How to connect? Peer networks and competence development in multiple thematic learning communities within one medical degree programme
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**SUMMARY**

The evolution of our society and the need of patients have transformed healthcare, as well as challenged medical education, resulting in instructional reforms. Many countries and institutions have mixed pedagogy patterns and design competency-driven curricula, taking into account local and global healthcare. The University Medical Center Groningen (UMCG) introduced an innovative competency-driven curriculum named G2020, which combines competency-based education (CBME) with problem-based learning (PBL) and thematic learning communities (TLCs). However, the effect of mixed patterns on students’ learning, especially competencies training, in a multicultural environment remains unclear so far.

This thesis comprises several chapters on students’ competencies training and peer relationship formation in multiple thematic learning communities within one medical degree program. The main research question is: How do TLCs in a formal CBME and PBL based curriculum influence students’ learning outcomes and peer relationships? In answering this research question, we use different methodologies.

In **Chapter 2** and 3 the students’ learning outcomes, specifically competencies performances in G2020 were explored. We used quantitative analysis methods to investigate if students can acquire similar learning outcomes in four parallel TLCs within the same curriculum that is taught in two different languages. **Chapter 2** describes an innovative curriculum design that combines four parallel thematic learning communities (TLCs) and problem-based learning (PBL) in one competency-based medical education (CBME) program. In Chapter 2, we used several quantitative analysis methods to compare students’ learning outcomes between TLCs in terms of both knowledge and competency. Most students in all four TLCs acquire the necessary level of knowledge and competencies to pass the assessments. Meanwhile, students’ learning outcomes reflect the diverse curriculum design of specific TLC task programs. The two TLCs, which focused more on knowledge development, outperformed the other two TLCs in knowledge assessment but underperformed in competencies assessments. The results of Chapter 2 also reflect the difficulty of comparing students’ learning outcomes due to the diversity of curriculum design, especially the assessment designs. Therefore, curriculum designers need to consider the balance between the comparability of assessment results and the diversity of assessment designs within one curriculum.
In Chapter 3, the competencies performances were investigated focused on three competencies (Collaboration, Leadership and Professionalism) assessments and in a more controlled environment. In this case, we compared students’ competencies assessment results between four TLCs in a shared program. In this shared program, students’ three competencies were assessed the same number of times by the same kind of assessor at the same timepoint. Chapter 3 focuses on whether international students and domestic students performed similarly when they studied in the same TLC. Students in English TLCs, which consist of both international and domestic students, outperformed students in the Dutch TLCs, which contain only domestic students. The differences were not caused by the differences in students’ backgrounds, as international students and domestic students performed similarly in the English TLCs. In this study, we also excluded the influence of students’ age, gender, prior knowledge, and bias of the assessors on these three competencies assessment results. Differences in motivation and differences in social networks of the students between English and Dutch TLCs might explain this finding.

In addition to the formal peer relationships organized by the faculty in TLCs, students’ informal peer relationships may also have a crucial impact on their learning process and outcomes. Chapter 4 investigates how students chose their collaborators when they can freely choose their fellow students within or across TLCs. The majority of students prefer to choose collaborators within their own TLC, reflecting that TLCs does enhance students’ collaboration. The more often they collaborate with their peers within their TLC, the more they prefer to choose group members within their TLC. Surprisingly, about 40% of students choose collaborators from different TLCs with whom they had never collaborated before in the formal curriculum. It reveals the positive influence of students’ informal peer relationships on collaborator selection. The homophily effect has also an impact on students’ informal peer relationship. In this study, gender and academic performance are related to students’ collaborator selection. High achievers prefer to choose collaborators from the same TLC and had limited collaboration with low achievers. Nonetheless, the TLCs still enhance the collaboration between high achievers and low achievers. The collaboration between high achievers and low achievers within TLCs was much more than across TLCs. Besides, although being either a domestic or international student does not relate to their collaborators’ selection, it is clear that international students had limited collaboration with domestic students, especially
domestic students from other TLCs.

In Chapter 5 and 6, students’ informal peer relationship and the influence of formal curriculum and students’ background were investigated. Chapter 5 uses the social network analysis method to explore how first- and second-year students formed their informal peer relationships under the impact of TLCs, to further understand the relationship of the students’ formal peer networks and informal peer networks, considering students’ attributes. Chapter 5 focuses on five informal networks (help-seeking, collaboration, friendship, information-sharing, learn-from) that have been shown to be related to students’ learning. Students have much more connections within TLCs than between TLCs in all informal peer relationships, and second-year students are more likely to be connected within TLCs than first-year students. The results reflect the positive impact of TLCs on the formation of five types of informal peer networks over time.

