2–T4). Seventy students who returned the written informed consent and completed the baseline (T1) and two or more follow-up surveys (T2–T4) were included in our analysis with the response rate of 34%. In total, 247 responses across the 1-year clerkship were analysed. Descriptive statistics, paired *t* tests, and generalised estimating equations were employed.

**Results:** Our study revealed that changes in empathy level in the dimensions of *perspective taking*, *compassionate care*, and *standing in patients' shoes* in their clinical clerkships. Relative to that at T1, their empathy decreased in *perspective taking* and *compassionate care* at T2–T4 but increased in *standing in patients' shoes* at T3. Additionally, our study verified the positive effect of medical students' preclinical SL experience in CBSTs and ECSTs on empathy in terms of *compassionate care* and *perspective taking*, respectively, but not on that of *standing in patients' shoes*.

**Conclusions:** Separate investigations into subconstructs of empathy, such as *perspective taking*, *compassionate care*, and *standing in patients' shoes*, in medical students may be necessary for exploring the various driving forces or barriers to developing empathy in medical students. Moreover, SL experience through both CBSTs and ECSTs at medical academies may have positive effects on medical students' empathy in their clinical clerkships and should be promoted at medical schools.

**Keywords:** Service learning, Curriculum-based service team, Extracurricular service team, Empathy, Clinical training, Clerkships

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## Background

In medicine, empathy is defined as a practitioner's ability to perceive and understand a patient's emotional state and clearly articulate the patient's feelings [1]. The Association for Medical Education in Europe recommended that empathy be included as a key criterion in the evaluation of academic performance and professionalism [2]. Studies have indicated a correlation between empathy and good clinical performance [3], specifically in communicative ability [4], low burnout rates [5], and improved well-being [6]. Moreover, empathy has been associated with high patient satisfaction [7–13], high medical compliance [11, 14–17], and favourable treatment results [8, 10, 14, 18–20] and reduced medical costs [21], medical errors [22], and medical malpractice [23–26]. Because of the critical role of empathy in medical training, the cultivation of empathy in medical students has been a recent topic of interest. Medical educators have endeavoured to propose methods for improving empathy in medical students; for example, by improving students' communication skills, incorporating perspectives of medical humanities, and reforming medical curricula [1, 27]. A study in Singapore reported that community service and socialisation may be key factors affecting the demonstration of empathy in medical students [28].

Service learning (SL) is a pedagogical process that enriches conventional coursework through the inclusion of activities outside the classroom that meet the needs of the community [29]. Implementing SL early in medical training as a form of community-based learning may provide a formative experience that influences the perspectives of medical students as they enter clinical clerkships [30]. SL can be traced back to 1938, when John Dewey first argued that education in prosocial values should not occur in the abstract, such as in classrooms or lectures; rather, students should learn from real-world experience [31, 32]. SL incorporates domains of education, such as knowledge, attitudes, skills, intentions, and relationships through a process-oriented participatory approach [33]. SL facilitates the transformation of student knowledge and attitudes in the context of holistic care through work with community organisations [34] to help students become more socially responsible, patient-oriented practitioners [35]. SL is also considered a method for nurturing the service commitments of medical students while promoting interactions with the communities they serve [36, 37]. SL has been argued to transform student perspectives on humanism in medicine, including the perspectives of students who respect and empathise with the struggles and strengths of their patients and peers [38]. For example, the Loyola University Chicago Stritch School of Medicine proposed a 5-year Global Health Fieldwork Fellowship track that was grounded in clinical and service learning, doing so to

foster the development of prosocial values, such as professionalism, advocacy, and social justice in their medical students [39]. SL programmes involving work with the homeless have also enhanced the professional and personal education of medical students by improving their understanding of biopsychosocial problems and by developing their empathy, compassion, and social awareness [40, 41].

The effectiveness of SL is often evaluated by assessing students' qualitative reflections immediately following such programmes. However, in such evaluations, common-method biases may give rise to instructors posing leading questions; thus, instructors may either implicitly or explicitly make assumptions regarding participants' responses. Few studies have longitudinally explored the effects of SL experience on empathy in medical students. Therefore, we quantitatively and longitudinally examined how preclinical SL experience at medical schools was related to medical students' empathy in clinical training. Two methods of analysis were employed. First, we longitudinally investigated the change in the level of empathy of medical students during their clinical clerkships. Second, we explored the relationship of medical students' preclinical SL experience with their empathy during their clerkships.

## Methods

This study administered a prospective web-based survey to a cohort of medical students at one medical school in Taiwan.

### Study participants

Our study involved a group of fifth-year medical students participating in clinical clerkships as part of a 7-year medical programme at a medical school in Taiwan starting in September 2015. After recruitment at the end of August 2015, 140 of 206 medical students (68%) who agreed to participate in the study returned written informed consent forms.

### Measurement

#### *Medical students' preclinical SL experience*

In higher education, SL can be fostered using various formats and is often classified as an academic course, either credited or noncredited. A curriculum-based service team (CBST) refers to a team that participates in community service activities included in credited academic courses, whether a required or elective course [37, 42, 43], with explicit learning objectives [44]. Students in CBSTs perform various activities in small groups in structured learning environments that incorporate preparation, action, reflection, and celebration under the supervision of course instructors [45]. Depending on the instructors' curriculum design, CBSTs perform several community services that focus on one or several themes

during one or more academic semesters. By contrast, extracurricular service teams (ECSTs) are composed of students in voluntary and interdisciplinary societies who perform community services that are outside the curriculum and for which academic credit is not given. ECSTs are typically led by senior students and advised by faculty members; this format is also common in Western medical schools [46, 47]. For medical students, the service themes of CBSTs and ECSTs include caring for older people, people with disabilities, or inpatients; junior student tutoring; health education and promotion; or offering free clinical services in urban, rural, or overseas regions.

In this study, medical students' preclinical SL experience was measured in terms of their membership of CBSTs and ECSTs and their service intensity in these teams during the preclinical stage of medical school (years 1 to 4 in a 7-year programme). One questionnaire item recorded whether the medical students were members of a CBST or ECST. In terms of service intensity, respondents reported the number of service themes they were engaged in and the average number of hours they spent on planning and preparation, action, reflection, and celebration per service theme for both CBSTs and ECSTs. In another questionnaire item, the students' reported their perceived SL self-efficacy at the preclinical stage of medical school by using a 5-point scale, with a higher score indicating greater SL efficacy.

