Building a case study for transdisciplinary thinking: The inclusion of Green Infrastructure as part of Spatial Planning education

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ABSTRACT

Green infrastructure (GI) is continuously gaining importance as an integral part of spatial planning approaches. The increased usage of GI calls into question the extent of its inclusion in current tertiary planning programmes which directly correlates with the successful transdisciplinary application of GI in the built environment. In an attempt to define GI in terms of spatial planning and subsequently guide future training initiatives this research firstly identified linkages between spatial planning and transdisciplinarity, secondly established the importance of GI within spatial planning and thirdly identified the importance of transdisciplinary education approaches relating to both GI and spatial planning. The South African Council for Planners (SACPLAN) competencies and standards report was employed as point of departure to guide the empirical research. The planning curricula of three purposefully selected planning schools in South Africa (selected in terms of level of qualification provided) were accordingly evaluated to determine the extent of GI inclusion and .level of transidicplinarity in each of the programmes. A quantitative research method was further employed whereby 40 professional planners completed an online questionnaire to capture expert perspectives regarding the understanding, interpretation and application of GI, as well as the need for further education regarding GI among practising planners. The results of these questionnaires were statistically analysed and interpreted to provide further insight relating to building a case for transdisciplinary thinking in terms of GI and spatial planning education. Based on the results of the research, recommendations were made to further enhance and integrate GI as part of transdisciplinary urban planning curricula that would ultimately contribute to the development and transformation of the planning profession.

Key terms: *Green infrastructure, spatial planning, tertiary education, transdisciplinarity*

OPSOMMING

Groen Infrastruktuur (GI) word voortdurend as ’n integrale deel van ruimtelike beplannings benaderings beskou. Die verhoogde gebruik van GI kan moontlik die mate waarby dit as deel van tersiêre beplannings programme ingesluit word bevraagteken aangesien dit direk verband hou met die suksesvolle transdissiplinêre toepassing van GI in die beboude omgewing. Om GI in terme van ruimtelike beplanning te definieer en toekomstige opleidings inisiatiewe te lei, poog hierdie navorsing om eerstens koppelvlakke tussen ruimtelike beplanning en transdissiplinêriteit te identifiseer, tweedens is die belangrikheid van GI binne ruimtelike beplanning bepaal en laastens is die belangrikheid van transdissiplinêre onderrig benaderings geïdentifiseer. Die Bevoegdhede en Standaarde van die Suid-Afrikaanse Beplanners Raad (SACPLAN) is as uitgangspunt gebruik om die empiriese navorsing te rig. Die beplanning kurrikulums van drie geselekteerde beplanningsskole in Suid-Afrika (gekies op grond van kwalifikasievlak wat gebied word) is dienooreenkomstig geëvalueer om die omvang van GI insluiting en vlak van transdissiplinêriteit in elk van die programme te bepaal. ‘n Kwantitatiewe navorsingsmetode is verder aangewend waarvolgens 40 professionele beplanners ‘n aanlyn vraelys voltooi het om deskundige perspektiewe rakende die interpretasie en toepassing van GI, sowel as die behoefte aan verdere opleiding van GI vas te lê. Die resultate van die vraelyste is statisties ontleed en geïnterpreteer om verdere insig te bied met betrekking tot verbeterde transdissiplinêriteit in terme van GI en ruimtelike beplanning te bewerkstellig. Op grond van die resultate is aanbevelings gemaak om GI verder te verbeter en te integreer as deel van transdissiplinêre stadsbeplannings kurrikulums wat uiteindelik sal bydrae tot die ontwikkeling en transformasie van die beplanningsprofessie.

Sleutelterme: *Groen infrastruktuur, ruimtelike beplanning, tersiêre onderrig, transdissiplinêriteit*

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CHAPTER 1 – INTRODUCTION AND CONTEXTUALISATION

1.1 Points of departure

“Numerous strategies within city planning have come and gone – will green infrastructure be just a fleeting fashion or will its full potential be unleashed?” Youngquist (2009:19).

Green Infrastructure (hereafter referred to as GI) is one of numerous approaches used within the realm of spatial planning and has recently become a hype due to its multitude of advantages. It is therefore of paramount importance that sufficient education and training approaches be in place to ensure that future planes are adequately equipped to implement GI successfully in practice.

Consequently, this research primarily attempts to determine the degree of GI inclusion as part of tertiary planning education and additionally investigates the principles and concepts of GI as observed in current local tertiary planning programmes. The aforementioned is to be used as a foundation to suggest and guide improvement of future training and education initiatives.

1.2 Problem statement

GI has recently begun gaining increasing importance as an integral part of broader sustainable development thinking and spatial planning approaches. Mell (2010:33) states that GI is both a very simple and simultaneously complex concept. As such, the rapid evolvement of GI research and implementation has led to a wide variety of GI definitions among practitioners in various disciplines.

Due to the differing transdisciplinary definitions and implementation contexts, a misconception regarding the understanding and integration thereof into spatial planning approaches has occurred (Molla, 2015:59). This misconception and misunderstanding is very much prominent in South Africa where GI is still, to a great extent, regarded as a scarce commodity.

This research argues that transdisciplinary thinking, embedded in transdisciplinary education, is essential in understanding the full scope of GI and the successful planning and application thereof in terms of spatial planning. Accordingly, this research considers the importance of transdisciplinary education and training by making use of a threefold evaluation:

1) Evaluating current education approaches in terms of the scope of GI planning as part of tertiary education, specifically Urban and Regional Planning curricula of purposefully selected planning schools;
2) Evaluating current application approaches of GI planning by capturing the viewpoints of purposefully selected Planning professionals;

3) Draw conclusions on the correlations between GI education and GI practice and the role of transdisciplinary thinking to enhance the successful interpretation and implementation of GI and to build a case for transdisciplinary thinking.

1.3 Aims and objectives

Primary research aim:

- To build a case for transdisciplinary thinking by considering the inclusion of GI as part of spatial planning education

Research objectives:

- To consider the notion of transdisciplinary thinking and planning
- To consider the recent hype of GI and linkages to spatial planning
- To consider the transdisciplinary interpretations of GI and create a definition for GI to be employed in the spatial planning context
- To outline the value of GI in terms of economic, environmental and social factors to emphasise the importance of inclusion of GI within mainstream spatial planning
- To conclude on the need for transdisciplinary planning approaches relating to GI
- To consider the importance of transdisciplinary education approaches relating to the spatial planning discipline
- To evaluate current education approaches relating to GI planning in order to outline academic perception and importance of GI
- To evaluate and outline current academic perception and importance of GI among planners
- To evaluate current application approaches relating to GI in order to outline academic perception and importance of GI
- To evaluate the current application and implementation of GI in practice by considering viewpoints of purposefully selected planners
- To consider the transformation of education approaches and build a case for transdisciplinary thinking based on the results of this research

1.4 Primary research questions

This research, both the literature review and empirical investigation, aims to answer the following questions:

- What is transdisciplinarity?
- What is transdisciplinary thinking and planning?

- What is GI?
- What are the transdisciplinary interpretations of GI?
- To what extent is GI currently included as part of local tertiary spatial planning education?
- To what extent are transdisciplinary elements included as part of tertiary spatial planning education?
- To what extent is GI currently being applied in practice?
- Can the linkage between spatial planning and GI support the case of transdisciplinary thinking?
- How can education approaches be transformed to enhance transdisciplinarity?

1.5 Methods of investigation

1.5.1 Theoretical grounding

This research originated in 2016 as part of research conducted for the partial completion of the degree B.Art et Scien. (Urban and Regional Planning). The research was furthered in terms of depth and width and presented accordingly.

The theoretical grounding consists of three chapters, each discussing a specific theme critical to this research and aligned with the research problem identified. The thematic discussion includes transdisciplinary thinking and planning, the notion of GI and the manner in which it can be associated with spatial planning and, lastly, the importance of transdisciplinary education and training relating to spatial planning education.

For the theoretical grounding searches for applicable information were conducted by making use of secondary data sources such as scientific peer reviewed papers available on numerous databases comparable with JSTOR and Google Scholar. Specific key words and phrases were used to gather sources, for example: *green infrastructure, transdisciplinary education, green value gap, sustainability thinking, spatial planning.*

Theory-based sampling is also employed to conduct a qualitative investigation into concepts, definitions and typologies of GI, in an attempt to create a singular definition of GI for purposes of this research, which is further employed in the empirical investigation.

1.5.2 Empirical investigation

The empirical investigation is conducted in two phases, each phase concerning a different aspect of GI in terms of planning.

1.5.2.1 Phase 1 – Evaluation of current planning education approaches in South Africa

The primary focus of this phase is to evaluate to what extent GI is included on tertiary level as part of spatial planning education by making use of a case study analysis.

1.5.2.1.1 Qualitative research method: Case study analysis

In order to comprehend fully the inclusion of GI as part of tertiary spatial planning curricula a case study analysis was done by means of an evaluation of selected planning schools' yearbooks. To guarantee that the evaluation was conducted legitimately, only the yearbooks of institutions offering accredited undergraduate planning qualifications at an NQF level of 8 were selected and evaluated.

In order to determine the extent of GI inclusion as part of the identified curricula, an evaluation was done where the module outcomes were considered, along with detailed descriptions of all modules as captured in the academic yearbook of each institution.

During the evaluation a numerical scale was used to indicate the level of GI inclusion. A value of 1 indicated that there was limited or no mention of GI or elements that comprise GI in the description or module outcomes; a value of 2 showed that the module outcome or description indicated moderate (yet still inadequate) mention of GI or elements that comprise it; and a value of 3 implied that GI, or elements thereof, were present to a large degree in the module outcome or description.

In order to determine the level of inclusion of GI in each of the subjects or modules offered by the identified institutions SACPLAN's (South African Council for Planners) Competencies and Standards were consulted to aid in developing a criterion to determine in which manner to award the level of inclusion, as discussed above. The outcomes and components of the core competency 'Environmental Planning and Management' were used as a measurement to determine the extent of GI inclusion. Table 1-1 below elaborates on these components and outcomes of said competency.

Table 1-1: Components and outcomes of environmental planning and management

Components	Outcomes
Natural systems Environmental management and planning Climate change	**Knowledge:** • Demonstrate an understanding of ecology, the environment, environmental issues and environmental impacts involved in the development of cities and regions. • Define key elements of environmental valuation and environmental impact assessment. • Demonstrate an understanding of the integrating of environmental issues in the planning and development process.

Sustainability	• Differentiate between various environmental management approaches such as policies, governance activities, quality of life and public awareness building. • Demonstrate understanding the processes, forms and limitations of objects and systems within the built and natural environments. **Skills:** • Analyse natural systems and appreciate environmental constraints. • Conduct research and evaluation of the environment and urban environmental issues. • Assess EIA's, SEA's, Environmental Impact Statements and other environmental management tools. • Carry our tasks of environmental planning and management. • Prepare and draft policies for environmental management. **Behaviour:** • Advocate the importance of environmental issues in the development and planning process. • Ethical stance on environmental issues, protecting the environment, sustainable development and its importance in planning procedures.

Source: SACPLAN (2014b:26)

In order to determine the extent of transdisciplinarity that forms part of tertiary spatial planning education, the definition of transdisciplinarity, as formulated by Ramadier, was used as a criterion for determining the inclusion of trans-disciplinary elements as part of the modules offered by the selected planning institutions. Ramadier (2004:424) defines transdisciplinarity as the simultaneous integration of two seemingly opposing movements of disciplinary thinking.

During the evaluation a numerical scale was used to indicate the level of transdisciplinarity. A value of 1 indicated that there was limited or no mention of transdisciplinarity or elements that comprise it in the description or module outcomes; a value of 2 showed that the module outcome or description indicated moderate (yet still inadequate) mention of transdisciplinarity and a value of 3 implied that transdisciplinarity or elements thereof were present to a large degree in the module outcome or description.

Boud and Falchikov (1989:529) stated that the method of assessment or evaluation, as used for this phase of the empirical investigation, is deemed justifiable providing that two critical elements are included as part thereof:

1) There is a criterion identified and used as benchmark; and
2) The determination is made based upon the extent the extent to which the predetermined criterion is met.

1.5.2.1.2 Quantitative research method – Structured questionnaire

The data used in the quantitative empirical investigation were gained by means of a research questionnaire. Due to the fact that this investigation was reliant on expert perspectives, the

questionnaire was circulated to purposefully selected practising planners and 40 completed questionnaires were returned. The purpose of the questionnaire was to capture the viewpoints of planning practitioners on the importance, role and current application of GI in spatial planning practice as well as to determine the GI education received by planners at tertiary level.

The questionnaire consisted of 23 questions divided into 4 broad categories, each respectively discussing a specific theme

The purpose of the questionnaire was:

(i) To obtain demographic data relevant to GI from planners;
(ii) To gauge the level of GI understanding among planners;
(iii) To evaluate the tertiary GI education received by planners;
(iv) To determine the current scope of application of GI among planners.

For the purpose of easy distribution, the questionnaire was compiled by making use of Google Forms. The use of this platform ensured that the questionnaire could be circulated efficiently via email to the purposefully selected respondents. In terms of ethics requirements, respondents were informed that the views and opinions expressed throughout the questionnaire were to be used solely for research purposes and would not be seen as a reflection of any individual partaking in the questionnaire. Respondents were also made aware of the option to withdraw participation in the questionnaire at any time if they so wished.

The data collected by the questionnaire were captured in Microsoft Excel and analysed in order to determine frequencies and relationships between variables.

1.6 Delineation of study area

Due to the fact that this research considers the inclusion of GI education in local tertiary education and training curricula by means of an evaluation, the study area has no cadastral characteristics. A 'hypothetical' demarcation can however be made by using South Africa in terms of the curricula evaluated.

1.7 Limitations of research

In order to fulfil the research aims as stipulated earlier in this chapter only tertiary education and training regarding GI in planning curricula were evaluated. The case study analysis of curricula was limited to three planning schools selected due to their corresponding to the level of tertiary education and accreditation status as awarded by SACPLAN.

From SACPLAN's Guidelines for Competencies and Standards for Curricula Development the competency 'Environmental Management and Planning' was identified and used as the barometer to evaluate the extent of GI inclusion in tertiary education. This research does not claim to present a comprehensive view of spatial planning education in South Africa, but the cases included in this research do however, as point of departure, emphasise the importance of transdisciplinary thinking and planning, and emphasise opportunities to enhance education approaches.

1.8 Structure of research

This research is broadly divided into four main phases, the theoretical grounding, empirical investigation, conclusions and recommendations sections, as captured accordingly.

1.8.1 Theoretical grounding

Chapter 2 – Trans-disciplinary thinking and planning

This chapter initiates the literature review by considering the core concepts related to transdisciplinary thinking and planning. Within this chapter all prominent role-players (universities, experts, communities) involved in transdisciplinary approaches are discussed, in order to examine spatial planning in terms of transdisciplinary objectives that relate to the broader sustainability and resilience thinking.

Chapter 3 – Green Infrastructure as the new hype of spatial planning

With the purpose of confirming the importance of GI as the crux of this chapter, the development, concepts and multitude of definitions as used by various practitioners are reviewed. Another topic of discussion within this chapter is the Green agenda (and the sustainable development approach that motivates it), in conjunction with ecosystem services and resilience thinking that will be used to stress the significance of GI further.

Chapter 4 – The importance of transdisciplinary education and training

The importance of transdisciplinary education and training on tertiary level is stressed during this chapter by referring to the green value gap, the limited literature base relating to planning in the Global South and viable structures for collaboration to contribute to curricula development. Detailed reference is made to the role of the professional body (SACPLAN) and their published competencies and standards that enhance transdisciplinary planning approaches.

1.8.2 Empirical investigation

As mentioned previously, both quantitative and qualitative methods of investigation were used and the results gained thereby were statistically interpreted in order to draw conclusions and correlations between GI education and GI practice and the role of trans-disciplinary thinking to enhance the successful interpretation and implementation thereof.

The empirical investigation consists of two phases, each phase assigned to a separate chapter.

Chapter 5 – Evaluation of current application approaches

Phase 1: Evaluation of current planning education approaches in South Africa

Quantitative research methods include a case study analysis and evaluation of current planning curricula of specifically selected universities in South Africa in order to determine the level of GI inclusion. Yearbooks of the selected institutions, capturing planning curricula, are used to generate data for this purpose.

Qualitative research methods include structured interviews with lecturers linked to modules identified in the previous step of this phase (those who lecture GI) in order to determine the scope of GI inclusion and to provide insights on the extent of transdisciplinary thinking in education structures.

Chapter 6 – Evaluation of current education approaches

Phase 2: Evaluation of current application approaches of GI

Quantitative research methods include a structured questionnaire provided to purposefully selected planning professionals (practitioners) in order to capture their viewpoint on the importance, role and current application of GI in spatial planning practice.

Qualitative research methods include a structured interview with nominated representatives of SACPLAN to understand the importance of transdisciplinary planning education and the intentions in the Competencies and Standards to enhance this.

1.8.3 Conclusions

Chapter 7 - Conclusions

Chapter 7 is a summary of the findings gathered throughout the course of the research done, to ensure that all research questions are answered and that all aims and objectives are met. This

chapter plays a key role in aiding the linkage of the literature research to the empirical investigation

1.8.4 Recommendations

Chapter 8 – Recommendations

With the literature review and empirical investigation complete, recommendations on the outcome of the research are made in Chapter 8. These recommendations are proposed so as to influence positively future education and training initiatives of GI on tertiary level, which might strengthen the case for transdisciplinary thinking and ultimately contribute to the development and transformation of the planning profession.

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CHAPTER 2 – THE NOTION OF TRANSDISCIPLINARITY AND PLANNING

2.1 Points of departure

> "Transdisciplinarity connotes a research strategy that crosses many disciplinary boundaries to create a holistic approach." – Nicolescu et al. (1994)

The broad theme of this chapter is transdisciplinarity and its association with spatial planning and will be discussed in order to fulfil the first of the research objectives as stated in Chapter 1 (c.f. 1.4):

- To consider the notion of transdisciplinary thinking and planning

Chapter 2 initiates the literature review of this research by differentiating between different disciplinarities (disciplinary, multidisciplinary, interdisciplinary and transdisciplinary) before discussing the theory and models of transdisciplinary thinking in the subsequent section in order to identify successfully all role players involved in transdisciplinary approaches. Finally, this chapter considers the link between transdisciplinarity and spatial planning as point of departure for rethinking education approaches of spatial planning programmes.

2.2 Understanding the planes of disciplinary interaction

"As scientific knowledge in a wide range of disciplines has advanced, scholars have become increasingly aware of the need to link disciplinary fields to answer more fully critical questions, or to facilitate application of knowledge in a specific area" (Aboelela et al., 2007:330).

From the above statement it is apparent that knowledge from various disciplinary fields is needed, not only within planning, but also within research, education and training to ensure that users within each field are equipped with correct tools to address productively problems that may arise.

Deppich and Hasibovic (2013:118) pose an integral question with regard to disciplinary interactions: "How can this integration of disciplines, methods and perspectives be organised in order to facilitate, for instance, a process of adaptation for such complex phenomena?"

In an attempt to answer the above question, the following segments of this section differentiate between the various interfaces of disciplinary interaction and the characteristics that each of them may hold.