Despite the fact that the five informal networks studied had distinct structures, they were all positively associated. Meanwhile, connections between students in informal networks were rarely linked to shared attributes (nationality (domestic or international), gender, academic performance). Furthermore, when students stay in formal networks like TLCs for a longer period of time, the association between students’ attributes and their informal networks decreases. In addition, not only collaboration relationships, as we focused on in Chapter 4, international students have limited connections with domestic students in other informal peer relationships as well. Most connections between English and Dutch TLCs were established by domestic students. The results suggest that international students require additional assistance in connecting with domestic students in the international curriculum.

Due to the pandemic of COVID-19 since 2020, the restrictions have changed students’ learning and social lives. Students have had to study online most of the time and limited their social activities for long periods of time. In Chapter 6, we used mixed methods to explore the extent to which the restrictions affect students’ academic performance and the formation of informal peer relationships. We compared knowledge assessment results and five types of social networks of first- and second-year undergraduate students before and during the pandemic cohorts. Besides, we used thematic analysis to analyse students’ responses to difficulties in interacting with
others. Both first- and second-year undergraduate students during the pandemic had significantly smaller social networks than before-pandemic cohort, while their knowledge assessment results were higher. The qualitative analysis results revealed the negative impact of online communication on informal peer relationships formation. This is emphasized by international students who study alone abroad and far away from their families. The results of Chapter 6 suggest that institutions need to consider providing additional social, educational and mental support to accommodate the shortcomings of narrow social networks when implementing blended or online learning, which may reduce students’ social interactions on campus.

This thesis demonstrates that students in four parallel TLCs within a degree program can obtain equivalent learning outcomes, which reflect the diversity of curriculum design of the four TLCs. Furthermore, this dissertation shows the relationship between formal curriculum and informal peer relationships formation, taking into account students’ attributes and different learning environments. In this way, this dissertation advises curriculum designers to consider the balance of diversity and comparability of assessment design, as well as increasing the diversity and frequency of interactions among students with different backgrounds in formal curricula.
NEDERLANDSE SAMENVATTING

De veranderingen in onze maatschappij en de veranderde behoeften van de patiënten hebben de gezondheidszorg getransformeerd, en ook het medisch onderwijs op de proef gesteld, met onderwijshervormingen als gevolg. Veel landen en instellingen hebben diverse pedagogische uitgangspunten en ontwerpen competentie-gedreven curricula, rekening houdend met de lokale en mondiale gezondheidszorg. Het Universitair Medisch Centrum Groningen (UMCG) introduceerde een innovatief competentiegericht curriculum genaamd G2020, dat competentiegericht onderwijs (CBME) combineert met probleemgestuurd leren (PBL) en thematische leergemeenschappen (TLC’s). Echter, het effect van een gemengde onderwijsopzet op het leren van studenten, met name op competentie training, in een multiculturele omgeving is tot nu toe onduidelijk.

Deze dissertatie omvat verschillende hoofdstukken over de competentietraining van studenten en de vorming van interpersoonlijke relaties in meerdere thematische leergemeenschappen binnen één medische opleiding. De belangrijkste onderzoeksvraag is: Hoe beïnvloeden TLCs in een formeel CBME en PBL gebaseerd curriculum de leerresultaten en de peer relaties van studenten? Bij het beantwoorden van deze onderzoeksvraag gebruiken we verschillende methodologieën.

In Hoofdstuk 2 en 3 werden de leerresultaten van studenten, in het bijzonder de competentieprestaties in G2020, onderzocht. We gebruikten kwantitatieve analysemethoden om te onderzoeken of studenten vergelijkbare leerresultaten kunnen verwerven in vier parallelle TLC’s binnen hetzelfde curriculum dat in twee verschillende talen wordt onderwezen. Hoofdstuk 2 beschrijft een innovatief curriculumontwerp dat vier parallelle thematische leergemeenschappen (TLCs) en probleemgestuurd leren (PBL) combineert in één competentiegericht medisch onderwijs (CBME) programma. In Hoofdstuk 2 hebben we verschillende kwantitatieve analysemethoden gebruikt om de leeruitkomsten van studenten tussen TLCs te vergelijken, zowel in termen van kennis als van competentie. De meeste studenten in alle vier de TLC’s verwerven het noodzakelijke niveau van kennis en competenties om te slagen voor de beoordelingen. Ondertussen weerspiegelen de leerresultaten van de studenten het uiteenlopende curriculumontwerp van specifieke TLC-taakprogramma’s. De twee TLC’s, die meer gericht waren op kennisontwikkeling, presteerden beter dan de andere twee TLC’s bij de beoordeling van kennis, maar minder goed bij de beoordeling van competenties.
De resultaten van Hoofdstuk 2 weerspiegelen ook de moeilijkheid om de leerresultaten van studenten te vergelijken als gevolg van de diversiteit van het curriculumontwerp, met name de verschillen in de beoordelingsontwerpen. Daarom moeten curriculumontwerpers rekening houden met het evenwicht tussen de vergelijkbaarheid van beoordelingsresultaten en de diversiteit van beoordelingsontwerpen binnen één curriculum.