#### **Empathy of medical students in clinical clerkships**

Several instruments have been developed to measure empathy. The Jefferson Scale of Empathy was applied in this study because it was designed not for the general population but rather for patient care situations [48]. Empathy ratings for medical students were measured using the Jefferson Scale of Physician Empathy-Student version (JSPE-S), which comprises 20 items rated on a 7-point Likert scale, ranging from 1 (*strongly disagree*) to 7 (*strongly agree*) [3, 48]. The JSPE-S was translated into traditional Chinese and evaluated by English language specialists and Chinese language specialists from Taiwan. An exploratory factor analysis using the principal component method (Kaiser–Meyer–Olkin statistic = 0.919) was performed first because of potential differences in responses due to perceived cultural differences (the questionnaire was originally developed in a Western country). Two items were omitted because their factor loadings were lower than 0.5 after an exploratory factor analysis using varimax rotation with Kaiser normalisation (item 1: physicians' understanding of their patients' feelings and the feelings of their patients' families does not influence medical or surgical treatment; item 18: physicians should not allow themselves to be influenced by strong personal bonds between their patients and

their family members). Three common factors were identified, namely *perspective taking* (nine items), *compassionate care* (seven items), and *standing in patients' shoes* (two items), and their Cronbach's  $\alpha$  values were 0.922, 0.935, and 0.844, respectively. These three factors were adopted from Hojat et al. [3]; *perspective taking* refers to the students' perception of patients' perspectives, *compassionate care* refers to the students' understanding of patients' affective states during inpatient care, and *standing in patients' shoes* refers to the students' ability to understand patients' experiences. Notably, these items' locations in the three factors in this study were similar to the item distributions verified in Japanese [49] and Korean [50] studies of medical students and a US study of students of osteopathic medicine [51].

Detailed information is provided in Table 1. For further analysis, three factor scores were calculated for the three factors by using regression methods.

#### **Background information**

The medical students' personal background information, namely sex and age, were recorded.

#### **Data collection**

Surveys were conducted at the beginning of the clerkship in September 2015 (T1), followed by three follow-up surveys in December 2015 (T2), April 2016 (T3), and August 2016 (T4). Data on the following were gathered: preclinical SL experience, specifically —membership of and service intensity in both CBST and ECST; demographic characteristics, specifically sex and age; and baseline empathy level (T1). Follow-up surveys were conducted to determine the empathy level of the medical students during their clinical clerkships (T2–T4). The completion of the follow-up surveys was voluntary, and those who completed the baseline (T1) and two or more follow-up surveys (T2–T4) were included in this study. In total, 70 medical students (response rate 34% =  $100\% \times 70/206$ ) with 247 responses were included in our analysis.

#### **Statistical analysis**

Descriptive statistics of the medical students' demographic characteristics, preclinical SL experience, and longitudinal empathy level during their clerkships were analysed. Paired *t* tests were performed to analyse the dynamics of the medical students in terms of empathy level across the three dimensions of *perspective taking*, *compassionate care*, and *standing in patients' shoes*; comparisons were performed for T1–T2, T1–T3, T1–T4, T2–T3, T2–T4, and T3–T4.

Generalised estimating equations (GEEs) were used to analyse the repeated measures of empathy in medical students according to selected predictors. Regression of

**Table 1** Factor structures for perceived empathy of medical students in clinical clerkships (N = 247)

| Items   | Question  | Mean  | SD    | Factor loadings    |                    |                             |
|---------|---|-------|-------|--------------------|--------------------|-----------------------------|
|         |   |       |       | Perspective taking | Compassionate care | Standing in patients' shoes |
| Item 16 | Physicians' understanding of the emotional status of their patients, as well as that of their families, is one important component of the physician-patient relationship.                                   | 5.563 | 0.960 | 0.860              |                    |                             |
| Item 17 | Physicians should try to think like their patients in order to render better care.  | 5.417 | 1.020 | 0.837              |                    |                             |
| Item 15 | Empathy is a therapeutic skill without which the physician's success is limited.  | 5.190 | 1.217 | 0.810              |                    |                             |
| Item 20 | I believe that empathy is an important therapeutic factor in the medical treatment.   | 5.510 | 1.100 | 0.792              |                    |                             |
| Item 13 | Physicians should try to understand what is going on in their patients' minds by paying attention to their nonverbal cues and body language.  | 5.405 | 1.103 | 0.754              |                    |                             |
| Item 2  | Patients feel better when their physicians understand their feelings.   | 5.749 | 0.934 | 0.709              |                    |                             |
| Item 10 | Patients value a physician's understanding of their feelings which is therapeutic in its own right.   | 5.130 | 1.243 | 0.699              |                    |                             |
| Item 4  | Understanding body language is as important as verbal communication in physician-patient relationships.   | 5.729 | 0.977 | 0.672              |                    |                             |
| Item 5  | A physician's sense of humor contributes to a better clinical outcome   | 5.389 | 1.014 | 0.671              |                    |                             |
| Item 14 | I believe that emotion has no place in the treatment of medical illness. (R)  | 5.619 | 1.266 |                    | 0.859              |                             |
| Item 8  | Attentiveness to patients' personal experiences does not influence treatment outcomes. (R)  | 5.360 | 1.327 |                    | 0.857              |                             |
| Item 12 | Asking patients about what is happening in their personal lives is not helpful in understanding their physical complaints. (R)  | 5.514 | 1.331 |                    | 0.852              |                             |
| Item 9  | Physicians should not try to stand in their patients' shoes when providing care to them. (R)  | 5.555 | 1.357 |                    | 0.848              |                             |
| Item 7  | Attention to patients' emotions is not important in history taking. (R)   | 5.445 | 1.384 |                    | 0.838              |                             |
| Item 11 | Patients' illnesses can be cured only by medical or surgical treatment; therefore, physicians' emotional ties with their patients do not have a significant influence in medical or surgical treatment. (R) | 5.150 | 1.364 |                    | 0.788              |                             |
| Item 19 | I do not enjoy reading nonmedical literature or the arts. (R)   | 5.304 | 1.335 |                    | 0.701              |                             |
| Item 3  | It is difficult for a physician to view things from patients' perspectives (R)  | 3.879 | 1.260 |                    |                    | 0.901                       |
| Item 6  | Because people are different, it is difficult to see things from patients' perspectives. (R)  | 3.510 | 1.300 |                    |                    | 0.899                       |

Note: (1) The item # in Table 1 is marked the same as that in the original version of the Jefferson Scale of Physician Empathy-Student version (JSPE-S) for readability and comparison across studies. (2) Each item was measured on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). (3) (R) refers to reversed scores for the item (ie, 1 → 7, 2 → 6, 3 → 5, 4 → 4, 5 → 3, 6 → 2, and 7 → 1)

the dependent variable for selected independent variables was conducted using a GEE method for the following reasons [52, 53]. First, a repeated measures analysis was employed for the dependent variable. Second, several missing values were identified for the predictors. Third, robust standard estimates were available for performing consistent and accurate tests of statistical significance. Fourth, the application of the Quasi-likelihood Information Criterion (QIC) reflected the relative

efficacy of the proposed model in fitting the data. In this study, three GEEs were used for each dependent variable; a repeated measures analysis was performed on medical students' empathy factor scores for *perspective taking*, *compassionate care*, and *standing in patients' shoes*, and the students' demographic characteristics and preclinical SL experience were applied as predictors. Notably, variables with skewness and kurtosis values greater than 2 and 7 [54], respectively, were transformed

(e.g. the students' age and total hours serving in CBSTs and ECSTs). Statistical analyses were performed using SPSS 25.0 (IBM Corporation, Chicago, IL, USA).

