

Article

Improved Understanding of Learning Characteristics among International Students in Post-Baccalaureate Medical Education for Sustainable Development

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Abstract: Ensuring the success of medical students in post-baccalaureate training is crucial for providing sustainable, high-quality healthcare worldwide. However, international medical students encounter unique sustainability challenges that may affect their ability to learn and excel in medical schools. Therefore, this study aimed to investigate and assess the key attributes of learning styles and attitudes among first- and second-year medical students from a university in Southern Taiwan using the Attitudes Toward Thinking and Learning Survey (ATTLS). In November 2022, a cross-sectional survey and purposive sampling were used to recruit all 43 international medical students. Factor analysis was employed to identify and simplify complex personality traits associated with learning styles and attitudes. The resulting four-factor solution, which accounted for 70.364% of the total variance, was labeled as follows: Factor 1 “Understanding, Interaction Insights, and Empathy”, Factor 2 “Respect, Trust, and an Objective and Rational Vision of Multicultural Diversity”, Factor 3 “Comment, Debate, and Declare One’s Position”, and Factor 4 “Critical Thinking, Logical and Rational Problem Solving, and Rigorous Inference”. This study highlights the significance of connected knowers, who possess both Factor 1 and Factor 2, in providing holistic empathy and multicultural insight for future pedagogy. The four factors identified in this research can serve as a guide for developing teaching strategies that consider students’ diverse learning preferences and needs. By cultivating connected knowers, this research contributes to the sustainable improvement of pedagogical quality and the reduction of non-intellectual challenges in the classroom.

Keywords: learning styles and attitudes; international students; factor analysis; understanding; empathy; Taiwan



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1. Introduction

An established method of evaluating methods of acquiring knowledge has categorized them into two groups: connected knowing and separate knowing [1]. According to multiple studies, connected knowing can be described as a process that involves subjective reactions, personal implementation, mindfulness and self-awareness, empathy, attentive listening, cooperative and collaborative learning, personal growth through the sharing of personal information, recognition of individual differences, feeling empowered through affirmation, using knowledge in novel situations, and taking inspiration from teachers who serve as role models [2–5]. Alternatively, separate knowing refers to the objective process of observing, analyzing, debating, distinguishing between facts and opinions, evaluating and critiquing individual and competitive learning, comprehending significant concepts,

individualistic pursuits, and the practical and just application of principles. It involves proving oneself, accurately defining problems, clarifying theoretical models, and viewing teachers as sources of knowledge. It is important to note that neither connected nor separate knowing is superior to the other [6]. Medical instructors strive to equip their students with proficiency in both modes of thinking.

Learning style theories propose that individuals have different ways of thinking and learning. These differences do not necessarily reflect variations in intelligence but rather refer to preferences for processing specific types of information. Abucay [7] identified various factors that can contribute to learning difficulties, such as intellectual factors (e.g., special intellectual disabilities), learning factors (e.g., inadequate mastery of taught material, limited background knowledge of a certain topic, and ineffective study methods), physical factors (e.g., health issues, visual or physical impairments, poor nutrition, and inadequate physical development), emotional and social factors (e.g., pupil–teacher relationships, social interactions among peers, relationships among school staff, classroom environment, social readiness, cooperative vs. competitive attitudes, and pupil attitudes towards teachers), mental factors (e.g., attitude), environmental factors (e.g., classroom setting, textbooks, equipment, school supplies, and other instructional materials), and teacher personality (e.g., the ability of the teacher to inspire and lead students through the power of their personality and example).

Having a good understanding of the learning styles and attitudes of students is crucial for improving the quality of teaching and reducing non-intellectual problems in the classroom [8]. By recognizing each student's learning style, teachers can adjust their teaching strategies and methods to better meet their needs. Similarly, teachers who understand their students' attitudes toward learning can design more engaging and meaningful lessons. For instance, highly motivated students may benefit from more challenging assignments, whereas those who lack motivation may benefit from more frequent feedback and encouragement. By tailoring their teaching methods to suit the diverse needs of their students, teachers can create a more inclusive and effective learning environment that can minimize non-intellectual difficulties such as behavioral problems, disengagement, and low self-esteem and enhance student outcomes. Although there is some controversy about the effectiveness of the learning styles theory, many experts agree that teachers' awareness of their students' individual preferences and needs can positively impact their teaching quality and students' learning experiences.

The medical education system in Taiwan underwent a modification in 1949, transitioning from a six-year program to a seven-year program. The revised program comprised pre-medicine for the initial two years, basic medicine for the following two years, clerkship for the subsequent two years, and finally, an internship for the seventh year [9]. In 1951, the National Taiwan University School of Medicine began incorporating American medical courses and resident training systems, which led to the establishment of the Taiwan Medical College Evaluation Committee (TAMC) in 1999 [10]. The TAMC played an indirect role in promoting medical education reform and ensuring its quality in Taiwan's medical schools. As a required component of doctors' national examinations since 2013, the Objective Structured Clinical Examination (OSCE) joint examination has been implemented. Additionally, in 2016, Taiwan's medical education system changed to a six-year program followed by two postgraduate years (PGYs) of general medical training [10,11].