In Hoofdstuk 3 werden de competentieprestaties onderzocht maar nu gericht op drie competenties (Collaboration, Leadership en Professionalism) in een meer gecontroleerde omgeving. In dit geval vergeleken we de resultaten van de competentiebeoordelingen van studenten tussen vier TLC's in een gedeeld programma. In dit gedeelde programma werden de drie competenties van studenten hetzelfde aantal keren beoordeeld door dezelfde soort beoordelaars op hetzelfde tijdstip. Hoofdstuk 3 richt zich op de vraag of internationale studenten en binnenlandse studenten vergelijkbaar presteerden wanneer ze in dezelfde TLC studeerden. Studenten in Engelse TLC’s, die bestaan uit zowel internationale als binnenlandse studenten, presteerden beter dan studenten in de Nederlandse TLC’s, die alleen binnenlandse studenten bevatten. De verschillen werden niet veroorzaakt door de verschillen in achtergrond van de studenten, aangezien internationale studenten en binnenlandse studenten vergelijkbaar presteerden in de Engelse TLC’s. In deze studie hebben we ook de invloed van de leeftijd, het geslacht, de voorkennis en de vooringenomenheid van de beoordelaars op de resultaten van de beoordeling van deze drie competenties uitgesloten. Verschillen in motivatie en verschillen in sociale netwerken van de studenten tussen Engelse en Nederlandse TLC’s zouden deze bevinding kunnen verklaren.

Naast de formele peer relaties die de faculteit in TLC’s organiseert, kunnen ook de informele peer relaties van studenten een cruciale impact hebben op hun leerproces en -resultaten. Hoofdstuk 4 onderzocht hoe studenten hun collega’s kiezen wanneer zij vrij hun medestudenten binnen of buiten TLC’s kunnen kiezen. De meerderheid van de studenten verkiest medestudenten binnen hun eigen TLC te kiezen, wat erop wijst dat TLC’s de samenwerking tussen studenten bevordert. Hoe vaker ze samenwerken met hun medestudenten binnen hun TLC, hoe meer ze de voorkeur geven aan het kiezen van groepsleden binnen hun TLC. Verrassend genoeg koos ongeveer 40% van de studenten medestudenten uit verschillende TLC’s met wie ze nooit eerder hadden samengewerkt in het formele curriculum. Dit wijst op de positieve invloed van de informele relaties van
studenten met hun medestudenten op de keuze van hun medestudenten om samen te werken. Ook het homofilie-effect heeft een invloed op de informele peer-relatie van studenten. In deze studie zijn geslacht en academische prestaties gerelateerd aan de keuze van studenten voor een medestudent. Hoog presterende studenten verkiezen medestudenten uit dezelfde TLC en werkten slechts in beperkte mate samen met laag presterende studenten. Desalniettemin bevorderen de TLC’s de samenwerking tussen leerlingen met hoge en lage prestaties. De samenwerking tussen hoog presterende en laag presterende studenten binnen TLC’s was veel groter dan tussen TLC’s. Hoewel het feit dat een student uit eigen land of uit een ander land afkomstig is, geen invloed heeft op de keuze van hun collega’s, is het duidelijk dat internationale studenten slechts in beperkte mate samenwerkten met Nederlandse studenten met name niet met studenten uit andere TLC’s.

In Hoofdstuk 5 en 6 werden de informele peer-relaties van studenten en de invloed van het formele curriculum en de achtergrond van studenten onderzocht. Hoofdstuk 5 gebruikt de sociale netwerk analyse methode om te onderzoeken hoe eerste- en tweedejaars studenten hun informele peer relaties vormden onder de invloed van TLCs. Dit werd gedaan om de relatie tussen de formele peer netwerken en informele peer netwerken van de studenten verder te begrijpen, rekening houdend met de eigenschappen van de studenten. Hoofdstuk 5 focust op vijf informele netwerken (hulp zoeken, samenwerken, vriendschap, informatie delen, leren-ervaren) waarvan is aangetoond dat ze gerelateerd zijn aan het leren van studenten. Studenten hebben veel meer connecties binnen TLC’s dan tussen TLC’s in alle informele peer relaties, en tweedejaars studenten zijn vaker verbonden binnen TLC’s dan eersteklas studenten. De resultaten weerspiegelen de positieve impact van TLC’s op de vorming van vijf soorten informele peer-netwerken in de loop van de tijd.