2.2.1 Disciplinary interaction

Tress et al. (2005:483) imply that disciplinarity can be defined as the interaction that is conducted within the demarcated area of presently recognised disciplines though acknowledging that the borders are of a simulated nature and are in essence dynamic.

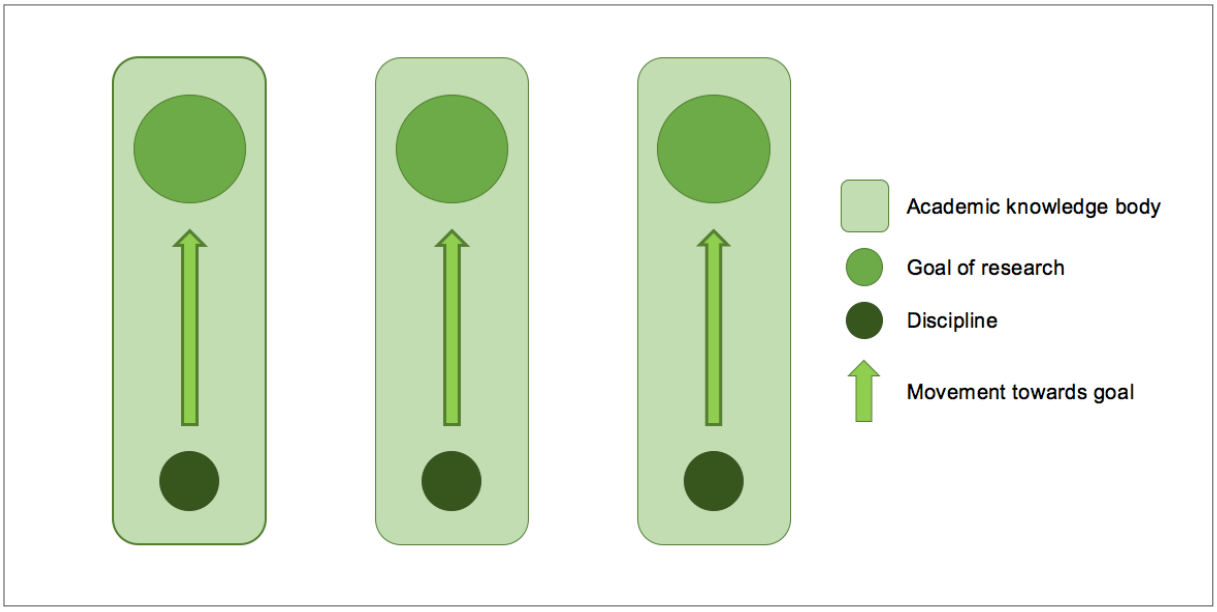


Figure 2-1: Illustration of disciplinarity
Source: Adapted from Tress et al. (2005:484)

Upon studying Figure 2-1 above, it is evident that when any activity of a disciplinary nature takes place, it occurs only within its own body of knowledge, making use of merely the tools and techniques available within its demarcated area of specialisation. This often results in the development of new disciplinary knowledge as well as the enlargement of current knowledge, all within the one specific discipline (Tress et al., 2005:484).

2.2.2 Multidisciplinary interaction

At first glance, assumptions regarding this specific plane of disciplinary interaction can be made based solely on the name itself. Multidisciplinary principally suggests an interaction between multiple disciplines.

Russel (2005:35) further rationalises the concept of multidisciplinarity by stating that it inclines to suggest an interaction (such as research, education or practice) that merely causes a joining of two or more disciplines. In order to comprehend fully what type of interaction comprises multidisciplinarity, Ramadier's (2004:433) notion, that when disciplines are reflected as being complementary in the instance of better understanding or solving a certain problematic occurrence, only selected parts of the different disciplines involved are to be taken into account in order to sustain consistency. Ramadier (2005:433) continues by stating that a benefit of a

multidisciplinary approach is that the use thereof stresses the different dimensions of the problem that need solving and as such serves as an indication of the disciplines that need to be involved.

To Horlick-Jones and Sime (2004:444) multidisciplinary implies a separation of work where various disciplinary fields review different aspects of one topic or problem with cooperation among the disciplines but each still having its own practice based upon each individual discipline.

Russel et al. (2007:460) synthesises the opinions above by simply defining multidisciplinarity as the process in which various disciplinary experts work in conjunction with one another while each continuously upholding their individual disciplinary methodologies and perceptions.

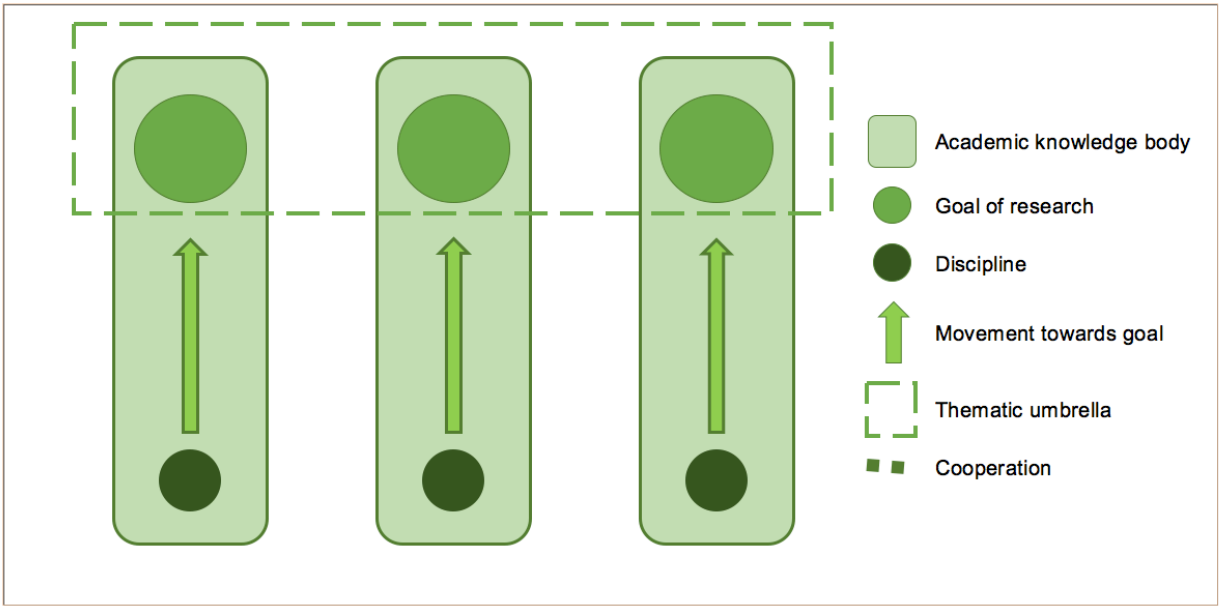


Figure 2-2: Illustration of multidisciplinarity
Source: Adapted from Tress et al. (2005:484)

After viewing Figure 2-2 above it becomes apparent that in the case of multidisciplinary interaction there is limited cooperation between disciplines that serves as a gateway for the interchange of information in order to aid disciplinary theory development (Tress et al, 2005:484).

2.2.3 Interdisciplinary interaction

Ramadier (2004:426) is of the opinion that the challenge to capture fully the complexity or things of a complex nature has led to disciplinary borders being taken down. Madni (2009) agrees with Ramadier's reasoning by stating that the complexities of problems are evolving in such a manner that the application of approaches within one discipline will not lead to solving them effectively. Considering the need for disciplinary boundaries to be removed is therefore becoming evident.

Russel (2005:35) confirms the need for these boundaries to be removed by describing this plane of disciplinary interaction as "the activity that goes on in the space between disciplines and

particularly the interaction between disciplines". Russel et al. (2007:460) correspondingly describe interdisciplinarity as intersections between disciplines.

In order to illustrate the manner in which interdisciplinarity combines various bodies of knowledge and information available within different disciplines in a practical context, Ramadier (2004:425) uses the example of the collaboration between geographers, who establish an affiliation between movement of residents in any built-up area and urban development, and psychologists who determine the connection between urban morphology and human behaviour.

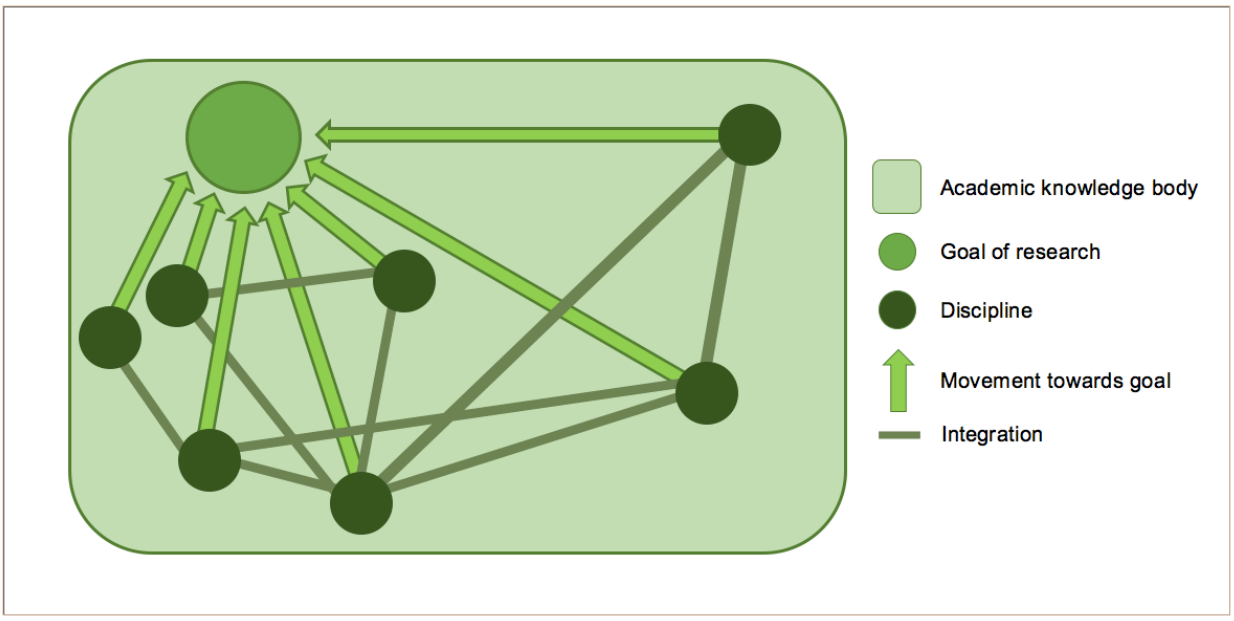


Figure 2-3: Illustration of interdisciplinarity
Source: Adapted from Tress et al. (2005:484)

Tress et al (2005:484) clearly illustrate in Figure 2-3 above within the plane of interdisciplinary interaction the requirement that disciplinary borders are noticeably removed in order to satisfy a singular purpose. The removal of said boundaries allows a combination and integration of disciplinary knowledge to occur and sets about the development of cohesive comprehension and theory.

2.2.4 Transdisciplinary interaction

"The specificity of transdisciplinarity is that it simultaneously integrates two contradictory movements of disciplinary thinking: on the one hand, the compartmentalisation of knowledge; on the other hand, the existence of relationships between the disciplines – the aim being to determine how the different forms of knowledge thus produced can be articulated together." Ramadier (2004:424).

Ramadier (2004:424) further argues that transdisciplinarity differs from interdisciplinarity by fundamentally regarding the articulation amongst disciplines, instead of relations between them.

In the above statement Ramadier identifies an extensive characteristic of transdisciplinarity: the combination of opposing disciplinary rationales. Wickson et al. (2006:1048) identifies another feature of transdisciplinarity as the clear intent of the interaction to solve complications that are multifaceted and multidimensional, that require an overlap of human and natural systems.

Russel (2005: 35) refers to transdisciplinarity as an endeavour that contravenes the various boundaries as set by individual disciplines. Although inter-disciplinary activity is also described as the transgression of disciplinary boundaries, Russel (2005:35) continues by adding that within transdisciplinarity there is a greater degree of incorporation and fusion of content, theory and methodology from different disciplines that contribute to new knowledge production.

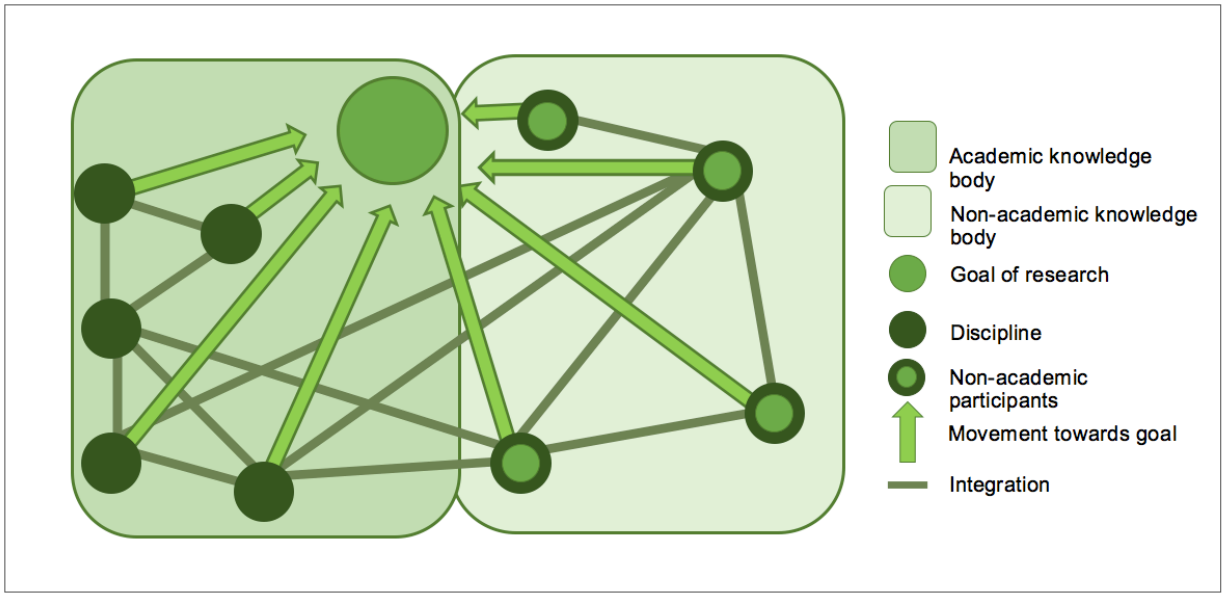


Figure 2-4: Illustration of transdisciplinarity
Source: Adapted from Tress et al. (2005:484)

The crossing of disciplinary boundaries (noticeably seen in Figure 2-4 above) can be considered the characteristic that primarily distinguishes transdisciplinarity from other planes of disciplinary interaction. Tress et al. (2005:484) states that transdiscipliarity is similar to other disciplinarities in that the aim of the interaction is to achieve one mutual objective. The difference is, however, that there is a combination of inputs from various disciplines and non-academic participants. This collaboration between different stakeholders and role-players is indicative of an element of community participation within transdisciplinary interaction. Tress et al. (2005:484) conclude their discussion by asserting that transdisciplinarity ultimately leads to the development of cohesive knowledge among science and society.

2.3 Theory and models of transdisciplinary thinking

Wickson et al (2006:1048) state that transdisciplinary research addresses difficulties that are "in the world and actual" rather than problems that are regarded as merely conceptual. Transdisciplinarity also deals with the complexity in science and it challenges knowledge disintegration (Thompson-Klein, 2004:517 and Ramadier 2004:423). Lawrence (2004:489) is of the opinion that transdisciplinarity addresses problems that arise from multifaceted and dissimilar spheres of interest.

In terms of the nature of transdisciplinarity, Balsiger (2003:421) describes it as having hybrid characteristics since it transcends most academic structures. Thompson-Klein (2004:521 states that transdisciplinarity is to be treated as a "context-specific negotiation of knowledge".

Horlick-Jones and Sime (2004:444) elaborate on the manner in which problems that require transdisciplinary approaches should be addressed by stating that transdisciplinary approaches require inputs from various knowledges. These various knowledges are categorised into 'hard', or quantitative, and 'soft', or qualitative, knowledges (Horlick-Jones and Sime 2004:444).

Horlick-Jones and Sime (2004:444) continue the discussion on transdisciplinary research by highlighting that, to date, the majority of transdisciplinarity integration has occurred among 'hard' disciplines (such as physics and chemistry) and that the integration of 'soft' disciplines (which spatial planning can be considered to be a part of) is a rare occurrence.

2.3.1 Features of transdisciplinarity

Gibbons et al. (1994:4), who are considered to be pioneers in terms of knowledge production, identified four main features of transdisciplinarity.

2.3.1.1 Feature 1: Guide problem-solving

Gibbons et al. (1994:4) state that transdisciplinarity fosters a distinctive but developing outline to guide problem solving which is developed and sustained in the perspective of application as opposed to being created and applied in the same context by another group of practitioners. In cases where solutions are developed to solve problems that require transdisciplinary inputs, said solutions are not the product existing knowledge. Instead, solutions are formulated by integrating features of existing knowledge and creativity to achieve theoretical agreement.

Although elements of existing knowledge must have entered into it, genuine creativity is involved and the theoretical consensus, once attained, cannot easily be broken down into disciplinary fragments (Gibbons et al., 1994:4).

2.3.1.2 Feature 2: Contribute to knowledge production

Solutions used in transdisciplinary approaches consist of empirical and theoretical elements and thus contribution to knowledge production, although it might not be deemed disciplinary by nature, is being made (Gibbons et al., 1994:5). Gibbons et al. (1994:4) further state that since transdisciplinary knowledge developed from a particular perspective of application creates its own unique manners of practice, methods of research and theoretical constructs that cannot necessarily be charted on the prevailing spectrum of disciplines.

While there are cumulative inputs present in the solving of problems when transdisciplinary approaches are used "the direction of accumulation may travel in a number of different directions" (Gibbons et al., 1994:5)

2.3.1.3 Feature 3: Enhance dissemination of results due to communication structure

The third feature of transdisciplinarity is described to be vastly different from knowledge production (where cognitive and social norms prescribe which problems are regarded as significant and that the solving of these problems is done in accord with these predetermined norms) (Gibbons et al., 1994:3). Unlike inter-disciplinary projects where results are strictly passed on via institutional networks), results gained by use of transdisciplinarity are communicated to all who have participated.

This method of communication allows for diffusion of the results to all stakeholders. Gibbons et al. (1994:5) continues by stating that although the contexts of problems are temporary and those aiding in solving the problems are moveable, the communication systems tend to stay in place and the knowledge encapsulated therein stays accessible to be used in other structures.

2.3.1.4 Feature 4: Dynamic nature

"Transdisciplinarity is dynamic. It is problem solving capability on the move" (Gibbons et al., 1994:5). Problems solved by making use of transdisciplinary approaches can evolve to become the departure point from which supplementary progresses can be made. The difficulty that could arise is that it might be challenging to foresee how this newly contributed knowledge could further develop and how it could be applied in future (Gibbons et al., 1994:5).

Other disciplinary interactions (which are more 'heterarchical', transient, socially accountable and reflexive) are known by the close interaction through which knowledge is produced (Gibbons et al., 1994:3). The major difference between discoveries made within the varied interactions is that, disciplinary and interdisciplinary findings build upon one another, but in transdisciplinary findings

are not confined to any disciplinary boundaries and do not need to be validated by practitioners (Gibbons et al., 1994:5).