On the other hand, post-baccalaureate medical education was introduced in 1983 for Taiwanese medical students, while international medical students had to wait until 2013 to benefit from this program. In 2008, a study conducted by Tsai et al. revealed that Taiwanese post-baccalaureate medical students displayed superior learning motivation, teamwork, and willingness to cooperate. They were also able to identify deficiencies in other doctors based on their pre-medical experience [12]. However, these students exhibited lower academic performance, which may be attributed to maladaptation, a condensed curriculum, external factors, and their advanced age. These findings have implications for the design of Taiwan's medical education system and the academic performance of its students [12].

Despite these findings, there is currently no research on how international medical students respond to Taiwan's medical education system or their academic performance. Therefore, it is necessary to conduct further research to improve the current system. One way to achieve this is by designing suitable courses that cater to the unique needs of each class, allowing students to learn more effectively based on their learning and tactics. This can be accomplished by identifying students' learning styles and understanding the correlation between learning styles and academic performance.

In 2013, a university in Kaohsiung, Taiwan initiated a program that offers a post-baccalaureate medical education exclusively for international students. This program is sponsored by the International Cooperation and Development Fund, which is a top foreign aid organization [13]. It aims to provide opportunities for doctoral training to students from various regions such as Africa, the Caribbean, Central America, and the Pacific through international collaborations. As students from diverse ethnic and cultural backgrounds are enrolled, it poses certain challenges to teachers across different levels of medical education. However, if teachers can comprehend the various concepts and attitudes of these students, they can effectively minimize these challenges while simultaneously accomplishing multiple educational objectives in medicine and multicultural diversity [14].

Medical education programs are facing diversity challenges as more international students enroll, resulting in cultural, ethnic, and linguistic gaps. This can create difficulties for medical teachers, who need to be prepared to accommodate diversity in the classroom effectively. While traditional teaching methods such as teacher-centered learning (TCL) have been used in the past, the emphasis now is on student-oriented teaching methods such as student-centered learning (SCL) [15], which promotes active learning, deep understanding, learner autonomy, interdependence between the student and the teacher, and mutual support [16]. To be effective, curricular components should integrate the demographic profiles and personal characteristics of international students, building on themes from the past while addressing communication skills with more participation and motivation. SCL and patient-centered care share similar characteristics, such as the importance of lifelong learning, learning evaluation, and learning from others [17]. Medical students should develop skills such as problem-solving, reflection, decision-making, technology use, information literacy, and inductive and deductive reasoning to make informed decisions in the future, which are key components of medical education.

We utilize factor analysis to identify and simplify a range of intricate features concerning the attitudes and learning styles of multicultural international students enrolled in a post-baccalaureate medical training program. Through this method, we aim to investigate the underlying characteristics among these students and analyze how they are linked to the different dimensions of the connected and separate knowing styles and recognized personality traits.

2. Materials and Methods

We used a cross-sectional study and factor analysis to assess and evaluate the characteristics of learning styles and attitudes of international students in a post-baccalaureate medical education training program.

2.1. Setting and Participants

To recruit participants for a factor analysis study, purposive sampling was utilized, specifically targeting all first- and second-year medical students who took part in the "International Health" and "Population Health and Sustainable Development" curricula at a university in Kaohsiung City, Taiwan, during the first semester of 2022. The study enrolled a total of 21 first-year students from "International Health" and 22 second-year students from "Population Health and Sustainable Development", both of which were taught by the same instructor. While the course material varied, other aspects of the teaching process were consistent, including the teacher's expectations for student performance and assessment criteria.

2.2. Measurement

The Attitudes Toward Thinking and Learning Survey (ATTLS) [1] was used to assess the learning styles and attitudes of 43 international students who participated in the teaching processes of “International Health” and “Population Health and Sustainable Development” courses. The survey comprises 20 statements, where the first 10 statements represent connected knowing (such as “I appreciate listening to the thoughts of individuals from diverse backgrounds than mine as it helps me comprehend how the same things can be seen differently” and “Learning to understand people who are vastly different from me has been the most valuable part of my education”), and the next 10 statements represent separate knowing (such as “When solving problems, I value using logic and reasoning more than considering my concerns” and “I spend time finding faults in things. For instance, I scrutinize a literary interpretation that is not argued well enough.”). These two types of statements were mixed in the survey.