Ondanks het feit dat de vijf bestudeerde informele netwerken verschillende structuren hadden, waren ze allemaal positief geassocieerd. Ondertussen waren de banden tussen studenten in informele netwerken zelden gekoppeld aan gedeelde kenmerken (nationaliteit (binnenlands of internationaal), geslacht, academische prestaties). Bovendien, wanneer studenten langere tijd in formele netwerken zoals TLC’s verblijven, neemt de associatie tussen de kenmerken van studenten en hun informele netwerken af. Daarnaast hebben internationale studenten niet alleen samenwerkingsrelaties, zoals we in Hoofdstuk 4 hebben onderzocht, maar ook in andere
informele peerrelaties beperkte connecties met binnenlandse studenten. De meeste connecties tussen Engelstalige en Nederlandstalige TLC’s zijn tot stand gebracht door binnenlandse studenten. De resultaten suggereren dat internationale studenten extra hulp nodig hebben bij het leggen van contacten met binnenlandse studenten in het internationale curriculum.

De beperkingen als gevolg van de pandemic van COVID-19 sinds 2020 hebben het leergedrag en het sociale leven van studenten veranderd. Studenten hebben het grootste deel van de tijd online moeten studeren en hebben hun sociale activiteiten voor lange periodes moeten beperken. In Hoofdstuk 6 gebruikten we verschillende methoden om te onderzoeken in hoeverre deze beperkingen van invloed zijn op de academische prestaties van studenten en op de vorming van informele relaties met medestudenten. We vergeleken de resultaten van de kennistoets en vijf soorten sociale netwerken van eerste- en tweedejaars studenten voor en tijdens de pandemic. Daarnaast gebruikten we thematische analyse om de antwoorden van studenten op moeilijkheden in de omgang met anderen te analyseren. Zowel eerste- als tweedejaars studenten hadden tijdens de pandemic significant kleinere sociale netwerken dan vóór de pandemic, terwijl hun resultaten op het vlak van kennisbeoordeling hoger waren. Uit de resultaten van de kwalitatieve analyse bleek de negatieve impact van online communicatie op de vorming van informele relaties met medestudenten. Dit wordt benadrukt door internationale studenten die alleen in het buitenland studeren, ver weg van hun familie. De resultaten van Hoofdstuk 6 suggereren dat instellingen moeten overwegen om extra sociale, educatieve en mentale ondersteuning te bieden om de tekortkomingen van kleine sociale netwerken op te vangen bij het implementeren van blended of online leren omdat de sociale interacties van studenten op de campus sterk kan verminderen.

Dit proefschrift toont aan dat studenten in vier parallelle TLC’s binnen hetzelfde programma gelijkwaardige leerresultaten kunnen behalen, die aan de andere kant wel de diversiteit van het curriculumontwerp van de vier TLC’s weerspiegelen. Verder toont dit proefschrift de relatie aan tussen formeel curriculum en de vorming van informele relaties tussen medestudenten, rekening houdend met de eigenschappen van studenten en verschillende leeromgevingen. Op deze manier adviseert dit proefschrift curriculumontwerpers om rekening te houden met de balans tussen diversiteit en vergelijkbaarheid van beoordelingsontwerp, en met het vergroten van de diversiteit en
frequentie van interacties tussen studenten met verschillende achtergronden in formele curricula.
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Lishui
18th April 2022
CURRICULUM VITAE

Yan Zhou was born on October 12th 1990 in Lishui, China. She studied Law and Educational Technology at Lanzhou University and obtained her Bachelor’s degrees in July 2012. In the same year, she began her postgraduate study at Beijing Normal University. She did several studies regarding curriculum reform, concept change, and learning community when she was a master’s student. She finished her master’s thesis with the title Design-based study of multimedia learning strategy according to self-explanation theory and obtained a master of science degree in July 2015. After finishing her master’s, she worked at China National Chemical Corporation Information Center for enterprise employees’ online training.

In October 2016, she won the CSC scholarship and went to the Netherlands and started as a Ph.D. candidate in the Center for Education Development and Research in Health Professions (CEDAR) at the University Medical Center Groningen (UMCG) under the supervision of Prof. Dr. Nico Bos, Dr. Agnes Diemers, and Dr. Jasperina Brouwer. She focused on studying how various thematic learning communities in an innovative formal curriculum that combines competency-based medical education and problem-based learning influence students’ professional competency development and peer relationships. The results of her Ph.D. project are presented in this thesis, entitled How to connect? Peer networks and competence development in multiple thematic learning communities within one medical degree programme.
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