2.3.2 Challenges of transdisciplinarity

Wickson et al. (2006:1052) stated that the primary challenges of transdisciplinarity are those related to integration, reflection and paradox.

2.3.2.1 Integration

Wickson et al. (2006:1052) are of the opinion that transdisciplinarity provides opportunities for integration on several levels; the three most prominent levels included are integration of epistemologies, theory and practice and the context of transdisciplinarity.

2.3.2.1.1 Integration of epistemologies

Ramadier (2004: 434) speaks of the necessity of seeking coherence instead of searching for a unity of knowledge where integration is considered, Thompson-Klein (2004:522) describes integration in terms of transdisciplinarity as "the science and art of ridges between different areas of knowledge and different beings" and Henagulph (2000) recommends that "knots of communication" be found within the integration of epistemologies. These various viewpoints all advise that, while transdisciplinarity attempts to integrate knowledge from diverse disciplines, those who make use of transdisciplinary approaches (in any regard) should search for coherence across diverse disciplines rather than endeavour to develop a singular cohesive truth (Wickson et al., 2004:1053)

2.3.2.1.2 Integration of theory and practice

To comprehend the integration of theory and practice, the term 'praxis' aids in the explanation thereof. Fawcett et al. (2002:226) define 'praxis' as the notion that practice and theory are not only related, but that "theory should be grounded and practice should be enriched by theory". 'Transdisciplinary praxis', a term coined by Carew (2005:87), suggests another dimension of integration. The aim of transdisciplinary praxis, according to Wickson et al. (2006:1053), is to ensure that the bodies of knowledge (both theoretical and practical) inform each other and that the user not 'visit' theory and practice iteratively. The success of this process in practice remains an ongoing challenge in transdisciplinarity.

2.3.2.1.3 Integration of contexts

Wickson et al. (2006: 1053) states that the third level of integration can be considered an elaboration of transdisciplinary praxis and that it conveys the notion of the user of

transdisciplinarity being engaged. The engagement of the user with the problem at hand is advantageous as it ensures that a deeper understanding of the problem is developed and a richer understanding of viable solutions arises (Wickson et al., 2006:1053). The main challenge that occurs during the integration of contexts is that critical distance needs to be maintained.

2.3.2.2 Reflection

Since the integration of theory and practice highlights that it is beneficial for users of transdisciplinarity to be engaged in the problem solving process, Wickson et al (2006:1053) states that, accordingly, it becomes important to emphasise the necessity of reflection to be included as a part thereof. Primarily there are two categories of reflection identified: personal reflection and comparative reflection.

2.3.2.2.1 Personal reflection

Wickson (2006: 1053) further says that users become engaged during the course of the transdisciplinary approach and that the assumptions of objectivity unavoidably come into question, meaning that it is necessary for the user to reflect on the manner in which their values, beliefs and unique frames of reference have contributed to shaping the conceptualisation of the problem at hand, in addition to the investigation methods used and the solution applied. Once more, Wilkson (2006:1053) adds that how the reflection is implemented remains a challenge.

2.3.2.2.2 Comparative reflection

Wickson et al. (2006:1053) deems this dimension of reflection as a requirement of transdisciplinarity for the purpose of a transformative development since it uses the various knowledges involved as well as their different procedural approaches to reflect on one another. Comparative reflection mainly differs from personal reflection due to its being considered as more collective (Wickson et al., 2006:1053). Further it is stated that comparative reflection is seen as a process in which knowledges or disciplines are studied in comparison with one another in order to determine any common values (Wickson et al., 2006: 1054). Wickson et al (2006:1054) conclude the discussion on comparative reflection by explaining that, instead of merely merging two bodies of knowledge, it is imperative to portray them in light of each other and that this type of reflection necessitates users to “deconstruct and rebuild knowledges through exposure to one another.

2.3.2.3 Paradox

Since the use of transdisciplinarity deals with the integration of knowledge as present in a wide variety of disciplines, paradoxes are sure to arise. Wickson (2006:1054) states that some users

might regard the presence of paradoxes as an indication that the outcomes of transdisciplinarity are of a poor quality and that others might simply view paradoxes as a feature of transdisciplinarity.

“A great truth is a truth whose opposite is also a great truth” (Otaway, 1987:127). Wickson et al (2006:1054) use this quote as a statement to enable users that encounter paradoxes within transdisciplinarity to deliberate the matter. Using deliberation ensures that users adopt creative and innovative approaches that will aid them in effectively utilising transdisciplinary approaches (Wickson et al., 2006:1055).

2.4 Recognising all role players involved

According to Horlick-Jones and Sime (2004:442) transdisciplinarity can be used as a tool to deal with progressively compound difficulties, the type which passes through the boundaries formed between conventional disciplinary knowledges. Since transdisciplinarity is efficient in solving complex problems it is fair to presume that a variety of stakeholders and role players are involved in the process.

Russel et al. (2007:464) describe disciplines as ‘silos’ that distil available resources and research activity into isolated structures with seemingly no interdependence. Transdisciplinarity is regarded as the remedy for the forming of these ‘silos of knowledge’ and offers a structure for knowledge production that has a greater capacity (Russel et al., 2007:464).

Russel (2005: 36) notes that in order for transdisciplinary approaches to be implemented with success, the partnerships between public and private spheres of research and general activity need to be improved. These partnerships enable universities (which are regarded as public research organisations) to better their ability to generate knowledge and apply this knowledge practically (Krimsky, 2003:364)

Figure 2-5 below shows that transdisciplinarity essentially consists of high levels of integration among academic and non-academic participants. Thus it is clear that there are various role players during the course of a transdisciplinary activity.

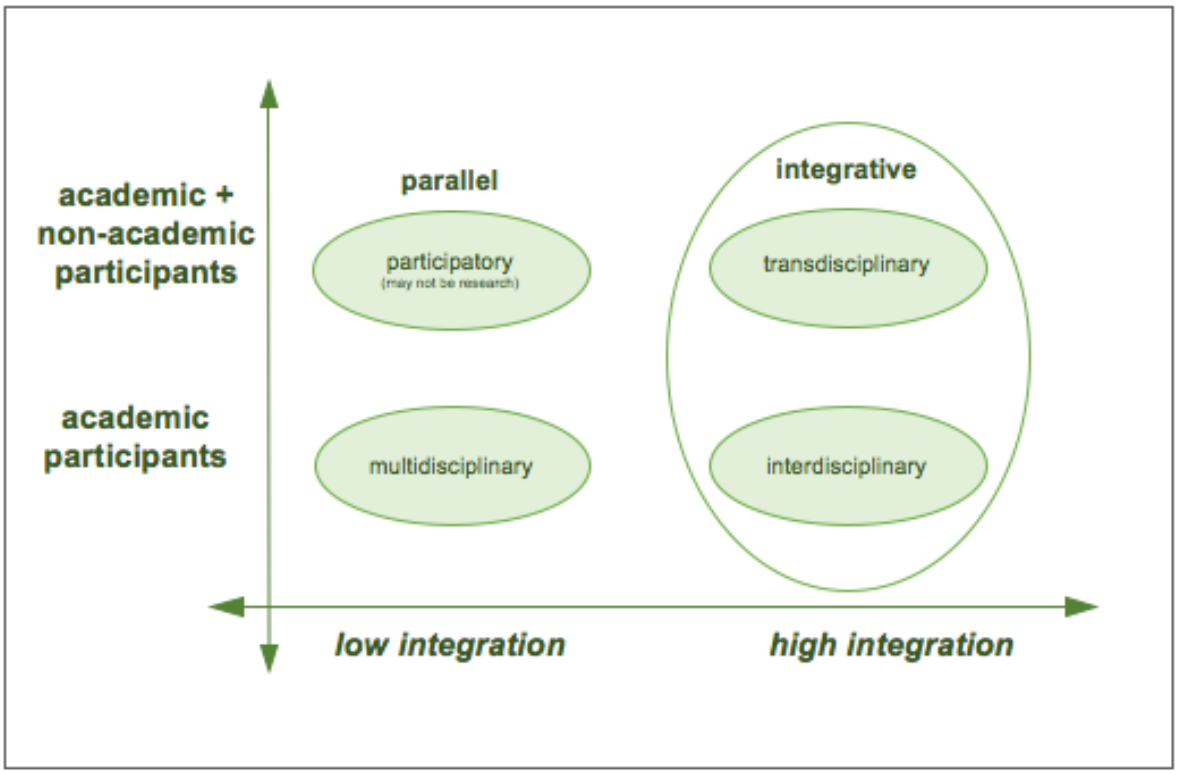


Figure 2-5: Degrees of interaction and stakeholder involvement in integrative and non-integrative approaches

Source: Tress et al. (2005:484)

2.5 Transdisciplinary planning

Planning is defined by Cilliers et al. (2014:265) as the process of ongoing anticipation and preparation for changes that might occur in the future, balancing all public and private interests involved and attempting to resolve conflicts regarding demands for space.

In agreement with this definition of planning, the South African Council for Planners (SACPLAN) (2014b:6) states that the Professional Planning Act (2002) regards a planner as "a person who exercise skills and competencies in initiating and managing change in the built environment in order to further human development and environmental sustainability".

Furthermore, contemporary spatial planning is regarded as a political process which seeks to balance public and private demands on space used to facilitate change (Cilliers and Cilliers, 2016:16).

Considering the presence of both human and natural elements present in the definitions above, Figure 2-6 below approaches planning from a transdisciplinary perspective indicating that successful transdisciplinary planning not only involves a combination of various stakeholder inputs, but also includes participation from a variety of disciplines.

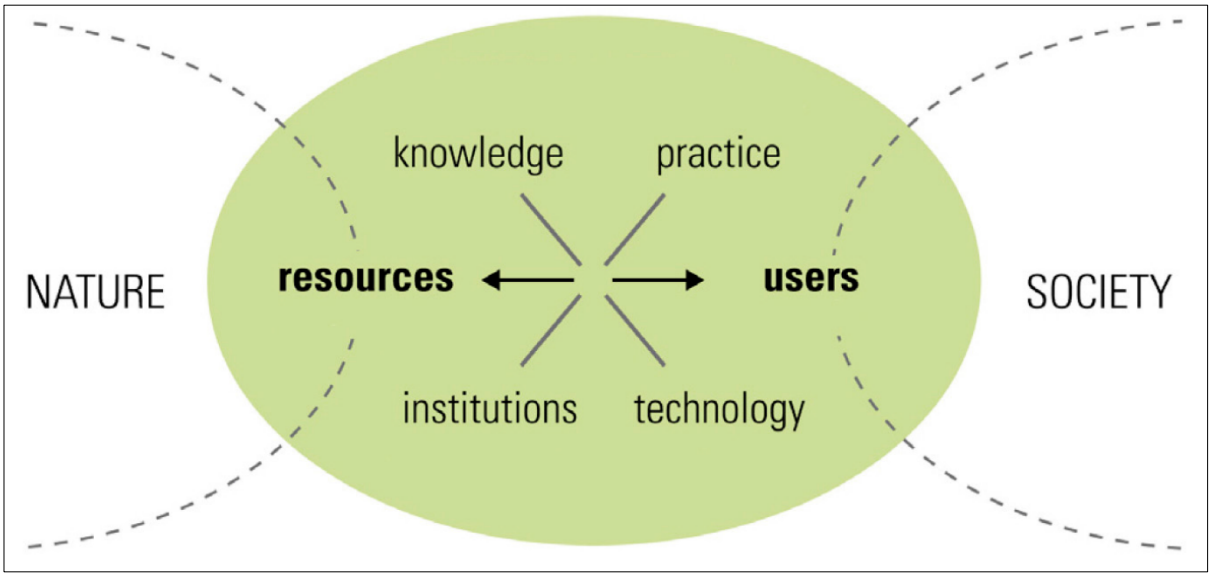


Figure 2-6: Transdisciplinarity in planning
Source: Hummel et al. (2017:10)

Rooij and Frank (2016:472) state that, although it is critical to acknowledge that planners are to be regarded as agents of change, it is equally important "to recognise that they are in reality only one of many players in a sea of actors involved in shaping future developments and projects". As such spatial planning has developed from a designing art (which it was considered to be in its earliest form) to a multidisciplinary science it is today (Zhang, 2006:12). Further discussing the development of spatial planning over the course of time, Rittel (1972:394) states that spatial planning problems cannot be successfully addressed by solely relying on rational problem solving. Rooij and Frank (2016:475) make a similar argument to that of Rittel and state that to solve spatial planning problems successfully "there is never a single, optimal solution but only better and worse options.

Synthesising the arguments made above, De Roo et al (2012:152) state that planning related need to be solved by means of collaborative functioning that enables a diverse set of possible solutions to be developed.

2.6 Conclusion

The primary aim of this chapter was to address the first of the research objectives as stated in Chapter 1 of this dissertation (c.f. 1.4), which was to consider the notion of transdisciplinary thinking and planning.

Transdisciplinarity was concluded to include the amalgamation of divergent disciplinary practices to solve complex and multidimensional problems that occur in human and natural systems. Similarly, transdisciplinary planning was deduced to include the involvement of all stakeholders

and disciplines in spatial planning processes to ensure that sustainability and resilience are achieved.

Chapter 2 has shown that planners are involved in addressing complex issues that require single disciplines such as environmental planning, social science, engineering and design to be transcended. Thus integration is required for spatial planning to be conducted in a transdisciplinary manner. The integration of epistemologies, theories, methodologies, and the research paradigms are needed to truly overcome the boundaries between disciplines involved in spatial planning. Integration is also required for all role-players in the decision making process to work collectively together to achieve joint goals. Additionally, acknowledging the different roles of the various stakeholders and disciplines in the transdisciplinary process is important to access broad skill-sets for complex problem-solving. Therefore, the challenge of creating sustainable and resilient urban environments must be addressed through transdisciplinary approaches, where planners and “planning” constitute an important element within larger “bodies of knowledge” with a collective methodology of achieving environmental and urban development objectives within the realm of spatial planning.

In essence, due to the transdisciplinary nature of planning, it is crucial that planners be educated and trained to think in a transdisciplinary manner, to include all stakeholders and disciplines in the plan-making process. This is especially true when considering the green agenda and recent movement towards sustainability and resilience.

Accordingly, Chapter 3 will consider spatial planning and the recent hype of GI within the context of transdisciplinarity and associated planning challenges.

CHAPTER 3 – CONSIDERING TRANSDISCIPLINARY PLANNING AND GREEN INFRASTRUCTURE

3.1 Points of departure

Green Infrastructure (GI) recently became a crucial consideration within spatial planning approaches, especially in terms of broader sustainability and resilience thinking. This chapter aims to illustrate the need for transdisciplinary planning approaches by considering GI from a spatial perspective.

This chapter attempts to fulfil the following research objectives as stated in Chapter 1:

- To consider the recent hype of GI and linkages to spatial planning
- To consider the trans-disciplinary interpretations of GI and create a definition for GI to be employed in the spatial planning context
- To outline the value of GI in terms of economic, environmental and social factors to emphasise the importance of inclusion of GI within mainstream spatial planning
- To conclude on the need for transdisciplinary planning approaches relating to GI

3.2 Considering the recent hype of GI and linkages to spatial planning

Cilliers and Cilliers state that GI includes all natural, semi-natural and artificial ecological systems at all spatial scales within and around urban areas (Cilliers and Cilliers, 2016:10). The idea of GI has experienced a rapid emergence in planning policy with little opportunity to reflect on the meanings attached to the concept by different (transdisciplinary) interests (Wright, 2011). GI recently gained importance within spatial planning approaches, however, Mell (2010:40) is of the opinion that GI in its earliest form dates back to the late 1800's where it took shape as Fredrick Law Olmsted's urban parks, developed in the USA. Little (1990:98) stated that the spaces developed by Olmsted were considered to be multi-functional and interconnected, as illustrated in the Emerald Necklace, which was considered the first planned green network (depicted in Figure 3-1 below).



Figure 3-1: Olmstead's Emerald Necklace system
Source: Benfield (2013)

Similar to the green spaces pioneered by Olmsted in the USA during the seventeenth century, Ebenezer Howard was piloting comparable approaches in the UK (Mell, 2010:42). Howard's Garden Cities hosted extensive green networks which would, nowadays, align with the objectives of GI (Mell, 2010:42).

The realisation of the importance of GI is encapsulated in the 'green agenda' (UN Habitat, 2009:114) as outlined in the Millennium Ecosystem Assessment of 2000, concerning the natural systems of "local, bioregional and global ecosystem, which are used by cities and other settlements as services for open space, biodiversity, water provision, waste dispersion, healthy air, and reliable climate, food and fibre". UN Habitat (2009:115) called for the integration of the 'brown agenda' and 'green agenda' in an attempt towards more sustainable development practices.

Table 3-1 compares the green and brown agendas by illustrating each agenda's characteristics in contrast to one another.

Table 3-1: Characteristics of the green and brown agendas in the urban environment

The green agenda	The brown agenda
Natural systems, global, regional and local, used as services by cities	Human systems required to make cities healthy and liveable and which are part of the metabolism of the city
• Ecosystems that provide green open space used by the city for biodiversity protection and recreation. • Water systems that cities use to tap the natural flow for water supply and waste	• Waste systems to recycle and remove wastes from cities, including solid, liquid and air waste. • Energy systems to provide power, heating, cooling and lighting for all city functions.

disposal. • Climate and air systems that provide cities with the requirements for healthy life. • Other ecological services, including agricultural and forestry systems providing food and fibre for cities.	• Transport systems to enable mobility in the city, including the fuel. • Building and materials systems that provide the physical basis of life in cities.

Source: UN Habitat (2009:114)

The 'green agenda' emphasises sustainable development and the integration and alignment of environmental issues and concerns with the economic decision making process (Lehtonen, 2004:200). Dresner (2002:67) agrees that it is crucial to consider constantly the restrictions of the natural environment when trying to satisfy human needs within these restrictions. While the environmental aspects of sustainable development emphasise the improvement and maintenance of physical and biological systems, the main goal of economic development should be to gauge the capacity of the natural systems to facilitate economic activities (Ciegis et al., 2009:33). Sikdar (2003: 1930) states that for economic development to be considered as sustainable the development should firstly be approached from an environmentally sensitive perspective, and secondly should occur in conjunction with public participation to ensure that future improvements with minimal efforts and damages can be made on current development should needs change over the course of time.

However, in practice it is often observed that economic development is prioritised above the preservation of the natural environment. While there might be varying reasons for this, this research argues that transdisciplinary planning and education approaches might be part of the problem. As a point of departure GI is accordingly contextualised.

3.3 Contextualising GI

Davies et al. (2014:14) proposed a set of principles that compose the content of urban GI as a planning approach. These principles included multi-functionality, connectivity, integration, multi-scale and long term strategies. Table 3-2 below explain these principles as substantiated by various authors.