The initial version of ATTLS consisted of 50 items, which typically required an average of 45 min to complete. However, the current study employed a reduced version of ATTLS, comprising 20 items, which has been shown by prior research to be highly correlated and nearly as dependable as the original 50-item variant [1]. The ATTLS has been utilized because it has undergone validation and has proven to be an effective instrument for measuring attitudes and learning styles [1,18]. It has also been constructed on Moodle to provide prompt feedback on learning styles and attitudes, making it convenient for the professor to administer and present descriptive statistical results to students enrolled in two distinct curricula within a classroom setting.

2.3. Procedures

In November 2022, eight weeks into the semester, students were asked to participate in an ATTLS questionnaire to assess their learning styles and attitudes toward the teaching process. Participation was optional, and those who chose to participate were required to provide informed consent. All 43 students agreed to participate and were informed that the survey aimed to assist them in assessing their attitudes toward thinking and learning in class discussions.

The professor emphasized that there are no definitive answers, only opinions that hold value. Students were assured that their feedback would be kept strictly confidential and would not impact their grades. To maintain student privacy and provide constructive feedback on their learning approaches and attitudes, the professor requested that they identify their preferred learning methods. The resulting frequency distributions, which represented depersonalized data, were presented in the classroom.

2.4. Data Analysis

Demographic data and the responses to both connected and separate items of ATTLS were analyzed using descriptive statistics such as mean and standard deviation (SD). Reliability was assessed by conducting the Cronbach’s Alpha coefficient test.

Factor analysis was employed to identify the underlying factors that contribute to the Attitude Toward Thinking and Learning Survey (ATTLS) scores. The initial assessment involves conducting two tests, namely the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy and Bartlett’s test of sphericity. The KMO test evaluates the strength of the partial correlation between the variables, which indicates how well the factors account for each other. It is also used to determine whether the data are appropriate for factor analysis. An ideal value for KMO is close to 1.0, while values below 0.5 are deemed unsuitable. Bartlett’s test of sphericity was employed to examine whether the correlation matrix was an identity matrix, which implies that the variables are independent and unsuitable for factor analysis. A statistically significant result (typically below 0.05) indicates that the correlation matrix is not an identity matrix, thereby rejecting the null hypothesis and making it possible to perform factor analysis.

To determine the optimal number of components that accurately describe the data, eigenvalues were calculated for each factor extraction. An acceptable score greater than 1 was considered to ensure that the factors were sufficiently significant for each extraction. The cumulative total score variance of the various factors was also analyzed. A higher cumulative score variance indicates less information loss. To obtain simple and interpretable factors, Principal Component Analysis with Varimax rotation was conducted to allow for the reduction of the number of factors while maximizing the variance explained by each factor, resulting in simpler and more meaningful factors. Finally, factor identification and labeling based on higher loading factors for each component were also utilized in this study. All statistical analyses were performed using the Statistical Packages for Social Sciences (SPSS) (version 27.0) (IBM Corp., Armonk, NY, USA). The p -value for statistical significance was set at 0.05.

2.5. Ethical Considerations

The study was approved by a university and the Institutional Review Boards (IRB) of the collaborating E-DA Hospital (IRB No. 2022020). Informed consent was obtained from the students attending the “International Health” and “Population Health and Sustainable Development” curricula while completing the self-administered survey. All methods were performed by the relevant guidelines and regulations.

3. Results

The Cronbach’s Alpha coefficients indicate that the items, connected aspects, and separate aspects have high reliability, with values of 0.93, 0.93, and 0.85, respectively. Table 1 demonstrates that regardless of the student’s gender or curriculum, the scores on the Likert scale for connected knowers are significantly higher than those for separate knowers.

Table 1. Likert scales of connected and separate knowing by gender and curriculum.

Characteristics	Knowing				
	N	Connected		Separate	
		Mean	SD	Mean	SD
Gender					
Female	26	4.2	0.8	3.5	0.7
Male	17	4.0	0.9	3.4	1.0
Curriculum					
International Health	21	4.2	0.9	3.5	0.7
Population Health and Sustainable Development	22	4.0	0.8	3.4	0.9

Table 2 indicates that seven items on the Likert scale scored higher than four points, specifically 4.558, 4.372, 4.302, 4.209, 4.163, 4.07, and 4.023. These items correspond to the following statements: item 10—“I have an interest in understanding other people’s perspectives and experiences that led them to feel the way they do”, item 8—“I find it enjoyable to listen to opinions of individuals from diverse backgrounds as it broadens my understanding of how different individuals perceive the same thing”, item 13—“When evaluating what someone says, I focus on the quality of their argument rather than on the individual presenting it”, item 9—“The most crucial part of my education has been learning to comprehend individuals who are dissimilar to me”, item 7—“I am always curious about the reasons why individuals say and believe what they do”, item 3—“When discussing controversial issues, I tend to empathize and put myself in the shoes of the other person to understand their perspective”, and item 5—“I strive to work collaboratively with individuals rather than against them”. These statements align with the majority of medical students who were assessed by ATTLS as connected knowers.