### Results

In total, 70 medical students (men: 36, 51%; women: 34, 49%) with response rate 34% were included in our study, with an average age of 23 years. Among them, 54 students (77%) served as CBST members, engaging in an average of six service themes and spending 15 h per theme. In total, 42 students (60%) served as ECST members, engaging in an average of five service themes and spending 31 h per theme. The students reported an average SL self-efficacy score of 3.4 on a 5-point scale. Detailed information is presented in Table 2.

Three dimensions of empathy level (*perspective taking*, *compassionate care*, and *standing in patients' shoes*) were measured over four periods (T1, T2, T3, and T4). The T1, T2, T3, and T4 evaluations were completed by 70, 64, 65, and 48 students, respectively (Table 3). Paired *t* tests were performed for individual comparisons at two time points; the results revealed that the scores for *perspective taking* at T2, T3, and T4 were lower than those at T1, and the scores for *compassionate care* at T2, T3, and T4 were significantly lower than those at T1 ( $p < 0.05$ ). By contrast, the score for *standing in patients' shoes* at T1 was significantly lower than that at T3 ( $p < 0.05$ ). Detailed information is listed in Table 3.

Table 4 illustrates the GEE results for the effects of predictor variables in repeated measures of medical students' empathy level in the individual dimensions of *perspective taking*, *compassionate care*, and *standing in patients' shoes*. The results revealed that (1) the students'

preclinical experience measured by total hours serving in ECSTs was positively related to their empathy in terms of *perspective taking* ( $p < 0.05$ ) and (2) that in CBSTs was positively related to students' empathy in terms of *compassionate care* ( $p < 0.05$ ). However, the medical students' preclinical SL experience in CBSTs and ECSTs was not related to their empathy in terms of *standing in patients' shoes* ( $p > 0.05$ ).

### Discussion

After longitudinally tracking the empathy levels of 70 medical students during their clerkships for 1 year (i.e. four iterations:T1–T4), our study revealed various changes in empathy level across the dimensions of *perspective taking*, *compassionate care*, and *standing in patients' shoes*. Specifically, relative to that in T1, the students' empathy decreased in *perspective taking* and *compassionate care* at T2–T4 but increased in *standing in patients' shoes* at T3. In addition, our study verified the positive relationship of medical students' preclinical SL experience in CBSTs and ECSTs on *compassionate care* and *perspective taking*, respectively, but not on *standing in patients' shoes* in terms of empathy level during their clinical clerkships.

Previous studies have employed a cross-sectional approach and the JSPE-S to determine the empathy level of medical students during medical school, and diverse findings have been reported; for example, in terms of changes in medical student empathy during medical school, several studies have reported decreasing levels [55–60], several have reported increasing levels [49, 50, 61, 62], and others have reported no statistically significant differences [63]. Notably, the cross-sectional

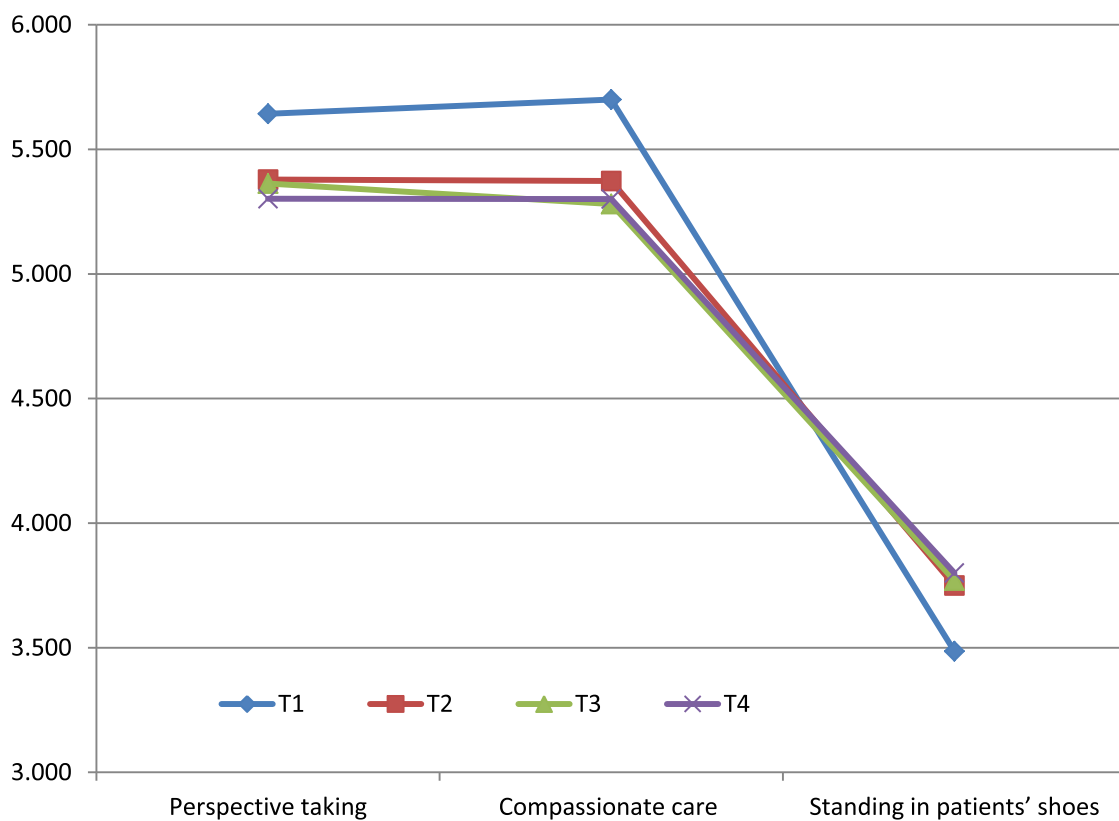
**Table 2** Medical students' personal backgrounds and preclinical SL experience (N = 70)