Table 3-2: Principles of GI

Principle	Description
1. Multi-functionality	Clear deliberation of multiple ecological, social and economic functions, goods and services provided by UGI, including the manner in which they combine to deliver benefits (Davies et al., 2014:39). Within multi-functionality Davies et al. (2014:39) includes there the capability of urban GI to provide simultaneously multiple ecological, socio-cultural, and economic advantageous. "UGI planning aims at intertwining or combining different functions to enhance the capacity of urban green space to deliver valuable goods and services" Davies et al (2014:39).
2. Connectivity	The goal of urban GI planning, according to Davies et al. (2014:39), is primarily

	to add value by interlinking green spaces functionally and physically. Physical and functional connections between different parts of green infrastructure include recreation, distribution of biodiversity, reduction of urban climate and successful storm water management.
3. Integration	In terms of integration Davies et al (2014:39) suggests "consideration of urban green as a kind of infrastructure, integrated and coordinated with other urban infrastructures in terms of physical and functional relations (e.g. built-up structure, transport infrastructure, water management system)" Planning for urban GI deems urban green areas as an infrastructure typology that necessitates the combination and synchronization of urban green areas with other urban infrastructures by means of physical and functional relations (Davies et al., 2014:39) Integration promotes interactions between green infrastructure and all other types of infrastructure in order to become a physical and functional unit while creating constructive multidisciplinary relationships
4. Multi-scale	Davies et al. (2014:39) state that the planning of urban green areas that takes links between various spatial scales into consideration is required in the multi-scale principle. Urban GI planning is applicable on different spatial levels ranging from city-regions to local projects.GI planning contains a variety of urban blue space, natural and semi-natural areas, bodies of water and public and private green space according to Hansen and Pauleit (2014:56)
5. Long-term strategies	Pauleit et al. (2011:39) propose making use of long term strategies rather than choosing short term strategies as there would be advantages. These strategies should focus primarily on a multitude of uses, interactivity as well as the involvement of various dissimilar stakeholders in order to reach the final objectives.

Source: Own construction from various sources (2017)

Within these principles, Mell (2010:39) suggests that GI can be classified into three different typologies: namely form, function and context. Each of these typologies holds environmental, economic, social and cultural elements (refer to Table 3-3 below).

Table 3-3: GI typologies as proposed by Mell

Classification	Criteria	Function
Form	Ecological	Connectivity; Physical space
	Economic	Cost of space; Design
	Social/Cultural	Users of space; Aesthetics; Motivations
Function	Ecological	Biodiversity; Conservation
	Economic	Industry; Business; Recreation
	Social/Cultural	Education; Recreation; Health
Context	Ecological	Biodiversity; Supporting networks; Ecological mobility
	Economic	Cost of space; Economic development; Sustainability
	Social/Cultural	Location; Facilitations; Motivations; Perceptions

Source: Own construction from Mell (2010:39)

Accordingly, the form, function and context of GI will be further explained.

3.3.1 GI form

Schäffler (2013) addressed land cover (or form) and broadly groups green space, where GI is applicable, into two categories: natural green space and man-made green spaces. Natural green spaces are comprised of natural surfaces (which include bare rock and soil), areas covered by little or no vegetation, wetlands, natural grassland, forests, thicket, bushland, bush clumps as well as degraded natural vegetation (Schäffler, 2013).

As for man-made green spaces all cultivated land for commercial, agricultural and recreational use, as well as areas partially covered by trees, mines and quarries are included (Schäffler, 2013).

Considering that GI could then consist of both natural and man-made elements simultaneously, Van Leeuwen et al. (2009:4) state that there is an assortment of benefits that grey infrastructure adds to the functionality of GI which include ecological values, economic values, social values, planning values and multidimensional values. Davies et al. (2006:24) makes use of Figure 3-2 below for differentiation between 'green' and 'grey' infrastructure.

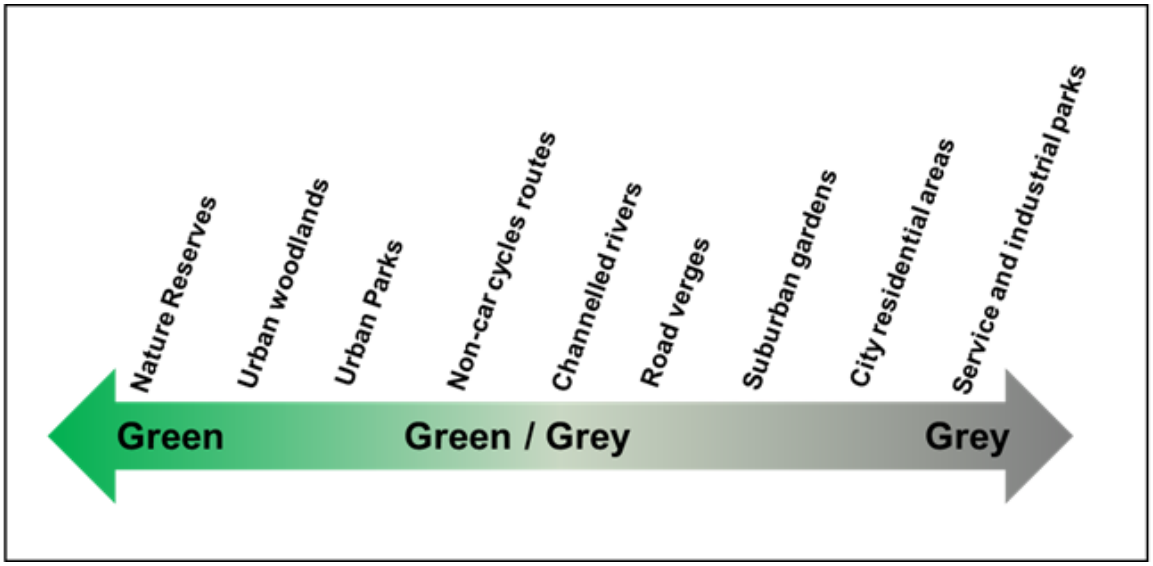


Figure 3-2: The green-grey continuum
Source: Davies et al. (2006:24)

3.3.2 GI Function

According to Benedict and McMahon (2002:7) GI can be divided into two broad networks (illustrated in Figure 3-3 below), each holding a range of ecosystem and landscape functions.

These networks are identified as hubs and links. Benedict and McMahon (2002:7) expand on the concept of GI networks by stating that GI differs from green spaces in the sense that green spaces are secluded areas, while GI is a connected system.

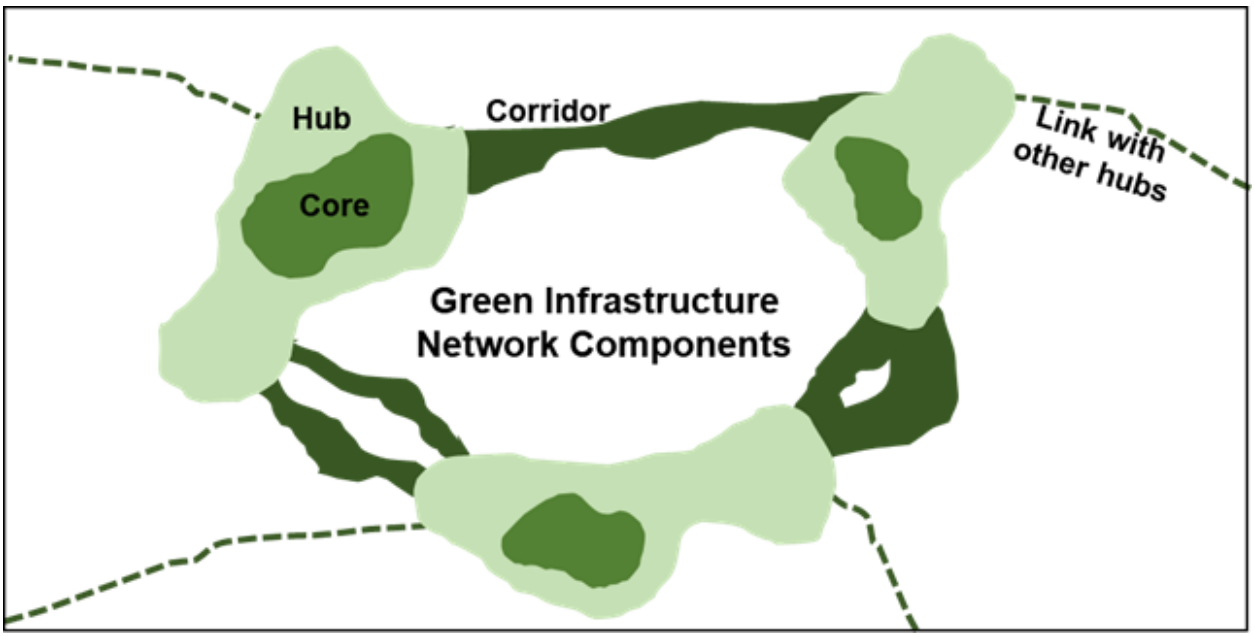


Figure 3-3: Conceptual GI network diagram
Source: Natural England (2009)

By studying the illustration, it can be seen that these networks include some of the principles discussed in the previous subsection: namely connectivity (provided by links) and multi-scale (provided by hubs which holds cores and differ in size and shape).

Hubs serve as a point of origin for biota and ecological processes to travel toward or pass (Benedict and McMahon, 2002:7). There is a variety of hubs, differing in size and shape, such as:

- Reserves: Sizeable safeguarded spaces such as parks and wildlife resorts.
- Managed native landscapes: Large areas of land owned publically, mostly used for resource mining and recreation
- Working lands: Farms, forests and ranches in an open and emergent state owned privately and used for production
- Regional parks and preserves: Less encompassing hubs of ecological consequence
- Community parks and natural areas: Less sizeable parks at neighbourhood level with threatened and repaired natural topographies and ecological procedures.

According to Benedict and McMahon (2002:8) links join systems together and allow GI networks to function optimally and differ in dimension, function and ownership, such as:

- Landscape linkages: Great protected areas (historic sites and recreational areas) of land that link current parks and function as passageways to connect ecosystems and landscapes
- Conservation corridors: Smaller widespread linear areas of protection, like rivers and

streams functioning as biological ducts for biota as well as areas of recreational opportunity.

- Greenways: Conservational and recreational protected corridors of land
- Green belts: Natural and working areas of land acting simultaneously as guidelines for growth and preservation
- Eco belts: Buffer zones that decrease strain on metropolitan and rural land uses whilst offering ecological and social benefits to inhabitants.

3.3.3 GI Context

When studying GI elements and categorising them into the different typologies, it is important to consider the context as part of the categorisation since different elements provide a variety of uses.

Further the City of Tshwane (2007:25) classifies green spaces into five types of networks that set the context in which GI are implemented spatially, as can be seen in Table 3-4

Table 3-4: Characteristics of GI network classification

Classification	Description
Green network	Ecological nodes are green nodes and ridge systems as green-ways
Blue network	Wetlands serve as blue nodes and biological watercourses as blue-ways
Grey network	Grey nodes include cemeteries, parking areas and reservoirs and grey-ways are made up of railway lines
Brown network	Local parks make up brown nodes and urban core streets are brown ways
Red network	Recreational space is identified as red nodes and local boulevards as red-ways

Source: City of Tshwane (2007:25)

Mell (2010:37) uses a cemetery as an example to illustrate the influence that context has on classifying an area into a specific GI typology. A cemetery may be considered to have social and cultural elements due to its being used as a site for reflection and spiritual practices, but it could also be seen as an ecologically important landscape. Therefore, the context wherein GI is regarded is related to the ecological, economic and social influences associated with that area.

Mell (2010:38) suggests making use of the classifications of green space (as seen in Figure 3-4) to aid in the classification of GI into specific typologies.

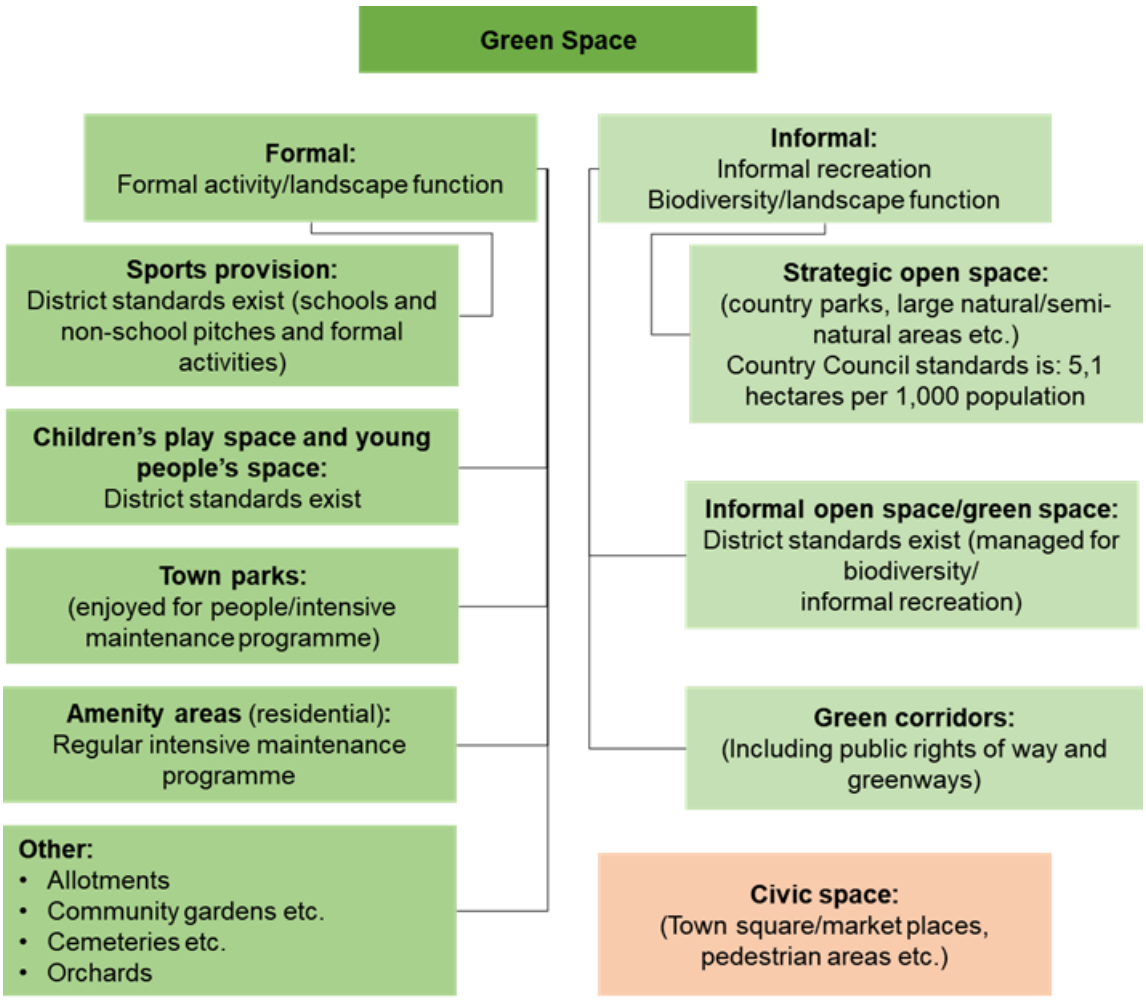


Figure 3-4: Classifications of green space
(Source: Mell, 2010:38)

Based on the points of discussion in this section it can be seen that GI has evolved extensively since originating in the form of urban parks and garden cities in the previous century. The form, function and context of GI as presented above pose various challenges for the spatial planning discipline, since they entail a trans-disciplinary planning approach, enforced as part of systems thinking. The following section considers the transdisciplinary interpretation of GI.

3.4 Considering the transdisciplinary interpretations of GI

"Without a clear idea of what GI entails, it is difficult to debate the different semantic and disciplinary values of the concept" Mell (2010:30). This statement serves as the point of departure for the following section of this chapter.

The rapid evolvement of GI over the past few decades also led to increased confusion regarding the concept. Molla (2015:59) stated that the confusion is primarily linked to the use of the word 'infrastructure' in the phrase 'green infrastructure' because infrastructure is mostly regarded as manufactured elements that aid in the provision of services. Since GI often implies a combination

of both natural and man-made elements, the grey-green continuum is often presented to capture the scope of GI (Davies et al., 2008

Within this broad range, Benedict and McMahon (2002:6) state that the term GI is often misunderstood due to a lack of definition, referring to the interchangeable use of concepts such as green spaces, ecosystem services and GI. It is essential that key concepts are defined, understood and consistently interpreted by all stakeholders. “Aspects that are easily definable and understood tend to get the most attention from politicians and decision-makers. If all role-players understand the concepts and positive value that good quality places contribute to areas, we are able to convincingly argue for, and attract, sufficient resources to manage and maintain spaces” (Beck, 2009:247).

Mell (2010:35) states that according to most definitions, GI is a part of a greater ecological network that links different ecological features ranging from specific landscape qualities to broader, more typical uses of ‘green spaces’. Mell (2010:35) continues by stating that constants recurring in the definitions are the role of connectivity as well as the benefits of GI.

There are other definitions that include ecological systems as well as human technology, identifying GI as an adjustable term used to describe a wide variety of products, technologies and practices that make use of both natural systems and engineered systems that duplicate required natural processes in order to improve the quality of the environment and provide services (Young, 2014: 2579). Definitions that include natural and artificially engineered components, that are ecological and social elements, are fundamental.

Another element present is defining GI as much by its production of ecosystem services as by its existence as a physical artefact. Like other structural components supporting metropolitan systems, GI is only infrastructure through its ability to deliver goods and services. As a result, our critical exploration includes both ecosystem services and GI typologies.

Mell (2010:17) poses an important question: “Is there consensus as to what it is?” In order to initiate a discussion to answer this question, Table 3-5 captures the most prominent definitions of GI as published in various sources.

Table 3-5: Definitions of GI

Author	Definition
Benedict and McMahon (2002:12)	Green Infrastructure is an interconnected network of green spaces that conserves natural ecosystems values and functions and provides associated benefits to human populations. Green Infrastructure is the ecological framework needed for environmental, social and economic sustainability.
Williamson (2003:4)	Our nations natural life support system - an interconnected network of protected land and water that supports native species, maintains natural ecological processes, sustains air and water resources and contributes to the health and quality of life for (America's) communities and people
TCPA (2004:6)	Green Infrastructure is a sub-regional network of protected sites, nature reserves, green spaces and greenway linkages. Green Infrastructure should provide for multi-functional use...it should operate at all spatial scales from urban centres through to open countryside.
TEP (2005:1)	Green Infrastructure: the physical environment within and between cities, towns and villages. The network of open spaces, waterways, gardens, woodlands, green corridors, street trees and open countryside that brings many social, economic and environmental benefits to local people and communities.
Countryside Agency (2006:1)	Green infrastructure comprises the provision of planned networks of linked multifunctional green spaces that contribute to protecting natural habitats and biodiversity, enable response to climate change and other biosphere changes, enable more sustainable and healthy lifestyles, enhance urban liveability and wellbeing, improve the accessibility of key recreational and green assets, support the urban and rural economy and assist in the better long-term planning and management of green spaces and corridors.
Davies (2006:2)	Green infrastructure is the physical environment within and between our cities, towns and villages. It is a network of multi-functional open spaces, including formal parks, gardens, woodlands, green corridors, waterways, street trees and open countryside. It comprises all environmental resources, and thus a green infrastructure approach also contributes towards sustainable resource management.
Ahern (2007:145)	GI is a concept that is principally structured by a hybrid hydrological/drainage network, complementing and linking green areas with built infrastructure that provides ecological functions. It is the principles of landscape ecology applied to urban environments.
Natural England 2009:7)	GI is a strategically planned and delivered network if high quality green spaces and other environmental features. It should be designed and managed as a multifunctional resource capable of delivering a wide range of environmental and quality of life benefits for local communities. GI includes parks, open spaces, playing fields, woodlands, allotments and private gardens. Green Infrastructure includes established green spaces and new sites and should thread through and surround the built environment and connect the urban area to its wider rural hinterland. Consequently it needs to be delivered at all spatial scales from sub-regional to local neighbourhood levels, accommodating both accessible natural green spaces within local communities and often much larger sites in the urban fringe and wider countryside.
EEAC (2009:15)	GI is the action to build connectivity nature protection networks as well as the actions to incorporate multifunctional green spaces in an urban environment.