Table 2. Descriptive statistics of a 20-item survey for 43 international students.

	Item	Mean	SD
1.	When I encounter people whose opinions seem alien to me, I make a deliberate effort to “extend” myself into that person, to try to see how they could have those opinions.	3.930	1.0778
2.	I can obtain insight into opinions that differ from mine through empathy.	3.977	0.9877
3.	I tend to put myself in other people’s shoes when discussing controversial issues, to see why they think the way they do.	4.070	0.9101
4.	I’m more likely to try to understand someone else’s opinion than to try to evaluate it.	3.744	0.9535
5.	I try to think with people instead of against them.	4.023	1.0348
6.	I feel that the best way for me to achieve my own identity is to interact with a variety of other people.	3.814	1.2584
7.	I am always interested in knowing why people say and believe the things they do.	4.209	1.1246
8.	I enjoy hearing the opinions of people who come from backgrounds different to mine—it helps me to understand how the same things can be seen in such different ways.	4.372	1.1756
9.	The most important part of my education has been learning to understand people who are very different to me.	4.163	1.1533
10.	I like to understand where other people are “coming from”, what experiences have led them to feel the way they do.	4.558	0.9336
11.	I like playing devil’s advocate—arguing the opposite of what someone is saying.	2.581	1.1999
12.	It’s important for me to remain as objective as possible when I analyze something.	3.930	1.1211
13.	In evaluating what someone says, I focus on the quality of their argument, not on the person who’s presenting it.	4.302	1.0586
14.	I find that I can strengthen my own position through arguing with someone who disagrees with me.	3.256	1.4158
15.	One could call my way of analyzing things “putting them on trial” because I am careful to consider all the evidence.	3.721	1.1196
16.	I often find myself arguing with the authors of books that I read, trying to logically figure out why they’re wrong.	2.605	1.1157
17.	I have certain criteria I use in evaluating arguments.	3.512	1.0773
18.	I try to point out weaknesses in other people’s thinking to help them clarify their arguments.	3.186	1.3497
19.	I value the use of logic and reason over the incorporation of my own concerns when solving problems.	3.651	1.1728
20.	I spend time figuring out what’s “wrong” with things. For example, I’ll look for something in a literary interpretation that isn’t argued well enough.	3.628	1.2914

According to Table 3, the study has a Kaiser–Meyer–Olkin value of 0.840, suggesting that the variables have a high degree of overlap and a strong partial correlation. Therefore, it is reasonable to begin conducting factor analysis. Bartlett’s test of sphericity indicates that factor analysis is viable, as evidenced by the small values of the significance level. Furthermore, Table 4 indicates that the extraction communalities for this dataset are acceptable.

Table 3. KMO and Bartlett’s Test.

Kaiser–Meyer–Olkin Measure of Sampling Adequacy		0.840
Bartlett’s Test of Sphericity	Approx. Chi-Square	574.281
	Degree of Freedom	190
	Significance	0.000

Table 4. Communalities.

	Components	Extraction
1.	When I encounter people whose opinions seem alien to me, I make a deliberate effort to “extend” myself into that person, to try to see how they could have those opinions.	0.667
2.	I can obtain insight into opinions that differ from mine through empathy.	0.684
3.	I tend to put myself in other people’s shoes when discussing controversial issues, to see why they think the way they do.	0.748
4.	I’m more likely to try to understand someone else’s opinion than to try to evaluate it.	0.734
5.	I try to think with people instead of against them.	0.710
6.	I feel that the best way for me to achieve my own identity is to interact with a variety of other people.	0.683
7.	I am always interested in knowing why people say and believe the things they do.	0.811
8.	I enjoy hearing the opinions of people who come from backgrounds different to mine—it helps me to understand how the same things can be seen in such different ways.	0.844
9.	The most important part of my education has been learning to understand people who are very different to me.	0.668
10.	I like to understand where other people are “coming from”, what experiences have led them to feel the way they do.	0.833
11.	I like playing devil’s advocate—arguing the opposite of what someone is saying.	0.469
12.	It’s important for me to remain as objective as possible when I analyze something.	0.716
13.	In evaluating what someone says, I focus on the quality of their argument, not on the person who’s presenting it.	0.756
14.	I find that I can strengthen my own position through arguing with someone who disagrees with me.	0.749
15.	One could call my way of analyzing things “putting them on trial” because I am careful to consider all the evidence.	0.598
16.	I often find myself arguing with the authors of books that I read, trying to logically figure out why they’re wrong.	0.574
17.	I have certain criteria I use in evaluating arguments.	0.715
18.	I try to point out weaknesses in other people’s thinking to help them clarify their arguments.	0.682
19.	I value the use of logic and reason over the incorporation of my own concerns when solving problems.	0.734
20.	I spend time figuring out what’s “wrong” with things. For example, I’ll look for something in a literary interpretation that isn’t argued well enough.	0.698