| Variables   | Scale  | Mean (Frequency) | SD (Percentage) |
|---|--------|------------------|-----------------|
| <b>Demographic characteristics</b>  |        |                  |                 |
| Sex   | Male   | (36)             | (51)            |
|   | Female | (34)             | (49)            |
| Age   |        | 23.486           | 2.005           |
| <b>Preclinical SL experience</b>  |        |                  |                 |
| CBST membership   | No     | (16)             | (23)            |
|   | Yes    | (54)             | (77)            |
| CBST service intensity: the number of service themes the student engaged in |        | 6.069            | 6.250           |
| CBST service intensity: the average time spent per service theme (hrs)      |        | 14.987           | 30.177          |
| ECST membership   | No     | (28)             | (40)            |
|   | Yes    | (42)             | (60)            |
| ECST service intensity: the number of service themes the student engaged in |        | 4.579            | 10.485          |
| ECST service intensity: the average time spent per service theme (hrs)      |        | 31.029           | 66.420          |
| Perceived SL self-efficacy (5-point scale)                                  |        | 3.400            | 0.824           |

Note: SL: service learning; CBST: curriculum-based service team; ECST: extracurricular service team

**Table 3** Medical students' empathy level across four timelines (N = 247)

| Measurement Time Number | N  | Dimensions of Empathy |                    |                             |       |
|-------------------------|----|-----------------------|--------------------|-----------------------------|-------|
|                         |    | Perspective taking    | Compassionate care | Standing in patients' shoes |       |
| T1                      | 70 | Mean                  | 5.643              | 5.700                       | 3.486 |
|                         |    | SD                    | 0.714              | 1.078                       | 1.070 |
| T2                      | 64 | Mean                  | 5.379              | 5.373                       | 3.750 |
|                         |    | SD                    | 0.983              | 1.162                       | 1.089 |
| T3                      | 65 | Mean                  | 5.363              | 5.280                       | 3.770 |
|                         |    | SD                    | 0.938              | 1.146                       | 1.279 |
| T4                      | 48 | Mean                  | 5.302              | 5.300                       | 3.800 |
|                         |    | SD                    | 1.212              | 1.154                       | 1.281 |



| Paired-t tests | T1>T2* | T1>T2* |        |
|----------------|--------|--------|--------|
|                | T1>T3* | T1>T3* | T1<T3* |
|                | T1>T4* | T1>T4* |        |

Note: \*p < 0.05

designs applied in these studies could not account for the developmental trajectory of medical students or allow for repeated testing. To address these limitations, Costa et al. [64] conducted longitudinal research to collect data on the empathy of preclinical medical students;

their results revealed no decline in the medical students' empathy over time. However, we argue that summed empathy scores might hamper the identification of individual items or distinctive characteristics across the many dimensions of empathy. Therefore, by employing

**Table 4** Relationships of medical students’ preclinical SL experience with their empathy level in clinical clerkships: Generalised estimating equation modelling

| Variables   | Dimensions of Empathy            |       |       |                                 |       |       |                                  |       |       |
|---|----------------------------------|-------|-------|---------------------------------|-------|-------|----------------------------------|-------|-------|
|   | Perspective taking               |       |       | Compassionate care              |       |       | Standing in patients’ shoes      |       |       |
|   | Estimates                        | SE    | Sig   | Estimates                       | SE    | Sig   | Estimates                        | SE    | Sig   |
| Intercept   | -1.074                           | 1.253 | 0.391 | -1.880                          | 1.176 | 0.110 | 1.375                            | 1.215 | 0.258 |
| <b>Preclinical SL experience</b>                        |                                  |       |       |                                 |       |       |                                  |       |       |
| CBST membership (default = no)                          | -0.054                           | 0.272 | 0.843 | -0.132                          | 0.309 | 0.669 | -0.065                           | 0.248 | 0.792 |
| CBST service intensity: total hours served <sup>a</sup> | -0.019                           | 0.013 | 0.161 | 0.031                           | 0.012 | 0.012 | -0.011                           | 0.016 | 0.482 |
| ECST membership (default = no)                          | 0.041                            | 0.247 | 0.868 | 0.492                           | 0.253 | 0.052 | 0.162                            | 0.233 | 0.487 |
| ECST service intensity: total hours served <sup>b</sup> | 0.008                            | 0.003 | 0.013 | 0.003                           | 0.003 | 0.274 | 0.006                            | 0.004 | 0.101 |
| Perceived SL self-efficacy                              | 0.247                            | 0.137 | 0.071 | -0.186                          | 0.120 | 0.121 | 0.194                            | 0.150 | 0.197 |
| <b>Demographic characteristics</b>                      |                                  |       |       |                                 |       |       |                                  |       |       |
| SEX (default = male)                                    | -0.095                           | 0.194 | 0.625 | -0.070                          | 0.200 | 0.728 | -0.191                           | 0.181 | 0.290 |
| AGE <sup>c</sup>  | -0.329                           | 1.067 | 0.758 | -1.826                          | 1.098 | 0.096 | 1.737                            | 1.082 | 0.109 |
| Model fit   | QIC = 1020.826<br>QICC = 252.786 |       |       | QIC = 846.987<br>QICC = 246.639 |       |       | QIC = 1123.132<br>QICC = 245.870 |       |       |

Note:

1. SL: service learning; CBST: curriculum-based service team; ECST: extracurricular service team
2. <sup>a</sup>CBST service intensity: total hours served was calculated by multiplying the number of service themes a student was engaged in by the average number of hours spent per CBST service theme. The original value of total hours engaged in CBST was transformed using the square root value to meet the assumption of normality
3. <sup>b</sup>ECST service intensity: total hours served was calculated by multiplying the number of service themes a student engaged in by the average number of hours spent per ECST service theme. The original value of total hours engaged in ECST was transformed using square root value to meet the assumption of normality
4. <sup>c</sup>The original AGE value was transformed using LN(LN(LG(X))) because of the violation of the normality assumption

longitudinal tracking of the subconstructs of empathy in medical students, our study discovered that empathy decreased in the dimensions of *perspective taking* and *compassionate care* but increased in that of *standing in patients’ shoes* (Table 3, paired *t* tests,  $p < 0.05$ ). A previous study employed the JSPE at the beginning (pretest) and end (posttest) of medical students’ third year of clerkship at a medical school in the United States, noting statistically significant declines in empathy scores for items 2, 10, 11, 12, and 15, which related most closely to the dimensions of *perspective taking* and *compassionate care* [65]; these results are consistent with the current findings (Tables 1 and 3). We content that separate investigations into the subconstructs of empathy, such as *perspective taking*, *compassionate care*, and *standing in patients’ shoes*, in medical students enable future investigations of various potential driving factors of or barriers to the development of empathy with respect to these subconstructs.