Landscape Institute (2009)	GI is an approach to land use, underpinned by the concept of ecosystem services. Green assets such as parks, coastlines or embankments have generally been thought of in terms of their single functions. The approach that recognises their vast range of functions and their interconnectivity is called GI.
Mell (2010:33)	Green infrastructure is the resilient landscapes that support ecological, economic and human interests by maintaining the integrity of, and promoting landscape connectivity, whilst enhancing the quality of life, place and the environment across different landscape boundaries.
Commission for Architecture and Built Environment (CABE:2011)	GI is the network of natural areas and other open spaces that conserves natural ecosystem values and functions, sustains clean air and water and provides a wide array of benefits to people and wildlife.
NSF (2012:5)	Natural and engineered ecological systems which integrate with the built environment to provide the widest possible range of ecological, community, and infrastructural services.
CLiGS-NARC (2013)	GI thinking and planning brings together planning, natural resource, ecological and sustainable development concepts to provide a systems approach to infrastructure planning and development that recognises the value of ecosystem services and integrates those ecosystem services within the built environment.
Epsom and Ewell (2013)	GI is a term used to refer to the living network of green spaces, water and other environmental features both in urban and rural areas. It is often used in an urban context to cover benefits provided by wildlife, trees, parks, gardens, road verges, allotments, cemeteries, woodlands, rivers and wetlands.
European Union (2013)	GI can be broadly defined as a strategically planned network of high quality natural and semi-natural areas with other environmental features, which is designed and managed to deliver a wide range of ecosystem services and protect biodiversity in both rural and urban settings.
Schäffler (2013:3)	Green infrastructure refers to the interconnected set of natural and man-made ecological systems, green spaces and other landscape features. It includes planted and indigenous trees, wetlands, parks, green open spaces and original grassland and woodlands, as well as possible building and street-level design interventions that incorporate vegetation, such as green roofs. Together these assets form an infrastructure network providing services and strategic functions in the same way as traditional 'hard' infrastructure.

Source: Own construction from various sources (2017)

Mell (2010:33) states that there are recurring themes in most definitions of GI. These elements include access, spatial variance, multi-functionality, natural and human benefits, biodiversity, sustainability and connectivity. These themes can be identified in the definitions in the table above.

Considering Table 3-1 it is clear that there are as many definitions of GI as there are authors composing literature on the concept (Mell, 2010:33). Upon studying these varied definitions, it is apparent that the core of the definition is subjective to the focus of the author's field of expertise within the realm of GI.

Taking into account the various definitions, principles and characteristics of GI; this research employed theory based sampling as part of a qualitative enquiry to compose and propose a definition for GI to be employed within a spatial planning context. For purpose of this research GI is defined as "**all natural and man-made ecological systems, which integrate the built environment and ecosystem services with resilient landscapes supporting ecological, economic and human interests by maintaining and promoting connectivity while improving the quality of the environment**". This definition will accordingly be used throughout this research to consider educational and practical approaches relating to GI.

To place GI further in the context of spatial planning, the following section outlines the value of GI, and the importance thereof, within mainstream spatial planning.

3.5 Outlining the value of GI and the importance thereof within mainstream spatial planning

Cilliers and Cilliers (2016:16) state that the benefits of GI are evident on two levels: namely the household-level and the neighbourhood-level. Each of these levels holds financial, social and environmental benefits which offer either direct or indirect economic benefits (Cilliers and Cilliers, 2016:16). Table 3-6 captures the extensive benefits of GI present at household- and neighbourhood-level.

Table 3-6: Benefits of GI

Benefit	Household-level	Neighbourhood-level
Financial Direct economic benefit	• Higher property prices internationally • Raised property prices locally • Higher neighbourhood values locally • Positive impact on production • Increase in economic well-being • Lower maintenance costs • Contributes to house-buyers preferences	• Enhanced competitiveness of places • Increased market value • Lower storm water costs • Lower emissions • Better marketability of areas • Increased tourism spending • Reduction in the cost of pollution control and prevention • More inward investment • Favourable image of the place • Boost to retail sales • Improving the eligibility of the city or neighbourhood • Multidimensional values, scientific and policy value • Open space values • Lower cost of artificial wetlands
Social Indirect economic benefit	• Enhance community cohesion • Better quality living space • Aesthetic enjoyment • Recreation opportunities • Leisure possibilities • Health benefits • Contribute to well-being • Positive perception • Psychological restoration • Stress relief • Positive social impact on children • Facilitation of social contact and communication • Positive assimilation of values and moral attitudes • Access to experiences • Recreational value	• Enhance urban renewal • More social capital • Aesthetic values and visual amenities • Cultural values and cultural amenities • Genus Loci, Identity of space • Better neighbourhood relationships • Substitution of social value to other public spaces • Enhance urban liveability • Crucial to children's social and cognitive development • Establishes sense of place • Improved health of residents in surrounding areas • Exercise, recreation and leisure • Education (active and passive)
Environmental Indirect economic benefit	• Access to clean air • Noise reduction • Enhance natural settings for play (child-friendly spaces) • Increase intrinsic natural value • Life-support value • Air and water purification • Quiet environments • Clean water and air • Rainwater retention	• Greater biodiversity • More ecological functions and ecosystem services • Sustainable environments • Habitat protection and provision • Lower air pollution levels • Flooding alleviation, water management • Contributes to stormwater management • Improved land quality • Lower carbon dioxide • Climatic amelioration • Supports water storage/supply • Supports carbon sequestration

Source: Adapted from Cilliers and Cilliers (2016:17) and Mell (2010:60)

These benefits could present a strong case in favour of GI as part of mainstream spatial planning. It would be, however, required to explore further these benefits and application in

local context, as research linked to these benefits are mainly derived from international case studies (Cilliers and Cilliers, 2016:11). Foster et al. (2011:35) argue that “net-value of enhanced social, environmental, and economic resilience from green-infrastructure will be at the core of resilient communities in a climate changed future”, implying that it should form an integral part of broader spatial planning approaches. This would however call for enhanced transdisciplinary planning approaches relating to GI.

3.6 The need for transdisciplinary planning approaches relating to GI

“GI utilises a number of conceptual ideas drawn from landscape ecology, planning, and geography; it brings these ideas together to develop a holistic and dynamic approach to landscape planning.” (Mell, 2010:17).

The successful development and, eventually, consequent implementation of GI lie with the inputs and cooperation of its various role players (Mell, 2010:39).

A trans-disciplinary approach would incorporate academic knowledge and non-academic knowledge to promote the interface between various disciplines. A transdisciplinary approach would also enhance the level of strategic involvement of stakeholders whilst enhancing insight and lateral thinking, as is evident in Figure 3-5 below.

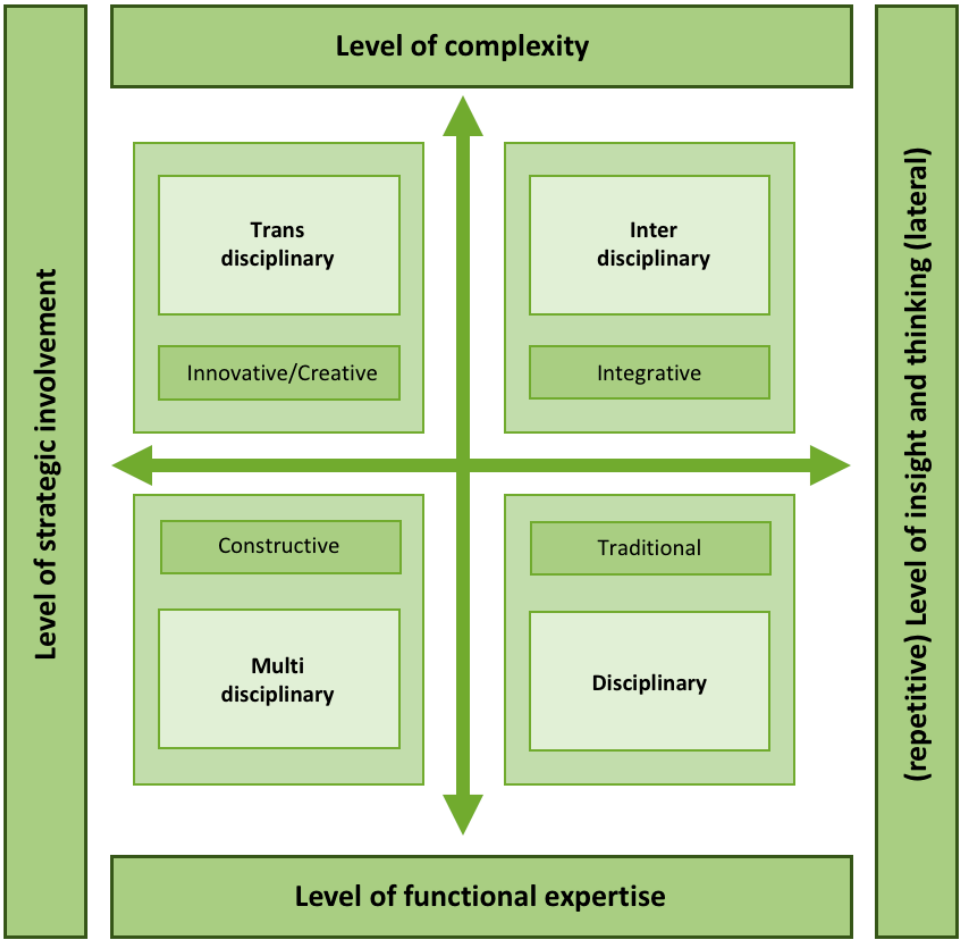


Figure 3-5: Process of development and insight of thinking
Source: Schoeman (2010:16)

Transdisciplinary thinking and collaboration is essential for realising the objectives of GI, but such should also be included in training curricula, especially when considering the fine balance between protecting green spaces and developing urban spaces, and their management, as important factors in urban sustainability and resilience thinking (Cilliers et al., 2015:352). The misinterpretation of concepts referred to as the 'value gap' should be addressed through adequate education, training and professional development initiatives, as explained in the following chapter.

3.7 Conclusion

Chapter 3 has shown the development and understanding of GI in order to contextualise the concept. Although it was not properly recognised at the time, GI has always been a part of urban planning from as early as the nineteenth century and even then it had a multitude of interpretations and definitions as is the case today.

By making use of theory based sampling as part of a qualitative construct, a definition of GI was created for the purpose of this research. GI, from a spatial perspective, thus includes all natural and man-made ecological systems, which integrate the built environment and ecosystem services with resilient landscapes supporting ecological, economic and human interests by maintaining and promoting connectivity while improving the quality of the environment.

The benefits of GI were accordingly considered on different levels (both neighbourhood and household level) in an attempt to emphasise the increasing importance of the application of GI in fostering resilience and sustainability of and in urban environments.

The different perspectives of GI, as perceived by different disciplines and stakeholders (such as landscape ecology, planning, geography, engineering etc.) calls for a transdisciplinary approach to ensure that the interface between all those involved is promoted and that both academic and non-academic knowledge is incorporated in such a manner that the application of GI within spatial planning facilitates the successful implementation thereof.

Appropriate education approaches should support the transdisciplinary thinking and interface between spatial planning and GI. This will be explored further in Chapter 4, which addresses the importance of transdisciplinary planning education with specific reference to the approach currently used in South Africa.

CHAPTER 4 – CONSIDERING TRANSDISCIPLINARY PLANNING EDUCATION AND THE SOUTH AFRICAN APPROACH

4.1 Points of departure

This chapter aims to highlight the importance of transdisciplinary training and education relating to spatial planning and GI, to fulfil the following research objective as stated in Chapter 1 (c.f. 1.4):

- To consider the importance of transdisciplinary education approaches relating to the spatial planning discipline.

In order to stress the importance of, and need for, transdisciplinary education, this chapter considers the green value gap, transdisciplinary education and the current approaches of spatial planning education in South Africa.

4.2 Considering the Green-Value-Gap

Chapter 3 of this research captured the benefits of green spaces and related GI. Although green spaces and GI were concluded to hold a multitude of benefits (c.f. 3.5) for a variety of users (both household-level and neighbourhood-level) the tendency in a developing country is for development to occur at the cost of green space (Cilliers, 2009:182).

The value of GI is challenging to calculate in this sense, since most of the indirect benefits provided by green spaces and GI (such as the social and environmental benefits) cannot be measured in monetary terms (Cilliers, 2009:182).

“Value” is subjective and measuring value often results in the Green-Value-Gap, where different disciplines perceive different values of the same concept. There is a gap in the understanding and valuing of green spaces and GI, as economic worth relating to indirect benefits of GI and green space are difficult to quantify. As a result of the difficulty to translate the benefits of GI to monetary value, UN Habitat (2009: 193) stated that planning education approaches should contain expanded transdisciplinary definitions on the roles of planners to include knowledge relating to economic development and environmental planning as part of spatial planning education.

In an attempt to bridge the Green-Value-Gap stakeholders should be sensitised to understand the concept and importance of GI (Cilliers, 2009:182).

This research argues that the education of GI at tertiary level could play a crucial role in training future planners and equip them with needed skills which would eventually result in better balance between environmental and developmental approaches, which, at this stage, are in constant conflict.

4.3 Transdisciplinary education

The transdisciplinary nature of the planning profession (c.f. 2.5), calls for transdisciplinary education approaches.

"Many of the world's critical problems involving the interactions between man and nature are transdisciplinary and cross-scale in nature" (Hammer and Söderqvist, 2001:1). Hammer and Söderqvist (2001:1) state that in order for planners to be equipped to make use of trans-disciplinary approaches in practice to solve complex problems efficiently, the education at tertiary level should include transdisciplinarity as part of curricula development. Currently there is a lack of trans-disciplinary approaches as part of university curricula.

Hammer and Söderqvist (2001:1) continue by stating that this lack of transdisciplinarity at tertiary level is because of institutional barriers that inhibit scholars to pursue transdisciplinary research successfully by collaborating with various faculties and departments.

Hammer and Söderqvist (2001:2) suggest four practical measures to be taken to improve the presence of trans-disciplinary approaches in university curricula, namely:

- Having external lecturers from other disciplines;
- Having seminar exercises and discussions with invited lecturers from other disciplines;
- Mixing students from courses in different disciplines for joint exercises;
- Giving full transdisciplinary courses and programmes

With specific reference to planning education, UN Habitat (2009:197) states that "there is a considerable need to increase the capacity of planning education" and that tertiary curricula should include sustainability approaches and social equity in the courses.

Regarding inputs from various stakeholders in terms of planning curricula development, UN Habitat (2009:197) states that universities should interact with professionals and scholars from a range of disciplines. This interaction should not only occur within academia but should also be extended to both the public sector authorities and private sector organisations.

4.4 Current approach of South African spatial planning education

This section provides information regarding planning curricula development in South Africa, focusing on the national qualifications framework and the content of SACPLAN competencies and standards.

4.4.1 National Qualifications Framework

SAQA (South African Qualifications Authority) states that the National Qualifications Framework Act 67 of 2008 provides the basis for the National Qualifications Framework (NQF), which is a system used to ensure qualifications of a high standard (SAQA, 2012). In order to guarantee that a high standard of education is maintained and continually improved, SAQA identifies a variety of level descriptors (described in Table 4-1 below) used to facilitate the advancement of the NQF (SAQA, 2012:2).

Table 4-1: Level descriptors and corresponding NQF levels

Areas	NQF level 6	NQF level 7	NQF level 8	NQF level 9
Scope of knowledge	Detailed knowledge	Integrated knowledge	Knowledge of engagement in forefront areas	Specialist knowledge
Knowledge literacy	An understanding of different forms of knowledge	An understanding of knowledge contested	Ability to interrogate multiple sources of knowledge	Ability to evaluate current processes of knowledge production
Method and procedure	The ability to evaluate, select and apply	An understanding of a range of methods	Understanding the complexities and uncertainties	The ability to design, select and apply creative methods
Problem solving	The ability to identify, analyse and solve problems in an unfamiliar context	The ability to identify, analyse, evaluate, critically reflect on a range of methods	The ability to use a range of specialised skills	The ability to use a wide range of specialised skills
Ethics and professional practice	Understanding of ethical implications of decisions and actions	Ability to take decisions and justify decisions	Ability to identify and address ethical issues based on critical reflection	Ability to make autonomous ethical decisions
Accessing, processing and managing information	Ability to evaluate different sources of information	Ability to develop appropriate processes of information gathering	Ability to review critically information in specialised context	Ability to design and implement processing strategy
Processing and communicating information	Ability to present and communicate complex information	Ability to develop and communicate well formed arguments	Ability to present and communicate academic, professional	Ability to use academic and professional resources and

			occupational ideas	defend substantial ideas
Context and system	Ability to make decisions and act appropriately	Ability to manage processes in unfamiliar contexts	Ability to operate effectively in a system	Ability to make interventions at an appropriate level within a system
Management of learning	Ability to evaluate performance against existing criteria	Ability to identify learning needs in a self-directed manner	Ability to apply in self-critical manner learning strategies	Ability to develop own learning strategies
Accountability	Ability to work effectively in a team	Ability to take full responsibility for own work, decision making and limited accountability	Ability to take full responsibility for own work, decision making and full accountability	Ability to operate independently and take full responsibility

Source: Own construction based on SACPLAN (2014:b) and SAQA (2012)

An important purpose of the level descriptors is to support the design and implementation of qualifications within the standards of the NQF. Levels 6 and 7 refer to bachelor-level outcomes, level 8 refers to honours (4th year) level outcomes and levels 9 and 10 refer to Master's and Doctoral levels' outcomes, respectively. Descriptors supply consistency among different tertiary institutions and curricula in learning through aiding assessment benchmarks for comparability within the parameters of the NQF (SAQA, 2012:2). Within these parameters planning curricula can be developed according to further requirements put in place by SACPLAN (The South African Council for Planners).

4.4.2 Competencies and standards of the South African Council for Planners

"The South African Council for Planners (SACPLAN) is the statutory council responsible for regulating the planning profession in terms of the Planning Profession ACT, 36 of 2002." (SACPLAN 2014b:3).

One of the primary purposes of this council is the accreditation of planning schools' curricula to ensure that the highest possible standards of education and training in terms of planning are met (SACPLAN, 2014b:3).

SACPLAN determines the accreditation status of planning schools by making use of a number of parameters, which include the NQF's competency levels and the different SACPLAN registrations that correlate with qualifications obtained. The identified competency levels and different registration categories will be discussed, followed by the accredited planning schools and details of their respective planning curricula, in an attempt to conclude on the status quo of planning education in South Africa.

(i) Competency levels

"Competencies are the amalgam of knowledge, skills and attitudes deemed to be required by a planner on graduation and as applied in practice" (SACPLAN, 2014b:12).