Table 5 displays four (4) factors derived from eigenvalues greater than 1. The first factor’s eigenvalue was 9.494 without rotation, explaining 47.470% of the variance in the original data. The remaining three factors had eigenvalues of 2.038, 1.437, and 1.104 without rotation, accounting for 23.364%, 10.191%, and 7.185% of the variance, respectively. The cumulative variance explained by all four factors was 70.364%. After rotation, the first factor’s eigenvalue was 4.67, explaining 23.364% of the variance. The next three factors had eigenvalues of 4.307, 2.585, and 2.509, accounting for 21.533%, 12.924%, and 12.543% of the variance, respectively. Thus, the cumulative variance explained by the factors after rotation and extraction was 70.364%, resulting in a substantial reduction in the dataset’s complexity, but with 29.636% information loss.

Table 5. Eigenvalues.

Component	Total Variance Explained *								
	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.494	47.470	47.470	9.494	47.470	47.470	4.673	23.364	23.364
2	2.038	10.191	57.661	2.038	10.191	57.661	4.307	21.533	44.897
3	1.437	7.185	64.846	1.437	7.185	64.846	2.585	12.924	57.821
4	1.104	5.518	70.364	1.104	5.518	70.364	2.509	12.543	70.364

* Extraction Method: Principal Axis Factoring.

Table 6 displays the results of a principal component analysis using Varimax rotation, which generated 20 components. These components indicate that there are four distinct personality learning styles and attitudes. Factor 1, which had eight items with a loading score greater than 0.5, is associated with the traits of “Understanding, interaction insights, and empathy”. Factor 2, which had six items with a loading score greater than 0.5, is associated with the traits of “Respect, trust, and an objective and rational vision of multi-cultural diversity”. Factor 3, which had four items with a loading score greater than 0.5, is associated with the traits of “Comment, debate, and declare one’s position”. Finally, Factor 4, which had four items with a loading score greater than 0.5, is associated with the traits of “Critical thinking, logical and rational problem solving, and rigorous inference”.

Table 6. Rotated factor matrix.

Item	Learning Styles and Attitudes	Factor *			
		1	2	3	4
4.	I’m more likely to try to understand someone else’s opinion than to try to evaluate it.	0.807			
6.	I feel that the best way for me to achieve my own identity is to interact with a variety of other people.	0.779			
5.	I try to think with people instead of against them.	0.737	0.317		
20.	I spend time figuring out what’s “wrong” with things. For example, I’ll look for something in a literary interpretation that isn’t argued well enough.	0.695		0.419	
3.	I tend to put myself in other people’s shoes when discussing controversial issues, to see why they think the way they do.	0.685	0.395		0.348
1.	When I encounter people whose opinions seem alien to me, I make a deliberate effort to “extend” myself into that person, to try to see how they could have those opinions.	0.641	0.359		0.315
9.	The most important part of my education has been learning to understand people who are very different to me.	0.608	0.511		
2.	I can obtain insight into opinions that differ from mine through empathy.	0.565	0.471		0.366
8.	I enjoy hearing the opinions of people who come from backgrounds different to mine—it helps me to understand how the same things can be seen in such different ways.		0.872		

Table 6. Cont.

Item	Learning Styles and Attitudes	Factor *			
		1	2	3	4
10.	I like to understand where other people are “coming from”, what experiences have led them to feel the way they do.	0.455	0.771		
12.	It’s important for me to remain as objective as possible when I analyze something.		0.739		0.358
7.	I am always interested in knowing why people say and believe the things they do.	0.409	0.719	0.318	
13.	In evaluating what someone says, I focus on the quality of their argument, not on the person who’s presenting it.		0.643		0.501
16.	I often find myself arguing with the authors of books that I read, trying to logically figure out why they’re wrong.			0.742	
18.	I try to point out weaknesses in other people’s thinking to help them clarify their arguments.			0.733	0.315
14.	I find that I can strengthen my own position through arguing with someone who disagrees with me.		0.491	0.701	
11.	I like playing devil’s advocate—arguing the opposite of what someone is saying.			0.672	
17.	I have certain criteria I use in evaluating arguments.				0.791
19.	I value the use of logic and reason over the incorporation of my own concerns when solving problems.	0.333	0.334		0.714
15.	One could call my way of analyzing things “putting them on trial” because I am careful to consider all the evidence.	0.360	0.382		0.509

Extraction method: principal component analysis. Rotation method: Varimax with Kaiser Normalization.

* Rotation converged in 6 iterations.