Most importantly, our study verified the benefits of CBST in cultivating empathy with respect to *compassionate care* during clinical clerkships ( $p < .01$ ). The items under *compassionate care* indicate how much respondents regard health and illness from a holistic perspective; that is, the medical practitioner considers medicine from not only a biomedical perspective (as a science) but also from a psychosocial perspective (as an art) [48]. CBSTs are typically incorporated into various educational domains by

instructors to influence students’ planning and preparation, behaviour, reflection and demonstration, and assessment and celebration [32]. By discussing learning objectives with instructors and community partners in academic courses, students can enhance their awareness and gain deeper insights into social problems to identify social needs and acquire strong problem-solving skills [66–68]. Therefore, we argue that the explicit learning objectives of CBSTs are related to cognitive ability, as reflected by academic performance, civic engagement, social skills, and improved attitudes towards the self [69–71]. Therefore, helping medical students regard patient services from a systematic perspective and holistically understand patient concerns may benefit medical students and help them perform compassionate care during their clinical training.

Furthermore, we revealed that engagement in ECSTs helps medical students cultivate empathy with respect to *perspective taking* during their clinical clerkship ( $p < .05$ ). The items related to the subconstruct of *perspective taking* emphasised empathy in interpersonal relationships when determining patients’ cognitive status [48]. ECSTs are typically led by senior students and advised by school faculty [46] and are typically composed of students from many disciplines who collaborate to solve community problems. Such teamwork may provide opportunities for students to build relationships with their partners, faculty, the community, or people they serve to reinforce

school and community ties and encourage collaboration [67, 72, 73]. Moreover, an interprofessional service and learning experience was reported to generate the greatest effect on medical students' perceptions of their competency and training in other disciplines [74]. Moreover, students can apply problem-solving and learning cycles to promote deep learning through service delivery [75]. Therefore, we maintain that ECSTs may provide opportunities to improve medical students' social awareness and cultural competency in relation to their student peers from other disciplines and their community partners from a diversity of backgrounds [47], thereby increasing their empathy in *perspective taking* towards patients following their clinical clerkships.

Although our study revealed that medical students' empathy in terms of *standing in patients' shoes* increased in clinical clerkships at T3 (Table 3), we could not verify the potential benefits of SL experience on medical students' empathy in terms of *standing in patients' shoes* (Table 4). Santiago et al. [76] compared medical students' empathy at two medical schools and argued that student empathy could be increased by implementing earlier and more intensive contact with patients under the supervision of skilled tutors. We contend that clinical training is essential for medical students to learn how to manage real-life situations, and through clinical training, medical students are encouraged to regularly interact with real patients to enhance their practical knowledge [77]. By learning to understand patients' experiences, medical students gradually develop the ability to provide exceptional medical care during clinical training.

This study has several limitations. First, the service intensity (i.e. the number of service themes engaged in and the average time spent per service theme) of medical students' SL experience was aggregated across various services themes in CBSTs and ECSTs because of the limited sample size. Thus, we were unable to analyse the effectiveness of individual service themes in SL experience. Second, the SL experience of medical students was analysed only in the context of the preclinical stage of their medical school, and their self-reported information on SL experience may have been affected by recall bias. Third, the successful implementation of CBSTs and ECSTs requires careful planning, the deliberate articulation of rationales and expectations, the strengthening of community relationships, and the conduct of iterated reviews and revisions to the programme [78]. Insufficient time, resources, and effort for effective implementation may burden students and educators with record keeping, transportation, and scheduling [79]. Thus, we could not confirm the quality of the CBST and ECST values reported by the medical students in our study, which may have confounded the effectiveness of SL experience. Fourth, the inclusion of medical students from only one

medical school and the small sample size (response rate 34%) with potential respondent bias may hamper the generalizability of the study findings. We got the medical students' written informed consents around 68% of the cohort of medical students in the study recruitment stage. However, in order to catch the dynamics of the medical students' empathy levels in their clinical training given the participants' voluntary survey responses, so as to enhance our study contributions on exploring the SL effects on empathy longitudinally, we might make the trade-off to include the small size (response rate 34%) in our data analysis. Moreover, to assess how medical students' SL effectiveness is sustained over time, we might call for action to routinely collect or record the medical students' well-being and soft skills such as empathy into their learning portfolio, especially at their socialization in the clinical training, even after clerkships or post-graduate medical training.

## Conclusion

Our study quantitatively and longitudinally explored how medical students' preclinical SL experience was related to their empathy in clinical clerkships. We found that medical students' empathy level in their clinical clerkships exhibited different patterns (increasing or decreasing) across the dimensions of *perspective taking*, *compassionate care*, and *standing in patients' shoes*. Moreover, our study revealed that SL experience in both CBSTs and ECSTs at medical academies may have positive effects on medical students' empathy in their clinical clerkships and should be promoted at medical schools.

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## Authors' contributions

YSY and PCL contributed to the conception and design of the work; the acquisition and interpretation of data; drafting the work. YKL, CDL, and DYC contributed to the acquisition, analysis, and interpretation of data; and revising it critically for important intellectual content. BYJL contributed to the conception and design of the work; the acquisition, analysis, and interpretation of data; drafting the work; and revising it critically for important intellectual content. All the authors made a final approval of the version to be published and agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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**Availability of data and materials**

The data included in this study, with departmental information and student identities removed, are available for use on reapproval by any eligible research ethics committee.

**Declarations****Ethics approval and consent to participate**

This work received ethical approval from the Institutional Review Board of China Medical University and Hospital (CMUH105-REC3-001). All participants provided written statements of informed consent. All the study protocol for involving humans was in accordance to guidelines of Declaration of Helsinki in the manuscript.

**Consent for publication**

Not applicable.

**Competing interests**

Blossom Yen-Ju Lin, is a member of the editorial board of BMC Medical Education. All authors declare that they have no competing interests.