SACPLAN identifies three interconnected sets of competencies within planning as a profession, which are generic competencies, core competencies and functional competencies (SACPLAN, 2014b:12). Although the NQF level and area of specialisation determines the focus and coverage of the competencies within different qualifications, SACPLAN requires that training and education in all three competencies is mandatory.

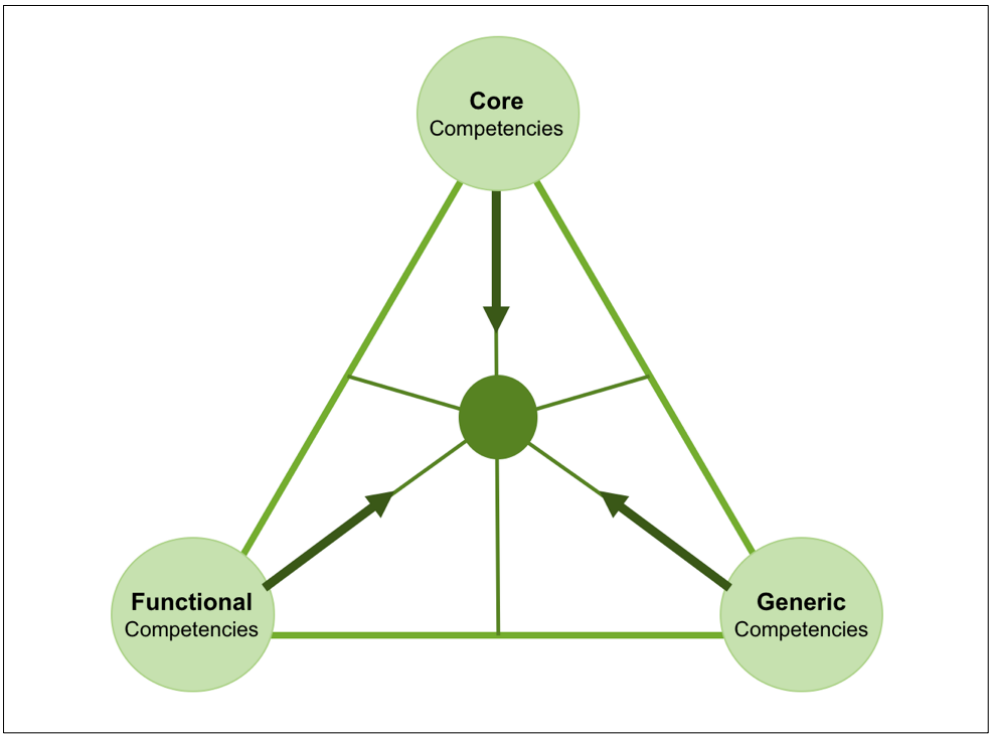


Figure 4-1: SACPLAN Competencies
Source: SACPLAN (2014b:13)

Table 4-2 below describes each of the competencies illustrated in Figure 4-1 in more detail.

Table 4-2: Competency descriptions and categories

Competency	Description	Categories
Generic competency	Essential skills, attributes and behaviours. Competencies common in built and natural environment disciplines.	• Critical thinking • Interpersonal competencies • Communications • Leadership • Professionalism and ethical behaviour • Social responsibility
Core competency	Specific knowledge, skills, abilities or experience required by planners to perform successfully as practitioners.	• Settlement history and theory • Planning theory • Planning sustainable cities and regions • Urban planning and place making • Regional development and planning

		• Public policy, institutional and legal frameworks • Environmental planning and management • Transportation planning and systems • Land use and infrastructure planning • Integrated development planning • Land economics • Social theories related to planning and development • Research
Functional competency	Basic skills focusing strongly on techniques and methodologies. A combination of studio based dexterities and in situ field work.	• Survey and analysis • Strategic assessment • Local area planning • Layout planning • Plan making • Plan implementation • Participation and facilitation

Source: Own construction from SACPLAN (2014b:12)

To differentiate qualifications at various NQF levels further SACPLAN (2014b:12) makes use of three competency levels (refer to Table 4-3) each correlating with a specific NQF level.

Table 4-3: Competency levels

Level of competency	Description	NQF level
Level 1	Awareness of and basic understanding of terminology and concepts; and ability to source further information and insights when required in the work environment	6
Level 2	Have a good understanding of a field of knowledge, or an ability to apply a methodology	7
Level 3	Be able to apply or engage with the area of competency with increasing degree of mastery and sophistication	8 and 9

Source: SACPLAN (2014b:13)

SACPLAN (2014b:13) further states that in order to adhere to the standards for accreditation, it is up to the discretion of each planning school to determine the level of competency covered in the programmes offered by determining the allocation of credits to modules. The basic hierarchy of competencies corresponding to the different registration categories is shown in Table 4-4 below.

Table 4-4: Hierarchy of competencies for each category of registration

Competencies	Professional Planner (NQF Level 8 or 9)		Planner (NQF Level 7)		Assistant Planner (NQF Level 6)	
Generic	All at Level 1		All at Level 1		All at Level 1	
+						
Core	35%	35% at Level 3	30%	25% at Level 3	25%	50% at Level 2

		35% at Level 2		40% at Level 2		50% at Level 1
		30% at Level 1		35% at Level 1		
+		**100%**		**100%**		**100%**
Functional	30%	35% at Level 3	35%	30% at Level 3	40%	75% at level 2
		35% at Level2		35% at Level 2		25% at Level 1
		30% at Level 1		35% at Level 1		
+	**65%**	**100%**	**65%**	**100%**	**65%**	**100%**

Source: SACPLAN (2014b:41)

By means of the information and parameters discussed above (including NQF levels, competency levels and different registration categories), SACPLAN accredited 11 tertiary planning curricula in South Africa. These schools all offer a variety of qualifications that fall within the Urban and Regional Planning realm, each of which corresponds to a predetermined NQF level as well as a registration category and competency level, as captured in Table 4-5.

Table 4-5: Planning schools and qualifications

Institution	Qualification(s)	NQF level	Competency level
Cape Peninsula University of Technology (CPUT)	National Diploma: Town and Regional Planning	6	1
	Bachelor of Technology: Town and Regional Planning	7	2
Durban University of Technology (DUT)	National Diploma: Town and Regional Planning	6	1
	Bachelor of Technology: Town and Regional Planning	7	2
North West University (NWU)	Bachelor of Arts and Science (Planning)	8	3
University of Cape Town (UCT)	Master in City and Regional Planning	9	3
	Master in City Planning and Urban Design	9	
University of the Free State (UFS)	Master in Urban and Regional Planning	9	3
	National Diploma: Town and Regional Planning	6	1

University of Johannesburg (UJ)	Bachelor of Technology: Town and Regional Planning	7	2
University of KwaZulu-Natal (UKZN)	Master of Town and Regional Planning	9	3
University of Pretoria (UP)	Bachelor of Town and Regional Planning	8	3
	Master of Town and Regional Planning (by coursework)	9	
University of Venda (UNIVEN)	Bachelor of Urban and Regional Planning	8	3
University of the Witwatersrand (Wits)	Bachelor of Science: Honours in Urban and Regional Planning	8	3
	Bachelor of Science in Town and Regional Planning	8	
	Master of Science in Development Planning	9	

Source: Adapted from SACPLAN (2012a:37)

In addition to the competencies guiding curricula development, SACPLAN specifies selected subjects to be considered for inclusion as part of tertiary planning qualifications. These subjects are geography; sociology or community based courses; environmental issues, natural systems and environmental impact analysis; mathematics for planners; economics; statistics; academic writing; planning theories, histories and philosophies; settlement/ morphology; layout design; spatial frameworks; infrastructure; transport; integrated development planning; land management; law and research design.

The subjects listed above indicate that SACPLAN requires planners to have knowledge of an extensive variety of disciplines, this is indicative that elements of transdisciplinarity should be present in education as proposed by SACPLAN. Taking into account that spatial planning as a profession is transdisciplinary in its nature (c.f. 2.5), the tertiary education and training of planning students should also reflect such to ensure that planning students are correctly equipped to solve problems in a transdisciplinary environment.

(ii) SACPLAN registrations

The hierarchy of competencies correspond to specific registration categories as stipulated by SACPLAN (2014b:43). SACPLAN identifies 3 categories of registration, namely Professional planner, Planner and Assistant Planner.

Each of these categories is described in the table below.

Table 4-6: SACPLAN registrations according to competencies

Registration category	Expected competencies	NQF level
Professional Planner	• Good conceptual grasp of the field of urban and regional planning as practiced in South Africa; • Ability to asses a situation which requires planning intervention and formulate appropriate responses; • Provide leadership to fellow professional planners, professionals in related fields, communities and other stakeholders in planning processes; • Possess some specialist planning knowledge or skills Must have an all-round set of competencies, most of which are at the upper competency Levels (2 and 3). Registration as a Professional Planner requires competencies spread over Core (35% of credit points) and Functional (30%). In each at least 35% must be at Level 3 and 35% at Level 2. All Generic competencies at Level 1 with the exception of Critical Thinking; Leadership and management; and Professional and ethical behaviour, which must be at Level 2 or 3.	8
Planner	• Reasonably good conceptual grasp of the field of urban and regional planning as practiced in South Africa; • Array of most technical skills expected from an assistant planner; • Ability to interact with other professionals, communities and stakeholders in planning processes under supervision of a Professional Planner; • Ability to provide direction to Assistant Planners Competencies must be spread over Core (30% of credit points) and Functional (35%) competencies. In contrast to the Professional, at least 25% of Core competencies must be at Level 3 and 40% at Level 2; while for Functional competencies 30% must be at Level 3 and 35% at Level 2. The requirement that a Planner has at least a Level 1 competency in the balance of Core and Functional competencies provides a base for further studies to register as a Professional Planner in due course	7
Assistant Planner	• Basic conceptual grasp of the field of urban and regional planning as practiced in South Africa; • Technical skills across the range of activities related to Functional Competencies; • Ability to carry out tasks as directed by a Professional Planner; • Ability to manage aspects or stages of a planning process under supervision • The emphasis is on the techniques and methodologies, the “how to do” aspects of planning; • Competencies must be spread over Generic, Core) and Functional, but weighted towards Functional competencies. • Most of the Functional competencies must be at Level 2, preferably one at Level 3, and the balance at level 1. • All the Generic must be at Level 1 at least • Of the Core competencies, the following must be at level 2: o Environmental planning and management; o Integrated Development planning; o Urban planning and place making. • The requirement that an Assistant Planner has at least a level 1 competency in the balance of Core and Functional	6

	competencies provides a base for further studies to register as a Planner, or a Professional Planner in due course.	

Source: Own construction from SACPLAN (2014b:40)

4.5 Conclusion

This chapter sought to determine the importance of transdisciplinary education and training relating to the spatial planning discipline.

Considering the findings of this chapter it is apparent that the misconception and misunderstanding of GI as identified in Chapter 3 (c.f. 3.4) is partly due to the Green-value-gap and could be addressed through adequate tertiary education and training methods, as well as continuous professional development initiatives, are in place. Improved. Transformed education approaches could contribute to minimising this (knowledge) gap since transdisciplinary thinking requires a sensitivity to understand perceptions from the viewpoint of different disciplines and stakeholders. As such, the application of GI in practice holds various economic benefits that, in some instances, could outweigh the benefits of traditional economic development holds.

This research has concluded that both. Sensitising planners and stakeholders to understand this value of GI could strengthen the importance of GI in the land-use decision-making process. Creating such awareness would need to start with appropriate educational approaches linking spatial planning and GI, which are both, transdisciplinary in nature (c.f. 2.5 and 3.6). As such, transdisciplinarity is an importance consideration within curricula development and transformation and subsequent teaching methods to ensure that the knowledge needed by planners (not only to apply GI successfully but also to solve efficiently all problems within spatial planning) is effectively transferred from planning educator to planning student. Similarly, transdisciplinary education will ensure that planners are able to thrive in transdisciplinary working environments.

The South African approach to planning education also calls for a transdisciplinary approach, as evident from the SACPLAN Competencies and Standards, enforcing the importance of transdisciplinary approaches in educationand standards report, aiming to provide future planners with adequate skills and knowledge to solve complex urban and regional problems. The list of prescribed subjects as provided by the guidelines and standards is indicative of transdisciplinarity and should be continuously enhanced by adapting current education approaches and methods of training at tertiary level to be more transdisciplinary by possibly including more elements of transdisciplinarity as part of existing modules or developing modules that are entirely transdisciplinary in nature.

Chapter 5 will accordingly seek to evaluate the current planning education approaches in South Africa, based on local tertiary planning curricula, in an attempt to conclude on the status quo and inclusion of GI and transdisciplinary as part of spatial planning education.

CHAPTER 5 – EVALUATION OF CURRENT PLANNING EDUCATION APPROACHES

5.1 Points of departure

Chapter 5 attempts to answer the following research questions as stated in Chapter 1 of this research (c.f. 1.3):

- To what extent is GI included as part of local tertiary planning education?
- To what extent are transdisciplinary elements being included as part of local tertiary planning education?

Along with answering the questions above, this chapter also seeks to fulfil the following objectives as highlighted in Chapter 1 (c.f. 1.4):

- Evaluate current education approaches relating to GI planning in order to outline academic perception and importance of GI.
- Evaluate current education approaches relating to the transdisciplinary nature of tertiary planning education.

To address the stated research questions and research objectives an evaluation and comparison was conducted of the curricula of planning school, as described in the following section.

5.2 Evaluation and comparison of curricula of planning schools

The following section seeks to investigate the extent of GI inclusion, as well as the transdisciplinary nature of tertiary education at purposefully selected institutions offering relevant, accredited planning qualifications. To achieve this objective, yearbooks of institutions which offer undergraduate NQF Level 8 planning qualifications in South Africa are investigated. While SACPLAN recognises and accredits eleven urban and regional planning institutions (c.f. 4.4.2), three of these institutions comply with delineated criteria.

These three institutions are the North-West University (NWU), the University of Venda (UNIVEN), and the University of Pretoria (UP). In the corresponding analysis, the degree of the inclusion of GI within the respective curricula is determined through evaluating the outcomes of the modules in terms of the SACPLAN core competencies (refer to Table 5-1) relating to “Environmental Planning and Management”. Accordingly, the module outcomes, as

stated in the respective yearbooks of the complying and purposefully selected institutions, are subjectively evaluated in terms of their compliance with the stated core competencies.

As mentioned in Chapter 1 (c.f. 1.5.2.1), the following methodology was employed:

- When references to GI are limited, a value of 1 is assigned to the relevant module
- When GI – or elements inherent to its definition – is moderately mentioned, the module is accredited a value of 2
- When GI is a significant element within a module, that module is assigned a value of 3

The SACPLAN competencies and outcomes on which said modules are evaluated are referenced in Table 5-1.

Table 5-1: Environmental Planning and Management components and outcomes as proposed by SACPLAN

Components	Outcomes
Natural systems Environmental management and planning Climate change Sustainability	**Knowledge:** • Demonstrate an understanding of ecology, the environment, environmental issues and the environmental impacts involved in the development of cities and regions. • Define the key elements of environmental valuation and environmental impact assessment. • Demonstrate an understanding of the integration of environmental issues in the planning and development process. • Differentiate between various environmental management approaches such as policies, governance activities, quality of life, and public awareness building. • Demonstrate understanding the processes, forms and limitations of objects and systems within the built and natural environments. **Skills:** • Analyse natural systems and appreciate environmental constraints. • Conduct research and evaluation of the environment and urban environmental issues. • Assess EIAs, SEAs, Environmental Impact Statements and other environmental management tools. • Carry out tasks of environmental planning and management • Prepare and draft policies for environmental management. **Behaviour:** • Advocate the importance of environment issues in development and planning processes. • Ethical stance on environmental issues, protecting environment, sustainable development and its importance in planning procedures.

Source: SACPLAN (2014b:26)

To determine the extent of inclusion of transdisciplinary elements within the modules, a similar methodology is employed to the one stated above:

- When references to transdisciplinarity (in terms of the reference to other disciplines) are limited, a value of 1 is assigned to the relevant module
- When transdisciplinarity – or elements inherent to its definition – is moderately mentioned, the module is accredited a value of 2
- When transdisciplinarity is a significant element within a module, that module is assigned a value of 3.

Furthermore, Table 5-2 illustrates the SACPLAN-proposed modules and purposefully selected planning schools' compliance in this regard.

The remaining sections seek to evaluate the curricula contained within the yearbooks of the various planning institutions according to the extent of inclusion of GI and the trans-disciplinary elements of each module.

5.2.1 Evaluation of North-West University planning curriculum

Table 5-2 illustrates the undergraduate planning curricula of the NWU as described in the Faculty of Natural Sciences yearbook (2016). As indicated in the evaluation conducted in the table, the curriculum is comprised of twenty planning modules. Of these modules, which amount to 322 credits, eight modules are considered NQF Level 8 modules; six modules are considered Level 7; five modules are Level 6; and two modules are on NQF Level 5.

Due to the inclusion of NQF Level 8 modules, this NWU planning qualification allows for graduates' Professional Planner registration.