4. Discussion

The focus of this research is to explore the methods through which international medical students acquire knowledge about sustainability during their advanced medical studies. The ultimate objective is to align this goal with Education 4.0, a contemporary educational paradigm that emphasizes the integration of technology, critical thinking, and global citizenship. Education 4.0, enabled by digital technology, has liberated learning from temporal and spatial constraints. It corresponds to the demands of the Fourth Industrial Revolution, in which humans and technology collaborate to generate fresh prospects [19]. This innovative educational approach not only facilitates the acquisition of essential skills and knowledge but also motivates learners to discover their learning resources. The learners take center stage, as the emphasis is on empowering them to determine when and how they learn and engage in peer collaboration. In this model, teachers act as facilitators. To meet the future needs and expectations of students, higher education must become a complex adaptive system that takes advantage of time and interaction with other systems [19]. According to Fisk (2017), the future of education will feature three key elements: understanding why learning is necessary, having a personal choice in where and how to learn, and learning together and from one another. Education 4.0 encompasses nine trends, including diversity in time and location, personalized learning, freedom of choice, project-based learning, practical experience, data interpretation, a complete overhaul of exams, student ownership, and the increasing importance of mentoring [19].

Upon contemplation of the development of education from Education 1.0 up to Education 3.0, it becomes apparent that we should give priority to investing in change and concentrate on designing relevant curricula and educational overhauls to secure the future of our learners. This is exemplified by the investigation of medical education programs tailored for international students. To enhance the learning experiences of our students, we need to reconsider how we deliver education within limited funding by incorporating threshold concepts into our teaching and learning [20]. This will enable students to comprehend their learning process and prepare for the future. Additionally, we can optimize digital technology to enhance efficiency, effectiveness, engagement, and communication, while ensuring that students receive authentic and valuable educational experiences (Admiraal et al., 2019) [20]. It is crucial to strike a balance between technology and human teaching, capitalizing on the best of both worlds.

Using factor analysis, we identified four distinct factors in our study. The first factor, named “Understanding, interaction insights, and empathy”, stresses the significance of understanding other people’s perspectives and establishing connections. The second factor, named “Respect, trust, and an objective and rational vision of multicultural diversity”, highlights the importance of respecting cultural differences while maintaining an objective viewpoint. The third factor, named “Comment, debate, and declare one’s position”, emphasizes the value of open discussions and expressing opinions. Lastly, the fourth factor, named “Critical thinking, logical and rational problem solving, and rigorous inference”, underscores the importance of using logic and reasoning in problem-solving. These factors collectively account for 70.364% of the variance in our study. Our findings show that international medical students prioritize connected knowing, as indicated by the eigenvalues of Factor 1 and Factor 2.

The Accreditation Council for Graduate Medical Education (ACGME) established a group of six core competencies in 1999 to define the essential abilities all practicing physicians should possess. These competencies were developed to guide and assess the education of competent doctors, including practice-based learning, patient care and procedural skills, systems-based practice, medical knowledge, interpersonal and communication skills, and professionalism. These competencies have significantly influenced medical education today, and the concept of competency-based medical education (CBME) has gained traction as a new paradigm in professional education [21]. The term “competencies” mentioned earlier pertains to the distinct actions exhibited by healthcare providers as they utilize their acquired knowledge, skills, attitudes, and values in various clinical scenarios to provide safe and effective medical care according to the demands of the healthcare system in specific situations. In light of the current push for CBME, four main themes have surfaced: prioritization of curricular outcomes, emphasis on abilities, training based on time, and encouragement of learner-centered approaches [21]. In an age of heightened public scrutiny, medical curricula must guarantee that students possess the necessary skills in critical domains.

In the 2013 academic year, a university introduced a distinctive medical education program for post-baccalaureate students, which was financed by the Ministry of Foreign Affairs (MOFA) of Taiwan. The program was centered on humanitarian assistance and was supplemented by the establishment of a medical school for international students. This school aimed to develop globally recognized medical professionals devoted to offering humanitarian services and promoting global healthcare. The program had four objectives: (1) to enlist first-rate faculty and enhance the integration of theoretical and clinical practices to meet international teaching standards; (2) to foster interprofessional collaboration, which would amalgamate academic research and clinical medicine; (3) to train medical professionals who could provide healthcare services internationally; and (4) to reinforce cross-cultural medical education and provide opportunities for collaboration and exchange with medical institutions across the world. Two curricula were developed for post-baccalaureate medical students: “International Health” and “Population Health and Sustainable Development”. The objectives of the two curricula were to develop physicians who possess the following

abilities: (1) Establishing fundamental theoretical and clinical practices, as well as developing a lifelong learning attitude and proficiency in different medical fields; (2) Enhancing preventive healthcare and public health policies; (3) Demonstrating humane and compassionate behavior while following ethical principles; and (4) Preparing physicians to assume significant responsibilities in medical care and leadership on a global scale.