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**References**

- Stepien KA, Baernstein A. Educating for empathy: a review. *J Gen Intern Med.* 2006;21(5):524–30. <https://doi.org/10.1111/j.1525-1497.2006.00443.x>.
- Hojat M, Erdmann JB, Gonnella JS. Personality assessments and outcomes in medical education and the practice of medicine: AMEE guide no. 79. *Med Teach.* 2013;35(7):e1267–301. <https://doi.org/10.3109/0142159X.2013.785654>.
- Hojat M, Gonnella JS, Mangione S, Nasca TJ, Veloski JJ, Erdmann JB, et al. Empathy in medical students as related to academic performance, clinical competence and gender. *Med Educ.* 2002;36(6):522–7. <https://doi.org/10.1046/j.1365-2923.2002.01234.x>.
- Casas RS, Xuan Z, Jackson AH, Stanfield LE, Harvey NC, Chen DC. Associations of medical student empathy with clinical competence. *Patient Educ Couns.* 2017;100(4):742–7. <https://doi.org/10.1016/j.pec.2016.11.006>.
- Thomas MR, Dyrbye LN, Huntington JL, Lawson KL, Novotny PJ, Sloan JA, et al. How do distress and well-being relate to medical student empathy? A multicenter study. *J Gen Intern Med.* 2007;22(2):177–83. <https://doi.org/10.1007/s11606-006-0039-6>.
- Kelm Z, Womer J, Walter JK, Feudtner C. Interventions to cultivate physician empathy: a systematic review. *BMC Med Educ.* 2014;14(1):219. <https://doi.org/10.1186/1472-6920-14-219>.
- Bertakis KD, Roter D, Putnam SM. The relationship of physician medical interview style to patient satisfaction. *J Fam Pract.* 1991;32(2):175–81.
- Derksen F, Bensing J, Lagro-Janssen A. Effectiveness of empathy in general practice: a systematic review. *Br J Gen Pract.* 2013;63(606):e76–84. <https://doi.org/10.3399/bjgp13X660814>.
- Epstein RM, Hadeed T, Carroll J, Meldrum SC, Lardner J, Shields CG. Could this be something serious? Reassurance, uncertainty, and empathy in response to patients' expressions of worry. *J Gen Intern Med.* 2007;22(12):1731–9. <https://doi.org/10.1007/s11606-007-0416-9>.
- Hojat M, Louis DZ, Maxwell K, Markham FW, Wender RC, Gonnella JS. A brief instrument to measure patients' overall satisfaction with primary care physicians. *Fam Med.* 2011;43(6):412–7.
- Kim SS, Kaplowitz S, Johnston MV. The effects of physician empathy on patient satisfaction and compliance. *Eval Health Prof.* 2004;27(3):237–51. <https://doi.org/10.1177/0163278704267037>.
- Pollack KI, Alexander SC, Tulsy JA, Lyna P, Coffman CJ, Dolor RJ, et al. Physician empathy and listening: associations with patient satisfaction and autonomy. *J Am Board Fam Med.* 2011;24(6):665–72. <https://doi.org/10.3122/jabfm.2011.06.110025>.
- Zachariae R, Pedersen CG, Jensen AB, Ehrnrooth E, Rossen PB, Von der Maase H. Association of perceived physician communication style with patient satisfaction, distress, cancer-related self-efficacy, and perceived control over the disease. *Br J Cancer.* 2003;88(5):658–65. <https://doi.org/10.1038/sj.bjc.6600798>.
- Attar HS, Chandramani S. Impact of physician empathy on migraine disability and migraineur compliance. *Ann Indian Acad Neurol.* 2012; 15(Suppl 1):S89–94. <https://doi.org/10.4103/0972-2327.100025>.
- Squier RW. A model of empathic understanding and adherence to treatment regimens in practitioner-patient relationships. *Soc Sci Med.* 1990; 30(3):325–39. [https://doi.org/10.1016/0277-9536\(90\)90188-X](https://doi.org/10.1016/0277-9536(90)90188-X).
- Stewart MA. What is a successful doctor-patient interview? A study of interactions and outcomes. *Soc Sci Med.* 1984;19(2):167–75. [https://doi.org/10.1016/0277-9536\(84\)90284-3](https://doi.org/10.1016/0277-9536(84)90284-3).
- Zolnierok KB. Physician communication and patient adherence to treatment: a meta-analysis. *Med Care.* 2009;47(8):826–34. <https://doi.org/10.1097/MLR.0b013e31819a5acc>.
- Lobchuk MM, Bokhari SA. Linkages among empathic behaviors, physical symptoms, and psychological distress in patients with ovarian cancer: a pilot study. *Oncol Nurs Forum.* 2008;35(5):808–14. <https://doi.org/10.1188/08.ONF.808-814>.
- Rakel D, Barrett B, Zhang Z, Hoelt T, Chewning B, Marchard L, et al. Perceptions of empathy in the therapeutic encounter: effects on the common cold. *Patient Educ Couns.* 2011;85(3):390–7. <https://doi.org/10.1016/j.pec.2011.01.009>.
- Rakel DP, Hoelt TJ, Barrett BP, Chewning BA, Craig BM, Niu M. Practitioner empathy and the duration of the common cold. *Fam Med.* 2009;41(7):494–501.
- Epstein RM, Franks P, Shields CG, Meldrum SC, Miller KN, Campbell TL, et al. Patient-centered communication and diagnostic testing. *Ann Fam Med.* 2015;3(5):415–21.
- West CP, Huschka MM, Novotny PJ, Sloan JA, Kolars JC, Habermann TM, et al. Association of perceived medical errors with resident distress and empathy: a prospective longitudinal study. *JAMA.* 2006;296(9):1071–8. <https://doi.org/10.1001/jama.296.9.1071>.
- Beckman HB, Markakis KM, Suchman AL, Frankel RM. The doctor-patient relationship and malpractice. Lessons from plaintiff depositions. *Arch Intern Med.* 1994;154(12):1365–70. <https://doi.org/10.1001/archinte.1994.00420120093010>.
- Levinson W, Roter DL, Mullooly JP, Dull VT, Frankel RM. Physician-patient communication. The relationship with malpractice claims among primary care physicians and surgeons. *JAMA.* 1997;277(7):553–9. <https://doi.org/10.1001/jama.1997.03540310051034>.
- Moore PJ, Adler NE, Robertson PA. Medical malpractice: the effect of doctor-patient relations on medical patient perceptions and malpractice intentions. *West J Med.* 2000;173(4):244–50. <https://doi.org/10.1136/ewjm.173.4.244>.
- Silvester J, Patterson F, Koczwara A, Ferguson E. "Trust me...": psychological and behavioral predictors of perceived physician empathy. *J Appl Psychol.* 2007;92(2):519–27. <https://doi.org/10.1037/0021-9010.92.2.519>.
- Jeffrey D, Downie R. Empathy - can it be taught? *J R Coll Physicians Edinb.* 2016;46(2):107–12. <https://doi.org/10.4997/JRCPE.2016.210>.
- Sng G, Tung J, Ping YS, Lee SS, Win MT, Hooi SC, et al. Complex and novel determinants of empathy change in medical students. *Korean J Med Educ.* 2016;28(1):67–78. <https://doi.org/10.3946/kjme.2016.11>.
- Kimble KJ, Ehman AC. Gerontology and youth-focused service learning: the relation between service recipient age and student responses. *Gerontol Geriatr Educ.* 2015;36(4):384–95. <https://doi.org/10.1080/02701960.2014.925890>.
- Buckner AV, Ndjakani YD, Banks B, Blumenthal DS. Using service-learning to teach community health: the Morehouse School of Medicine community health course. *Acad Med.* 2010;85(10):1645–51. <https://doi.org/10.1097/ACM.0b013e3181f08348>.