Table 5-2: North-West University planning curricula evaluation

Year 1							
Module Code	Name	Description/Outcomes	Credits	Prerequisites	NQF level	Extent of GI inclusion	Extent of transdisciplinarity
Semester 1							
SBES 111	Historical development of civilisation	• Demonstrate fundamental knowledge and insight into the settlement, origin and development of cities of different historical civilizations; • To demonstrate skills, as an individual and as a member of a group, in collecting, reading, interpreting, synthesising and presenting scientific information orally/in writing; • Act ethically in presenting his/her knowledge of the historical facts of planning cities and regions.	12	Admission requirements	5	1	1
Semester 2							
SBES 121	Urban morphology	• Demonstrate fundamental knowledge and insight into the implementation of the different manifestations of garden cities; • Evaluate the value and impact of Garden Cities; • Demonstrate fundamental knowledge and understanding of the different modern and post-modern models, including those that apply to South Africa; • Demonstrate skills, as an individual and as a member of a group, in collecting, reading, interpreting, synthesising and presenting appropriate scientific information orally/in writing; • Act ethically in presenting his/her knowledge of historical facts in planning cities and regions.	12	SBES 111	5	1	1

Year 2							
Module Code	Name	Description/Outcomes	Credits	Prerequisites	NQF level	Extent of GI inclusion	Extent of transdisciplinarity
Semester 1							
SBRS 221	Introduction to regional planning	• Demonstrate in-depth knowledge and insight into the nature and characteristics of forces that determine urban morphology; • Demonstrate skills in distinguishing independently underlying relations between forces that determine the forms and morphology of cities and regions; • Develop a project on spatial systems, to demonstrate skills, as an individual and as a member of a group, in identifying and applying forces that dictate urban settlement patterns and forces that lead to the establishment and development of service	16	SBES 111; SBES 121	6	1	1

		areas.					
SBSS 211	Planning approaches and practice	• Demonstrate in-depth knowledge and informed understanding of different types of layout, the layout process and qualitative and quantitative principles of planning layout and design; • Demonstrate the ability to apply this knowledge and understanding in analysing, evaluating and improving specific sites and layouts; • Demonstrate the ability, as an individual and as member of a group, to analyse unfamiliar and somewhat complex problems of layout and design, to identify variables and formulate proposals to solve the problem/problems; • Demonstrate the ability to communicate information and proposals regarding design orally, in writing and by means of drawing techniques in a coherent and trustworthy manner, using information technology where appropriate; • Demonstrate the ability to approach layouts and design in an ethical and responsible manner, taking into consideration the specific needs of the community and the necessity of environmental conservation.	16	SBES 111; SBES 121 ECON 111; ECON 121		1	2 • Information technology • Environmental considerations
Semester 2							
SBSL 221	Urban design	• Demonstrate an in-depth knowledge and informed understanding of basic principles of urban design, the origin of urban design, what it comprises, paradigm shifts in urban design theory and the challenges posed to urban design by the development of cities; • Demonstrate the ability to find creative solutions to existing or new urban spaces by means of urban design precedents in order to transform these spaces into quality places for people, taking into consideration the environment; • Demonstrate the ability to discover creative design solutions, independently as an individual and in close association with a group, and to communicate these solutions visually and orally to an audience.	16	SBSS 221	6	1	1
SBRS 221	Regional Plans	• Demonstrate in-depth knowledge and understanding of the different regional planning approaches in the world, of the physical and socio-economic characteristics and requirements of metropolises and world cities, and of the processes that led to the formation of structural elements in metropolises and regions; • Demonstrate skills, as an individual and in close association with a group, to apply planning policy and instruments in solving well-formulated, but unfamiliar problems regarding metropolitan formation;	16	SBRS 211; ECON 121		1	2 • Physical and social economics • Policy and legislation

		• Demonstrate the ability to conduct research, to collect and interpret appropriate information and present it in the form of a report.					
SSBP 221	Private law for planners	• Demonstrate knowledge of the general background to the law in general as well as the South African legal system, knowledge of the constitutional dispensation in South Africa, as well as the role and place of the Bill of Human Rights; • Understand Planning Law as a section of the South African legal system, basic knowledge of the most important planning legislation; • Understand the place and function of planning law • Understand the role and function of environmental law; • Understand the basic principles relating to ownership, servitudes and contracts; • Understand and have knowledge of the most important planning legislation and case law relating to planning issues and to utilise this in practice and interpret the implications thereof.	16	SBSS 211		2 • Environmental law	2 • Planning law

Year 3							
Module Code	Name	Description/Outcomes	Credits	Prerequisites	NQF level	Extent of GI inclusion	Extent of transdisciplinarity
Semester 1							
SBRS 311	Regional economics	• Demonstrate well-rounded knowledge and understanding of objectives of regional development in a regionally balanced and regionally unbalanced context; • Demonstrate knowledge of the anatomy of the formal and informal urban economic urban sectors and the “top-down” and “bottom-up” development processes in local economic development; • Demonstrate the ability, as an individual and as member of a group, to identify problems in economic development of regions, retrieve existing research on these problems, to analyse and evaluate them, and to explain the results of his/her/their findings orally and in written format at a seminar.	16	SBSS 211; SBRS 221; ECON 321	7	1	1
SBSS 311	Commercial planning and development	• Demonstrate integrated knowledge and logical understanding of the development of different formal and informal trade sectors in towns and cities. • Understand and explain the context, challenges and planning principles applicable to trade centres, with specific reference to the central business district, the identity of cities and the most recent planning trends. • Determine the hierarchy of trade centres by means	16	SBSS 221; SBSL 221		2 • Solutions beneficial to environment	2 • Understanding of trade sectors

		of various methods and interpret the interaction of the hierarchical structure in order to make practical planning recommendations. • Understand and explain the context applicable to formal trade centres in order to apply layout and planning principles. • Critically evaluate the role of the informal trade sector within the South African trade structure and reflect critically on the factors that can strengthen this role within the urban structure. • Rate the most recent planning trends with reference to virtual spaces, and analyse the important role thereof in terms of commercial planning and the Urban Planning discipline. • Demonstrate advanced abilities to present ethically sound and creative ideas and solutions that would be beneficial to the urban environment, urban communities and trade centres.					
Semester 2							
SBES 321	Engineering for planners	• Demonstrate knowledge and understanding of policy and legislation that guide engineering services; • Demonstrate skills in undertaking the planning of engineering services such as water supply, sewage systems, electricity supply and designing streets for vehicles, bicycles and pedestrians in town layouts; • Demonstrate the ability to do cost accounting based on the theoretical knowledge acquired in the module; • Demonstrate the development of the ability, as an individual or as a member of a team, • Undertake the provision and planning of engineering services in town layouts and development; • Gather, analyse, evaluate, and synthesise information with a view to formulate practical proposals to ensure the cost effectiveness and functionality in planning of project; • Demonstrate the ability to write a report on practical, integrated planning and design of engineering services and to communicate it to those concerned.	16	SBSS 311; SBSS 221	7	1	2 • Policy and legislation • Engineering • Transportation
SBRS 321	Regional development and analysis	• Demonstrate well-rounded and systematic knowledge and understanding of urban systems and planning approaches to regional	16	SBRS 311; SBRS 221; ECON 321		1	1

		systems in developed and developing countries; • Demonstrate skills in determining scientifically the order of cities in a region; • Apply, as an individual or in a group, regional analytical techniques to identify problems, to make calculations and to suggest creative solutions and to communicate solutions in writing and orally to an audience of peers.					
SBSS 321	Transport and planning systems	• Demonstrate well-rounded and systematic knowledge of intra-city transportation and the resulting flow of traffic; • Demonstrate the process of traffic planning and the relevant planning principles, as well as the Integrated Transport Plan; • Demonstrate skills in applying the planning principles maintained in planning the network component of the urban traffic system in order to solve transport problems identified; • Demonstrate the ability to identify and analyse traffic problems at national, provincial and municipal level and to do traffic planning on the basis of applicable planning principles, and to draw up these plans using a computer, to submit a business plan, evaluate the plans and improve them; • Demonstrate the ability to submit, as an individual or in group context, solutions in an ethical and responsible manner to an audience of peers and professional people.	16	SBRS 311; SBSS 311		1	1
SECO 321	Urban ecology for planners	• Demonstrate systematic knowledge and comprehension of the development of the ecosystem concept, biome and bio-regions of South- Africa, the development of Urban Ecology as a science, the uniqueness of urban ecosystems, application of ecological principals in urban planning and -design, ecological questionnaires that influence planning of urban regions, demonstrate proficiency in application of basic ecological principles in the planning and design of urban open areas; • Identify ecological questionnaires in urban planning and design • Research suitable scientific information; • Analyse information and collected data; • Integrate and communicate results in an ethical and responsible manner in writing.	16	SBSS 311; GGFS 112; GGFS 121; GGFS 212; GGFS 312		3 • Ecosystems • Biomes and biome regions • Urban ecology • Ecological systems and principles	3 • Ecology

Year 4

Module Code	Name	Description/Outcomes	Credits	Prerequisites	NQF level	Extent of GI inclusion	Extent of transdisciplinarity
Semester 1							
SBSS 421	Research Project	• Demonstrate knowledge and understanding of the influence of globalisation on the urban environment in the developed and developing world; • Demonstrate skills to apply theory and theoretical principles in practice to solve unfamiliar problems regarding migration and urban development in a global context; • Research the causes and implications of migration and urban development as found in different situations in a global context; • Analyse and interpret information and present proposals based on applicable theories and principles with a view to sustainable development in an economic and social context.	32	SBES 321; SBSS 321; SBRS 321; SSBP 221; SECO 321	8	1	1
SBRS 411	Regional analysis and application	• Demonstrate extensive and systematic knowledge of the role of planning policy and housing policy in modernistic and post-modernistic spatial planning; • Demonstrate skills to understand and solve real-life problems in socio-economic development by applying fundamental theories and principles of strategic and spatial planning; • Demonstrate skills in researching the impact of policy changes from a development perspective, in interpreting and analysing findings and in facilitating changes.	16	SBRS 311; SBRS 321			
SBSS 412	Integrated housing development	• Explain and criticise the different theoretical points of departure in housing; • Demonstrate basic knowledge and understanding of theoretical points of departure in housing; • Motivate and defend the role of housing policy in the planning system; • Demonstrate extensive and systematic knowledge and understanding of the role of the housing policy in the planning system; • Do a critical analysis and evaluation of international and national housing policy and legislation, as well as case studies from practice; • Display an ability to do research regarding a housing issue independently in a particular context and to formulate sustainable and creative strategic spatial solutions for the issue;	16	SBES 321; SBSS 321; SBSS 311		1	1

		• Develop skills required to communicate proposals regarding housing problems both visually and orally to an audience.					
Semester 2							
SBSL 412	Land use management and residential development	• Demonstrate extensive and systematic knowledge of residential types and the development thereof, the principles and processes of statutory planning that includes zoning and management of land use; • Demonstrate the ability to explain and discuss subdivision of land and town establishment; to demonstrate skills in using planning instruments to undertake spatial residential development and land management in a professional and ethical manner; • Demonstrate the ability to plan a quality residential development and promote sustainable land use; • Demonstrate the ability to promote urban density by researching residential development within the framework of differentiation and affordability; • Demonstrate the ability to process and interpret information, and to propose sustainable development orally and in writing.	16	SBES 321; SBSS 321	8	2 • Sustainable development • Sustainable land use	2 • Statutory planning
SSBP 421	Planning practice	• Gain background knowledge as part of the bigger picture and the way in which various outcomes are to be achieved; • Be able to deal with basic land-use applications to submit to decision makers.	16	SBES 311; GGFS 112; GGFS 121; GGFS 212; GGFS 312		1	1

Source: Own construction from NWU Yearbook (2016)

5.2.1.1 Summary of NWU planning curricula

Considering Table 5-3 it is clear that the modules that include GI as well as modules that make reference to transdisciplinarity are limited. Table 5-4 summarises the findings and shows that three modules include elements of GI education, namely:

- Private law for planners (SSBP 211) – 16 credits
- Commercial planning and development (SBSS 311) – 16 credits
- Urban ecology for planners (SECO 321) – 16 credits

Further it can be seen that there are limited modules that indicate the inclusion of trans-disciplinary elements as part thereof. The modules that make mention of transdisciplinarity are:

- Planning approaches and practice (SBSS 211) – 16 credits
- Regional plans (SBRS 221) – 16 credits
- Private law for planners (SSBP 211) – 16 credits
- Commercial planning and development (SBSS 311) – 16 credits
- Engineering for planners (SBES 321) – 16 credits
- Urban ecology for planners (SECO 321) – 16 credits
- Land use management and residential planning (SBSL 412) – 16 credits

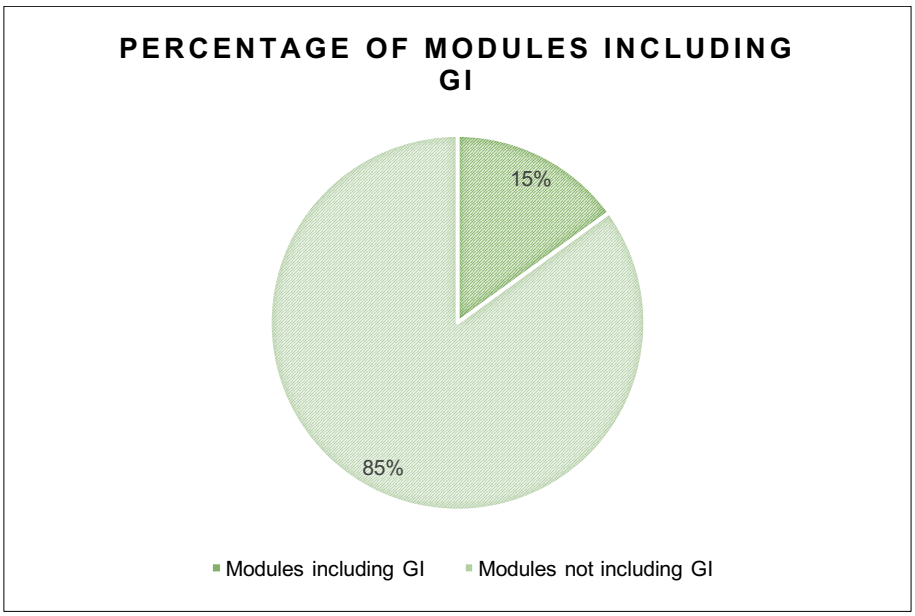
Table 5-3: Summary of GI and transdisciplinary incorporation in NWU planning curricula

Year of study	Total credits per year of study	NQF level	Module code	Extent of GI inclusion	Extent of transdisciplinarity
1	24	5	SBES 111	1	1
			SBES 121		
2	80	6	SBRS 211	1	1
			SBSS 211		2
			SBSL 221		1
			SBRS 221		2
			SSBP 221	2	
3		7	SBRS 311	1	1
			SBES 321		2
			SBRS 321		
			SBRS 321		1
			SBSS 311	2	2
			SECO 321	3	3
4		8	SBSS 471	1	1
			SBRS 411		
			SBSS 412		
			SBSL 412		

			SBES 421		2
			SSBP 421		1
	322				

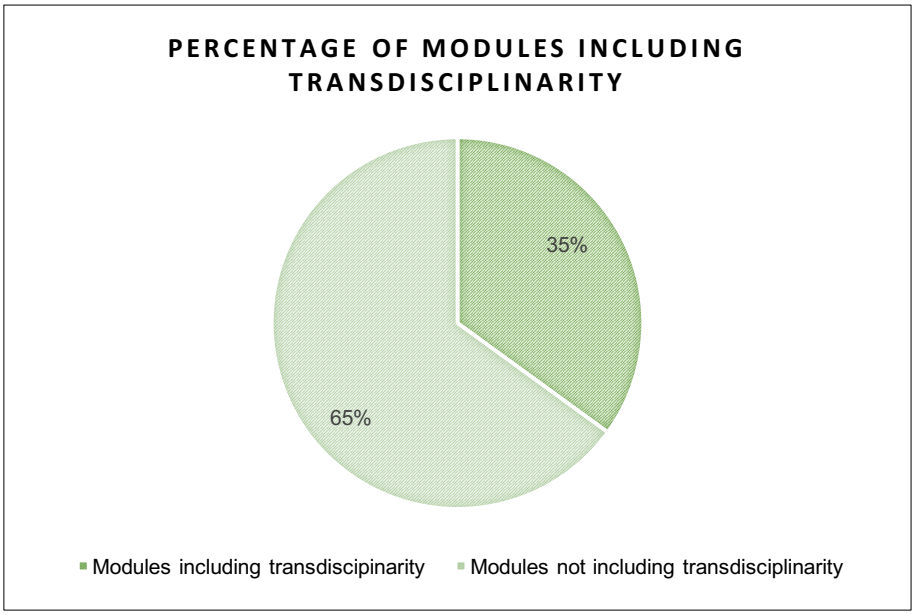
Source: Own construction (2017)

Of the 20 planning modules offered and 322 course credits offered by the NWU, 3 modules reference GI (one module does so comprehensively and the remaining two moderately). This translates to only 48 credits (15% of the curriculum) that include GI as part of the programme, as can be seen in Graph 5-1 below.



Graph 5-1: Representation of modules including GI at NWU
Source: Own construction (2017)

Accordingly, 7 of the 20 modules indicate some inclusion of transdisciplinarity, which translates to 112 credits including elements of a transdisciplinary nature. Graph 5-2 shows that 65% of the NWU curriculum does not include transdisciplinarity.



Graph 5-2: Representation of modules including GI at NWU
Source: Own construction (2017)

5.2.2 Evaluation of University of Pretoria planning curriculum

The following section seeks to evaluate the University of Pretoria (UP) planning curriculum with regard to its inclusion of GI elements and elements of transdisciplinarity. The Faculty of Engineering and the Built Environment yearbook (2016) includes the planning curriculum for UP undergraduates. This planning curriculum is illustrated in Table 5-4. This undergraduate qualification comprises 31 modules. Of these modules, which amount to 364 credits, eight modules are considered NQF Level 8 modules; six are considered Level 7; six at Level 6; and seven on NQF Level 5.

Due to the inclusion of NQF Level 8 modules, this UP planning qualification allows for graduates' Professional Planner registration.

Table 5-4: UP planning curriculum evaluation

Year 1							
Module Code	Name	Description/Outcomes	Credits	Prerequisites*	NQF level	Extent of GI inclusion	Extent of transdisciplinarity
Semester 1							
ALL 123	Academic literacy for town and regional planning	Cope more confidently and competently with the reading, writing and critical thinking demands that are characteristic of the field of Town and Regional Planning.	6	None	5	1	1
TRP 110	Introduction to planning	Definitions of planning; rationale for planning; focus areas of planning; planning processes; planners' roles and work places; the institutional framework for planning; planning legislation; values and ethics of planners; the future of planning.	12	None		1	1
TPH 110	Planning settlement histories before the industrial revolution	An in-depth analysis of city building and urban and regional planning in pre-modern times. The influence on settlement design and planning within the social, political and economic context of the Pre- historic; Classic (Roman and Greek); Feudal and Mercantile eras. Aspects such as visions of ideal cities, settlement patterns, the treatment of public space, the development of the edge of the settlement, functional zones and segregation are covered. Attention is given to the function, role, character, practice and beneficiaries of planning and the role of planners	12	None		1	1
TPA 110	Site analysis and assessment	Analysis and assessment of sites for planning purposes. Covers the analysis of context and natural (e.g. climate, geology), man-made (e.g. zoning, potential land value, land use and activity), and sensory elements (e.g. genius loci) of a site to determine the appropriate use of a site as well as the character of future development. Skills and techniques to communicate the analysis and assessment graphically.	16	None		2 • Natural elements	1
Semester 2							
TPH 120	Planning settlement histories since the industrial revolution	An in-depth analysis of city building and urban and regional planning in modern and post-modern times with special emphasis on the South African situation. The influence on settlement design and planning within the social, political and economic context of Industrial and Post-industrial eras. Aspects such as visions of ideal cities, settlement patterns, the treatment of public space, the development of the edge of the settlement, functional zones and segregation are covered. Attention is given to the	12	None	5	1	1

		function, role, character, practice and beneficiaries of planning and the role of planners.					
TPS 120	Principles of design	Introduction to the goals and principles of settlement design. Characteristics and measures as well as the design elements of a good living-environment; settlement design within both urban and rural contexts. Aspects that will be covered include settlement structure (open space and movement systems), sense, symbolism and legibility, accessibility, diversity and opportunity, sustainability, safety, justice and equity.	16	None		2 • Sustainability • Living environments	1
TPA 120	Settlement analysis and assessment	Theoretical component: South African cities in a global economic and national context; a framework for settlement analysis; overview and discussion of important demographic, social, economic, environmental and local government features of selected South African cities. Practical component: basic writing and presentation skills for planners; field methods; participatory methods; surveys; secondary sources; settlement analysis in a political context; analysis of a suburb in the Pretoria area.	16	None		2 • Environmental features	1