The learning objectives of international medical students who have completed their undergraduate studies are distinct from those of medical students in Taiwan. The majority of these international students are either healthcare professionals or registered healthcare staff with clinical experience. They intend to acquire advanced medical knowledge that is unavailable in their home country and apply it when they return. The bachelor's program is designed to develop the capacity to provide comprehensive healthcare rather than solely enhancing professional skills. The ultimate objective is to pursue holistic healthcare, which takes into account and includes all aspects of a patient's life, such as physical, emotional, social, economic, and spiritual needs [22]. The notion of holistic healthcare aims to cater to the overall well-being of an individual, their family, and the community. It takes into account the person's response to illness and the effect of illness on self-care. The American Holistic Medical Association has established ten principles to guide practitioners in holistic medicine. The ultimate objective of holistic healthcare is to achieve optimal health and attain the highest level of equilibrium and functionality in all aspects of human life, such as physical, environmental, mental, emotional, social, and spiritual. Our two designed curricula align with the principles of holistic healthcare.

Our study's factor analysis indicates that the key factors that have the most significant impact are "understanding, insight, and empathy". Medical educators concur that empathy is crucial to physicians' professionalism, and most research on the patient–physician relationship confirms that it plays a critical role in enhancing clinical outcomes. Multiple articles have examined and verified that empathy is linked to various factors, including specialties, cultural values, and gender, particularly among Italian, Indian, and Japanese medical students, with female students demonstrating higher levels of empathy than their male counterparts [23–25]. Yang SY et al. explored whether the utilization of various techniques, including perspective-taking, compassionate care, and assuming the patients' perspective, acted as motivating factors in cultivating empathy among medical students [26]. Medical students can improve their empathy by being exposed to clinical training and a curriculum that focuses on developing professional competencies, according to other researchers' findings [27]. The most significant elements influencing empathy in medical education are the experiences that encourage personal and professional development [28]. Medical students who exhibited high levels of empathy and low levels of burnout during their undergraduate studies reported the highest levels of life satisfaction [29]. Medical students need to possess empathy, which is particularly essential for students in post-baccalaureate medical programs. This program differs from the curriculum in Taiwan, where students begin medical school directly after high school at the age of 18 and complete their studies in six years. In contrast, the post-baccalaureate students in our program come from different countries, are older, and have some clinical experience prior to their enrollment. Differences in culture and education may impact how empathetic they are. Each student has a unique reason for pursuing medical studies and will benefit from their future work. The curriculum for international students in our post-baccalaureate program has been developed through factor analysis and group discussions to emphasize the learning process and achieve the desired objectives.

In our research, factor 2 has been classified as "Respect, trust, and an unbiased and reasonable approach to multicultural diversity" in our study. Medical education is an interdisciplinary field that integrates various disciplines such as medicine, education, and social sciences [30]. The fundamental principle of medical education is to respect diverse perspectives and disciplinary viewpoints. It involves synthesizing elements from different perspectives to develop something new, which is a unique aspect of medical education [31]. Respect for colleagues' perspectives and expertise is a crucial element in medical educa-

tion's practice and scholarship. It involves a distinctive blend of theoretical and practical components that underscores the significance of mutual respect between physicians and non-physicians at both undergraduate and postgraduate levels. Additionally, there exists a larger community of scholars and practitioners beyond the medical education circle, including individuals from the social sciences, humanities, business and management, and other sciences [32]. These colleagues can be valuable resources when dealing with medical problems, especially in situations where one lacks knowledge or expertise. Each individual brings their unique skills, knowledge, and insights to the table when addressing medical issues. It is neither appropriate nor wise to dismiss each other's ideas as impractical or anti-intellectual. Instead, it is essential to acknowledge and appreciate the practical application of specialized educational knowledge and skills that each party brings to the discussion when addressing medical issues.

Factor 3 has been identified as "Opinion expression, discussion, and taking a stance", which is the ability to express opinions, engage in discussions, and take a stance, is an integral part of communication skills. In medical practice, this skill is essential for medical students to communicate effectively with patients, families, and colleagues [33]. The ability to express one's opinions and take a stance is crucial in decision-making processes and can influence patient outcomes. Furthermore, effective communication and the ability to engage in discussions can enhance teamwork, resulting in improved patient care and outcomes [33]. Accreditation Council for Graduate Medical Education (ACGME) has listed communication skills as one of the six essential skills for medical students. The Association of American Medical Colleges (AAMC) and other medical regulatory bodies now recognize the value of developing communication skills, and the CanMeds Framework supports a move toward competency-based medical education (CBME) [34–36]. Given the significant benefits and potential patient risks, it is crucial to include educational interventions that enhance communication skills as part of undergraduate medical education [37,38]. The way healthcare professionals communicate and show respect toward others can significantly impact their interactions with patients and colleagues [39]. This holds for both verbal and non-verbal communication skills, as they are essential for creating a positive learning environment, especially among international medical students from diverse cultural backgrounds. Effective communication in a common international language, combined with mutual respect and trust, is crucial for achieving learning outcomes that align with the international medical community's standards. Thus, integrating such skills into undergraduate and pre-clinical education is a critical objective.