31. Seifer SD. Service-learning: community-campus partnerships for health professions education. *Acad Med.* 1998;73(3):273–7. <https://doi.org/10.1097/00001888-199803000-00015>.
32. Stewart T, Wubbena Z. An overview of infusing service-learning in medical education. *Int J Med Educ.* 2014;5:147–56. <https://doi.org/10.5116/ijme.53aec907>.
33. Du Toit E, Olivera S, Topper K, van de Venter R, Williams M, Ventres W. Toward interprofessional service-learning and social accountability in health: one south African University's process-oriented-participatory journey. *J Interprof Care.* 2019;33(3):291–4. <https://doi.org/10.1080/13561820.2018.1532399>.
34. Playford D, Bailey S, Fisher C, Stasinska A, Marshall L, Gawlinski M, et al. Twelve tips for implementing effective service learning. *Med Teach.* 2019; 41(1):24–7. <https://doi.org/10.1080/0142159X.2017.1401217>.
35. Olney CA, Livingston JE, Fisch S, Talamantes MA. Becoming better health care providers: outcomes of a primary care service-learning project in medical school. *J Prev Interv Commun.* 2006;32(1–2):133–47. [https://doi.org/10.1300/J005v32n01\\_09](https://doi.org/10.1300/J005v32n01_09).
36. Belkowitz J, Sanders LM, Zhang C, Agarwal G, Lichtstein D, Mechaber AJ, et al. Teaching health advocacy to medical students: a comparison study. *J Public Health Manag Pract.* 2014;20(6):E10–9. <https://doi.org/10.1097/PHH.000000000000031>.
37. Elam CL, Sauer MJ, Stratton TD, Skelton J, Crocker D, Musick DW. Service learning in the medical curriculum: developing and evaluating an elective experience. *Teach Learn Med.* 2013;15(3):194–203.
38. Lee WK, Harris CCD, Mortensen KA, Long LM, Sugimoto-Matsuda J. Enhancing student perspectives of humanism in medicine: reflections from the Kalaupapa service learning project. *BMC Med Educ.* 2016;16(1):137. <https://doi.org/10.1186/s12909-016-0664-7>.
39. Borah BF. Longitudinal service learning in medical education: an ethical analysis of the five-year alternative curriculum at Stritch School of Medicine. *J Med Humanit.* 2018;39(4):407–16. <https://doi.org/10.1007/s10912-018-9529-x>.
40. Chrisman-Khawam L, Abdullah N, Dhoopar A. Teaching health-care trainees empathy and homelessness IQ through service learning, reflective practice, and altruistic attribution. *Int J Psychiatry Med.* 2017;52(3):245–54. <https://doi.org/10.1177/0091217417730288>.
41. Clark DL, Melillo A, Wallace D, Pierrel S, Buck DS. A multidisciplinary, learner-centered, student-run clinic for the homeless. *Fam Med.* 2003;35(6):394–7.
42. Averill NJ, Sallee JM, Robinson JT, McFarlin JM, Montgomery AA, Burkhardt GA, et al. A first-year community-based service learning elective: design, implementation, and reflection. *Teach Learn Med.* 2007;19(1):47–54. <https://doi.org/10.1080/10401330709336623>.
43. Borges N, Hartung PJ. Service learning in medical education: project description and evaluation. *Int J Teach Learn High Educ.* 2007;19:1–7.
44. Spring K, Grimm R, Dietz N. *Community Service and Service Learning in America's Schools.* Washington DC: Corporation for National and Community Service; 2008.
45. Hancock CR, Shenk D, George J. Balancing structure and choice in intergenerational service-learning. *Gerontol Geriatr Educ.* 2013;34(2):115–34. <https://doi.org/10.1080/02701960.2012.679371>.
46. McWilliams A, Rosemond C, Roberts E, Calleson D, Busby-Whitehead J. An innovative home-based interdisciplinary service-learning experience. *Gerontol Geriatr Educ.* 2008;28(3):89–104. [https://doi.org/10.1300/J021v28n03\\_07](https://doi.org/10.1300/J021v28n03_07).
47. Sin D, Chew T, Chia TK, Ser JS, Sayampanathan A, Koh G. Evaluation of constructing care collaboration - nurturing empathy and peer-to-peer learning in medical students who participate in voluntary structured service learning programmes for migrant workers. *BMC Med Educ.* 2019;19(1):304. <https://doi.org/10.1186/s12909-019-1740-6>.
48. Hojat M, Mangione S, Nasca TJ, Cohen MJM, Gonnella JS, Erdmann JB, et al. The Jefferson scale of physician empathy: development and preliminary psychometric data. *Educ Psychol Meas.* 2001;61(2):349–65. <https://doi.org/10.1177/00131640121971158>.
49. Kataoka HU, Koide N, Ochi K, Hojat M, Gonnella JS. Measurement of empathy among Japanese medical students: psychometrics and score differences by gender and level of medical education. *Acad Med.* 2009; 84(9):1192–7. <https://doi.org/10.1097/ACM.0b013e3181b180d4>.
50. Roh M, Hahm B, Lee D, Suh D. Evaluation of empathy among Korean medical students: a cross-sectional study using the Korean version of the Jefferson scale of physician empathy. *Teach Learn Med.* 2010;22(3):167–71. <https://doi.org/10.1080/10401334.2010.488191>.
51. Hojat M, DeSantis J, Shannon SC, Mortensen LH, Speicher MR, Bragan L, et al. The Jefferson scale of empathy: a nationwide study of measurement properties, underlying components, latent variable structure, and national norms in medical students. *Adv Health Sci Educ Theory Pract.* 2018;23(5): 899–920. <https://doi.org/10.1007/s10459-018-9839-9>.
52. Ballinger GA. Using generalized estimating equations for longitudinal data analysis. *Organ Res Methods.* 2004;7(2):127–50. <https://doi.org/10.1177/1094428104263672>.
53. Wan TTH, Lin YL, Ortiz J. Contextual, ecological and organizational variations in risk-adjusted COPD and asthma hospitalization rates of rural Medicare beneficiaries. *Res Social Health Care.* 2016;34:135–52. <https://doi.org/10.1108/S0275-49592016000034008>.
54. Kline R. *Principles and practice of structural equations modeling.* 2nd ed. London: Guilford Press; 2005.
55. Chen D, Lew R, Hershman W, Orlander J. A cross-sectional measurement of medical student empathy. *J Gen Intern Med.* 2007;22(10):1434–8. <https://doi.org/10.1007/s11606-007-0298-x>.
56. Khademalhosseini M, Khademalhosseini Z, Mahmoodian F. Comparison of empathy score among medical students in both basic and clinical levels. *J Adv Med Educ Prof.* 2014;2(2):88–91.
57. Nunes P, Williams S, Sa B, Stevenson K. A study of empathy decline in students from five health disciplines during their first year of training. *Int J Med Educ.* 2011;2:12–7. <https://doi.org/10.5116/ijme.4d47.ddb0>.
58. Shashikumar R, Chaudhary R, Ryali VS, Bhat PS, Srivastava K, Prakash J, et al. Cross sectional assessment of empathy among undergraduates from a medical college. *Med J Armed Forces India.* 2014;70(2):179–85. <https://doi.org/10.1016/j.mjafi.2014.02.005>.
59. Williams B, Sadasivan S, Kadirvelu A. Malaysian medical students' self-reported empathy: a cross-sectional comparative study. *Med J Malaysia.* 2015;70(2):76–80.
60. Youssef FF, Nunes P, Sa B, Williams S. An exploration of changes in cognitive and emotional empathy among medical students in the Caribbean. *Int J Med Educ.* 2014;5:185–92. <https://doi.org/10.5116/ijme.5412.e641>.
61. Magalhães E, Salgueira AP, Costa P, Costa MJ. Empathy in senior year and first year medical students: a cross-sectional study. *BMC Med Educ.* 2011; 11(1):52. <https://doi.org/10.1186/1472-6920-11-52>.
62. Mostafa A, Hoque R, Mostafa M, Rana MM, Mostafa F. Empathy in undergraduate medical students of Bangladesh: psychometric analysis and differences by gender, academic year, and specialty preferences. *ISRN Psychiatry.* 2014;2014:375439. <https://doi.org/10.1155/2014/375439>.
63. Rahimi-madiseh M, Tavakol M, Dennick R, Nasiri J. Empathy in Iranian medical students: a preliminary psychometric analysis and differences by gender and year of medical school. *Med Teach.* 2010;32(11):471–8.
64. Costa P, Magalhães E, Costa MJ. A latent growth model suggests that empathy of medical students does not decline over time. *Adv Health Sci Educ Theory Pract.* 2013;18(3):509–22. <https://doi.org/10.1007/s10459-012-9390-z>.
65. Hojat M, Mangione S, Nasca TJ, Rattner S, Erdmann JB, Gonnella JS, et al. An empirical study of decline in empathy in medical school. *Med Educ.* 2004; 38(9):934–41. <https://doi.org/10.1111/j.1365-2929.2004.01911.x>.
66. Boss JA. The effect of community service work on the moral development of college ethics students. *J Moral Educ.* 1994;23(2):183–98. <https://doi.org/10.1080/0305724940230206>.
67. Eyler J, Giles DE Jr. *Where's the Learning in Service-Learning?* Jossey-Bass Higher and Adult Education Series. San Francisco: Jossey-Bass, Inc.; 1999.
68. Jacoby B. *Service-Learning in Higher Education: Concepts and Practices.* The Jossey-Bass Higher and Adult Education Series. San Francisco: Jossey-Bass Publishers; 1999.
69. Celio CI, Durlak J, Dymnicki A. A meta-analysis of the impact of service-learning on students. *J Exp Educ.* 2011;34(2):164–81.
70. McLellan JA, Youniss J. Two systems of youth service: determinants of voluntary and required youth community service. *J Youth Adolesc.* 2003; 32(1):47–58. <https://doi.org/10.1023/A:1021032407300>.
71. Shumer R. Community-based learning: humanizing education. *J Adolesc.* 1994;17(4):357–67. <https://doi.org/10.1006/jado.1994.1032>.
72. Asheer S, Zlef S, Neild R. Roadmap for effective school-based practices to support expectant and parenting youth: lessons from the New Heights program in Washington, DC. *Matern Child Health J.* 2020;24(Suppl 2):125–31. <https://doi.org/10.1007/s10995-020-02986-4>.
73. Eyler J. Reflecting on service: helping nursing students get the most from service-learning. *J Nurs Educ.* 2002;41(10):453–6. <https://doi.org/10.3928/0148-4834-20021001-10>.
74. Jones KJ, Vandenberg EV, Bottsford L. Prevalence, formation, maintenance, and evaluation of interdisciplinary student aging interest groups. *Gerontol*