Factor 4 has been labeled as "Analytical thinking, rational and logical problem-solving, and precise inference" in this study. This factor highlights the importance of problem-solving skills in learning. Problem-solving learning or problem-based learning (PBL) is a teaching method that encourages students to apply their knowledge to real-world problems, promoting a process of rethinking and reframing issues to identify novel solutions [40]. This approach diverges from traditional testing methods, which tend to limit students to finding a single correct answer. PBL is a student-centered approach to education in which students learn about a topic by actively engaging in solving open-ended problems presented by a teacher [41]. Moreover, PBL presents prospects for individual and team-based endeavors, promoting the cultivation of critical thinking, problem-solving, communication, and analytical abilities among adult learners. The type of task assigned in PBL can determine whether it requires independent or collaborative work. PBL enables medical students to apply theoretical knowledge in practical situations, and the investigation of relevant scenarios can spark an enduring passion for learning [41].

The academic performance of medical students can be influenced by their learning styles, and there is a need for further research in this area. Specifically, future studies should investigate the consistency and evolution of student's attitudes toward learning and thinking over time, as well as the correlation between these attitudes and academic achievement across different educational backgrounds [42–45]. Moreover, international medical students have the potential to make significant contributions to the fields of medicine and

public health in their home countries, in line with the World Health Organization's Sustainable Development Goals [44]. These goals include eradicating poverty and inequality, preserving the environment, and ensuring that everyone has access to health, justice, and prosperity, ultimately transforming our society. To achieve these objectives, it is essential to establish partnerships and provide support between Taiwan and its diplomatic allies in the medical sector, foster long-term relationships with returning graduates, explore more effective approaches to promote medical education, and assist in enhancing public health standards in developing countries, instead of relying solely on diplomatic funding.

This study utilized the ATTLS scale to gain insights into foreign students' learning styles and attitudes, though it has some limitations that must be considered. One such limitation is the narrow scope of the ATTLS scale, which only measures specific aspects of learning styles and attitudes, potentially leading to biased and incomplete findings. Another limitation is that the scale only assesses attitudes toward thinking and learning, failing to account for other factors that may impact learning outcomes, such as cognitive ability, environmental factors, learning preferences, individual differences, and social and cultural factors. Despite these limitations, the ATTLS scale can still provide valuable insights into foreign students' learning attitudes, as it has excellent content validity and high internal consistency reliability and is easy to administer to individuals from different age groups, educational backgrounds, and cultural contexts. However, future research could consider incorporating other assessment tools or examining additional factors that may impact learning outcomes to provide a more comprehensive understanding of foreign students' learning attitudes.

This study focused on analyzing the learning characteristics of medical students who had completed their bachelor's degrees and were enrolled in a specialized program for international students. The researchers deliberately chose students from this program, primarily from Caribbean countries. However, it is important to note that this selection method may limit the external validity and comparison opportunities in cases involving local post-baccalaureate medical students. As we are currently concentrating solely on two essential courses related to global health and sustainable population health, it is crucial to be careful while applying our results to other domains such as PBL or TBL courses, which are presently in the developmental phase.

5. Conclusions

The investigation is noteworthy, as we have the potential to expand and refine our understanding of the link between how the learning styles and attitudes of global medical students are linked. Our study has highlighted that these factors, i.e., understanding, respect, expression, and analytical thinking, had a significant influence on engagement levels and their perspectives toward learning among international medical students. Furthermore, we have underscored the significance of considering the individual needs and preferences of international medical students in medical education, which can be used to enhance their learning experience, engagement, and perspectives on learning. The study emphasizes the importance of recognizing and accommodating the diverse learning styles and attitudes of international medical students. These findings can be instrumental in the development of sustainable teaching strategies that promote holistic education which in turn can benefit both the students and the medical education system as a whole.

Author Contributions: All of the two authors met the ICMJE criteria for authorship including a substantial contribution to the design of the work and acquisition, analysis, or interpretation of data; drafting of the work or revising it critically for important intellectual content. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The study was approved by I-Shou University and the Institutional Review Boards (IRB) of the collaborating E-DA Hospital (IRB No. 2022020). Informed consent was obtained from the students attending the "International Health" and "Population Health

and Sustainable Development” curricula while completing the self-administered survey. All methods were performed by the relevant guidelines and regulations.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

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