- Geriatr Educ. 2011;32(4):321–41. <https://doi.org/10.1080/02701960.2011.618958>.
75. Anderson ES, Lennox A. The LeiECSTer model of Interprofessional education: developing, delivering and learning from student voices for 10 years. *J Interprof Care*. 2009;23(6):557–73. <https://doi.org/10.3109/13561820903051451>.
76. Santiago LM, Rosendo I, Coutinho ML, Maurício KS, Neto I, Simões JA. Comparing empathy in medical students of two Portuguese medicine schools. *BMC Med Educ*. 2020;20(1):153. <https://doi.org/10.1186/s12909-020-02034-3>.
77. Wilson BG, Myers KM. Situated cognition in theoretical and practical context. In: Johassen D, Land S, editors. *Theoretical foundations of learning environments*. Mahwah, NJ: Erlbaum; 1999.
78. Raskoff S, Sundeen R. Community service programs in high schools. *Law Contemp Probl*. 1999;62(4):73–111. <https://doi.org/10.2307/1192268>.
79. Tsueng G, Kumar A, Nanis SM, Su AI. Aligning needs: integration citizen science efforts into schools through service requirements. *Hum Comput (Fairfax)*. 2019;6(1):56–82. <https://doi.org/10.15346/hc.v6i1.4>.

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