Year 2							
Module Code	Name	Description/Outcomes	Credits	Prerequisites*	NQF level	Extent of GI inclusion	Extent of transdisciplinarity
Semester 1							
TPD 201	Introduction to development planning	Introduction to development problems, perspectives on and concepts of development. Approaches to development planning and development studies. Application of development proposals from local to national levels. International and local perspectives and case studies. Critical evaluation of development initiatives, and aspects such as culture, gender, diversity and sustainability. Role players in the development process	12	None	6	1	2 • Role players
TPU 210	Land use management theory	A brief history of land use management in South Africa; rationale for and use management; principles of good land use management in the context of transformation and development imperatives in post-apartheid South Africa, global environmental change, new economic geography, procedural, substantive and intergenerational justice and development economics; critique of land use management; ethics of land use management; the characteristics of an appropriate land use management system that advances transformation, sustainability, resilience, equity, inclusiveness and integration in South Africa; the link	12	None		1	2 • Economics • Geography

		between land use management and strategic spatial planning; international and South African examples of land use management systems; the future of land use management.					
TPA 210	Plan and policy analysis and assessment	Analysis and assessment of plans and policy frameworks from a planning and development perspective. Analysis and assessment of substantive and communicative content. Deconstruction of text, norms and values, planning and development approaches. The role of planners and the democratisation of planning	16	None		1	1
TPS 210	Settlement design concepts	The skills and techniques to design a layout of a new settlement or part of an existing settlement. It includes design for the provision of housing for both high and low income groups, as well as commercial and social facilities, open space systems, transportation systems and services. Design sustainable and equitable areas. Site analysis and assessment; development of alternative concepts; the detail design including the division of erven, infrastructure network, land development control and design guidelines.	16	None		2 • Sustainability • Equity	2 • Commercial and social sciences • Transportation systems
JCP 201	Community-based project	This project-orientated module is a form of applied learning which is directed at specific community needs and is integrated into all undergraduate academic programmes offered by the Faculty of Engineering, Built Environment and Information Technology. The main objectives with the module are as follows: (1) The execution of a community related project aimed at achieving a beneficial impact on a chosen section of society, preferably but not exclusively, by engagement with a section of society which is different from the student's own social background. (2) The development of an awareness of personal, social and cultural values, an attitude to be of service, and an understanding of social issues, for the purpose of being a responsible professional. (3) The development of important multidisciplinary and life skills, such as communication, interpersonal and leadership skills. Assessment in the module will include all or most of the following components: evaluation and approval of project proposal, assessment of oral and/or written progress reports, peer assessment in the event of team projects, written report back by those whom the project was aimed at, and final assessment based on the submission of a portfolio and a written report.	4	None		1	2 • Social and cultural values • Multidisciplinary skills
Semester 2							

TPD 220	Municipal development planning	Theories and processes of strategic, forward, and integrated development planning; origins and intentions of these concepts; international and local perspectives and case studies; policy framework for development planning in the South African context; role players in development planning processes, with specific reference to the role of the planner and the community; introduction to the concept, theory, aims, processes and practise of participatory planning.	12	None	6	1	2 • Role players • Development process • Participatory planning
TPS 220	Settlement establishment and housing delivery	Institutional and legal frameworks in which settlement establishment and housing provision takes place; user and site requirements; housing typologies and densities; engineering services; role players; financing; township establishment in terms of current legislation; simulated exercise; the detail design including the division of erven, infrastructure network, land development control and design guidelines.	16	None		1	2 • Engineering services • Legislation
TPU 261	Urban land development economics	The economics of settlements, including aspects such as economic advantages, transformation, equity, integration and inclusiveness; locational choices of urban land uses; density and intensity of development; the effects of densities, location and transportation economics on land values; implications of zoning; implications for sustainability and risk reduction; the cost of urban growth, whether by densification or sprawl. The functioning of the property market, e.g. how the property market works for the urban poor; key role players and decision-making in the property market; the role of urban planning as well as local government and their financial viability in the property market.	6	None		1	1
TPU 262	Land use management practice	Generic components of land use and land development applications and procedures; practical exercises in the preparation, submission, processing and evaluation of land use management applications; policy preparation in terms of land use management systems that advance equity, resilience, inclusiveness, sustainability and integration; appeals; introduction to Environmental Impact Studies (EIAs).	6	None		2 • Resilience • Sustainability • EIA's	2 • EIA's • Policy preparation
JCP 201	Community-based project	This project-orientated module is a form of applied learning which is directed at specific community needs and is integrated into all undergraduate academic programmes offered by the Faculty of Engineering, Built Environment and Information Technology. The main objectives with the module are as follows: (1) The execution of a community related project aimed at achieving a beneficial impact on a chosen section of society, preferably but not exclusively, by engagement with a section of society which is different	4	None		1	2 • Social and cultural values • Multidisciplinary skills

		from the student's own social background. (2) The development of an awareness of personal, social and cultural values, an attitude to be of service, and an understanding of social issues, for the purpose of being a responsible professional. (3) The development of important multidisciplinary and life skills, such as communication, interpersonal and leadership skills. Assessment in the module will include all or most of the following components: evaluation and approval of project proposal, assessment of oral and/or written progress reports, peer assessment in the event of team projects, written report back by those whom the project was aimed at, and final assessment based on the submission of a portfolio and a written report.					

Year 3							
Module Code	Name	Description/Outcomes	Credits	Prerequisites*	NQF level	Extent of GI inclusion	Extent of transdisciplinarity
Semester 1							
TPW 310	Institutional and legal structures for planning	Overview of South African institutional and legal structures for planning and development, on national and provincial scale. Relevant legislation and policies that influence planning. Specific reference to the legal frameworks guiding land development, the environment, municipal management and development, housing, transport, water, and Human Rights.	12	None	7	2 • Environmental development • Water management	2 • Legislation and policies • Transportation • Legal frameworks
TPD 310	Regional development planning	Theory and practice of regional development planning; strategic regional development analysis and thinking; preparation and implementation of regional development frameworks, and plans and strategies on supranational, national, provincial and metropolitan levels.	12	None		1	1
TPS 310	Spatial concepts	Spatial concepts regarding the development and planning of settlements. Morphological development processes such as decentralisation, counter urbanisation, residential infill and succession, urban sprawl. Spatial structuring elements, e.g. corridors, nodes, compact cities, mixed use.	12	None		1	1
Semester 2							
TRP 320	Planning prospects	Critical reflections on planning as construct, activity and profession. Case study-based exploration of innovative planning practices.	12	None	7	1	1

TPD 320	Rural development planning	Rural development in historical, political, ideological, social, economic, geographical and institutional context; theoretical perspectives on and approaches to rural development; case studies of rural development planning and plans in different developmental contexts; preparation, implementation and evaluation of rural development frameworks, strategies and plans.	12	None		1	1
TMS 320	Transport planning and municipal services provision	Section A – Transport planning: environmental, economic and social impact of transport; transport planning process; introduction to transport studies and evaluation; public transport; functional road hierarchy; geometric road layout; road reserve dimensions; parking; preparation of a layout. Section B – Municipal services provision: water supply; sanitation; storm water disposal; energy supply; public lighting; solid waste removal; inclusion of municipal services in the layout.	12	None		2 • Environmental impacts • Storm water disposal • Waste removal	2 • Transport planning • Economics

Year 4							
Module Code	Name	Description/Outcomes	Credits	Prerequisites*	NQF level	Extent of GI inclusion	Extent of transdisciplinarity
Semester 1							
TPI 452	Planning interventions: Peri-urban and rural areas	Introduction to planning and management of small towns, rural settlements, and peri-urban/rural districts; examples of planning interventions in rural areas; approaches to rural development, techniques and methods for planning in rural areas. Critique on and improvements on current practice; simulated planning exercise.	12	None	8	1	1
TPI 454	Planning interventions: Supranational, national and provincial scale	Introduction to planning at provincial, national and supranational scale. Approaches to planning and development of regions and provinces. Past and present examples of planning on each of these scales. Planners' roles in planning exercises at these scales; institutional requirements and implications of planning at these scales. Critiques and improvements on current practice; simulated planning exercise.	12	None		1	1
TPR 412	Professional practice	Starting a career in the planning profession (including issues such as public vs. private sector employment, essential skills required, applying for vacancies, interaction with co-workers and other parties, company culture, client relationships, workplace ethics); developing a career in the planning profession (including issues such as essential communication-, management- and political-skills, typical mistakes to avoid in practice, setting a career path); introduction to	6	None		1	2 • Communication management • Political skills • Project management • Client services

		project management; an overview of professional planning organisations in South Africa; remaining issues for class discussion, such as marketing, client service, promotion and time management.					
TPE 410	Research methodology	Defining research; research paradigms; research ethics; research problems/questions; literature reviews; research design; selected qualitative and quantitative methods for data collection, analysis and interpretation; reporting research; formulation of a research proposal.	12	None		1	1
Semester 2							
TPI 451	Planning interventions: Precinct scale	The drafting of urban development and design frameworks to ensure development or redevelopment of urban areas in a relevant, social and environmentally accountable way. Specific focus on rehabilitation of declining city centres, fast growing edge cities, and underdeveloped parts of urban areas. Critique on and improvements of current practice; simulated planning exercise.	12	None	8	2 • Environmentally accountable • Rehabilitation of declining cities	1
TPI 452	Planning interventions: Metropolitan scale	Introduction to planning at metropolitan level; examples of planning interventions at metropolitan level; approaches to and examples of the delivery of housing, infrastructure and facilities; tensions in resource allocation and prioritising of development in metropolitan areas; institutional requirements and implications of planning and management of metropolitan development; critiques and improvements on current practice; simulated planning exercise.	12	None		1	1
TPE 410	Research report	Contextualisation of a research problem/question; literature review; research design and methods; undertake empirical research in line with an approved research proposal; collection, analysis and interpretation of data; writing up of research findings.	30	None		1	1
POU 720	Practical development feasibility	The feasibility of a project is investigated by groups comprising students of the various fields of study in the built environment. The projects are presented to a panel of judges comprising practitioners.	2	None		1	1

Source: Own construction from UP Yearbook (2016)

* The UP Yearbook indicates that, although there are no prerequisites, the conditions of promotion are as follows:

- Second year of study is dependent on a student obtaining a minimum of 100 credits and no more than one first year subject to be repeated;
- Third year of study is dependent on a student obtaining a minimum of 210 credits, no more than one second year subject to be repeated and no first year subjects to be repeated;
- Fourth year of study is dependent on a student obtaining a minimum of 310 credits, no more than one third year subject to be repeated and no second year subjects to be repeated

5.2.2.1 Summary of UP Planning curriculum

In Table 5-5 below it can be seen that within the modules offered as part of the Town and regional Planning (B. Town and Regional Planning) programme, references to GI are limited. The following modules do include elements of GI:

- TPA 110 (Site analysis and assessment) – 16 Credits
- TPS 120 (Principles of settlement design) – 12 credits
- TPA 120 (Settlement analysis and assessment) – 16 credits
- TPS 210 (Settlement design concepts) – 16 credits
- TPU 262 (Land use management practice) -6 credits
- TPW 310 (Institutional and legal structures for planning) -12 credits
- TMS 320 (Transport planning and municipal services provision) – 16 credits
- TPI 451 (Planning interventions Precinct scale) – 12 credits

In terms of transdisciplinarity, the modules that form part of the UP curriculum, and include it to some extent, are:

- Introduction to development planning (TPD 201) – 12 credits
- Land use management theory (TPU 210) – 12 credits
- Settlement design concepts (TPS 210) – 16 credits
- Community based project (JCP 201) – 8 credits
- Municipal development planning (TPD 220) – 2 credits
- Settlement establishment and housing delivery (TPS 220) -16 credits
- Land use management and practice (TPU 262) – 6 credits
- Institutional and legal structures for planning (TPW 310) – 12 credits
- Transport planning and municipal services provision (TMS 320) – 12 credits
- Professional practice (TPR 412) – 6 credits

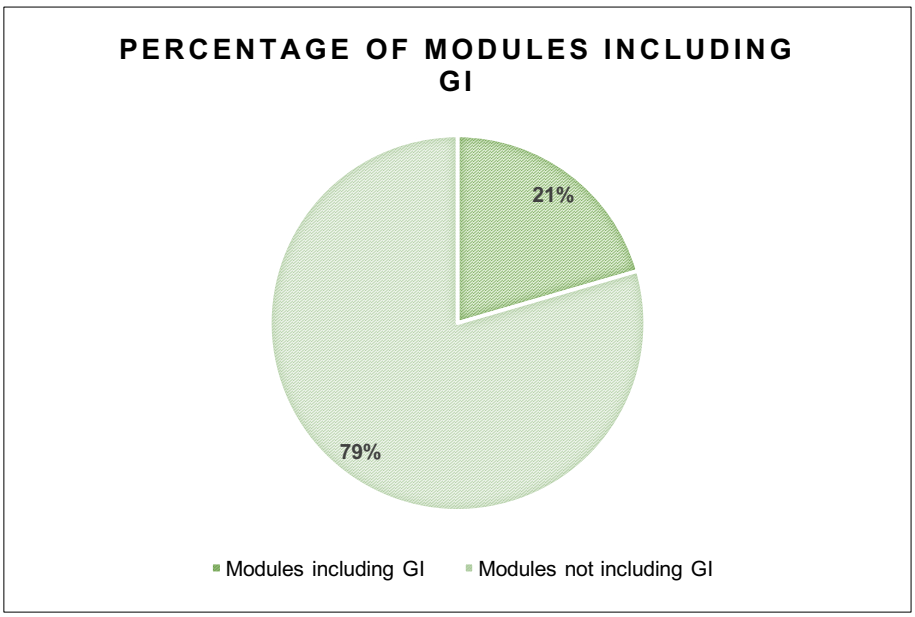
Table 5-5 provides a summary of the evaluation findings.

Table 5-5: Summary of GI and transdisciplinary incorporation in UP planning curriculum

Year of study	Credits per year of study	NQF level	Module code	Extent of GI inclusion	Extent of transdisciplinarity
1	90	5	ALL 123	1	1
			TRP 110		
			TPH 110		
			TPH 120		
			TPA 110	2	
			TPS 120		
			TPA 120		
2	104	6	TPD 210	1	2
			TPU 210		
			TPA 210		1
			JCP 201		2
			TPS 210	2	
			TPU 262		
3	72	7	TPD 310	1	1
			TPS 310		
			TRP 320		
			TPD 320		
			TPW 310	2	
			TMS 321		2
4	98	8	TPI 451	1	1
			TPI 454		
			TPR 410		2
			TPE 410		1
			TPI 452		
			TPE 410		
			POU 720		
			TPI 451	2	
	364				

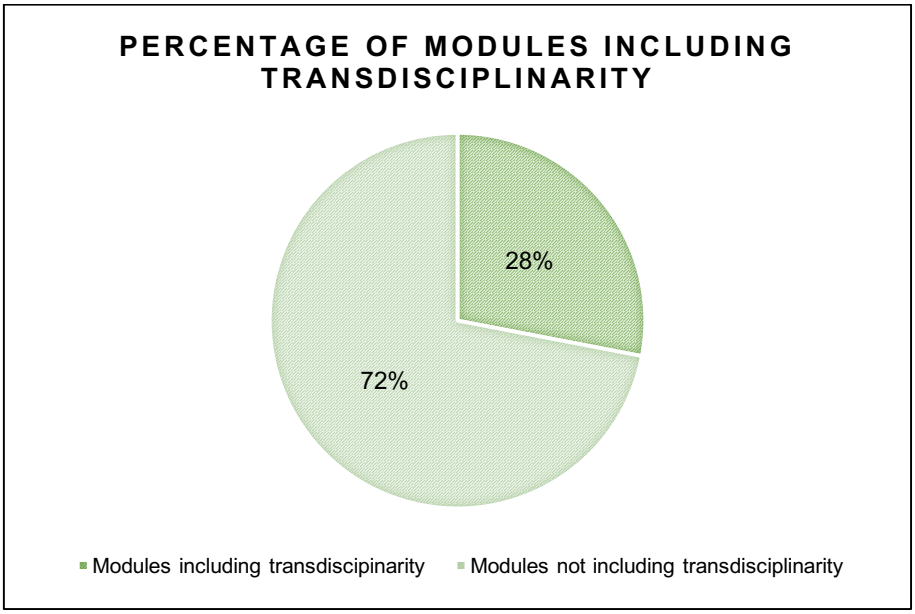
Source: Own construction (2017)

The eight modules which include GI elements make moderate mention of the concept. Accordingly, of the 360 course credits, 106 credits (21% of the curriculum) include references to GI. This is illustrated in Graph 5-3.



Graph 5-3: Representation of modules including GI at UP
Source: Own construction (2017)

Graph 5-4 shows that the 10 modules that were identified during the evaluation amount to 28% of the curriculum including trans-disciplinary elements.



Graph 5-4: Representation of modules including transdisciplinary elements at UP
Source: Own construction (2017)

5.2.3 Evaluation of University of Venda planning curriculum

The following section seeks to evaluate the UNIVEN planning curriculum with regard to its inclusion of GI elements and elements of transdisciplinarity. The Faculty of Natural Sciences yearbook includes the planning curriculum for UNIVEN undergraduates. This planning curriculum is illustrated in Table 5-7. This undergraduate qualification comprises 19 modules. Of these modules, which amount to 328 credits, eight are considered NQF Level 8 modules; four are considered Level 7; three on Level 6; and four on NQF Level 5.

Due to the inclusion of NQF Level 8 modules, this UNIVEN planning qualification allows for graduates' Professional Planner registration.

Table 5-6: UNIVEN planning curriculum evaluation

Year 1							
Module Code	Name	Description/Outcomes	Credits	Prerequisites	NQF level	Extent of GI inclusion	Extent of transdisciplinarity
URP 1541	Introduction to society and planning	Be aware of • The diversity of cultures, space, networks views and ideologies; • The need for an environmentally sensitive orientation to planning; • A people oriented approach top planning.	16	Admission requirements	5	2 • Environmentally sensitive approach	2 • Diversity of cultures • Ideologies
URP 1641	Principles and techniques	• Link the knowledge acquired to social, economic and spatial policies to plans; • Be aware of the three spheres of planning, in addition to political, institutional and techniques of planning; • Be able to understand the techniques for gathering and presenting site and user data; • Understand the techniques for evaluating site potentials.	16	Admission requirements		1	1
URP 1543	Settlement forms and urban history	• Link knowledge to spatial policies and plans; • Be aware of evolution of settlements in environmental planning; • Be aware of the political, legislative, environmental and institutional context of planning; • Sensitivity to the role of the public, politicians, and planners in the field of planning; • Appreciate the roles played by utopians and the role of history/époque in the evolution of built-up areas.	16	Admission requirements		2 • Environmental planning • Environmental context	1
URP 1643	Mathematics for planners	• Strengthen the quantitative skills of new entrants. Appreciation of those areas of planning in which quantitative methods are appropriate and useful; • Understand the use and value of information in planning, policy analysis and decision-making situations; • Become familiar with basic sources of Census Population and Housing data used in planning practice; • Explore concepts of model building including model specification, parameter estimation, and interpretation of results; • Provide a foundation for plan and program	16	URP 1542		1	1

		evaluation through the introduction of Policy Analysis, Program analysis, Benefit-Cost analysis and similar techniques; • Review basic quantitative skills (computation, problem structuring, table interpretation, algebra, etc.); • Develop a working skill with probability concepts and basic statistical methods; • Develop a working skill with Excel spreadsheets.					

Year 2							
Module Code	Name	Description/Outcomes	Credits	Prerequisites	NQF level	Extent of GI inclusion	Extent of transdisciplinarity
URP 2543	Introduction to urban planning	• Understand urban development concepts and dynamics and the variety and forms of interventions for sustainable urban development; • Undertake investigations, analysis and synthesize studies in order to contribute to the preparation and design of plans, formulation of policies within a spatial orientation for implementation; • Be aware of environmental sensitivity.	16	URP 1541	6	2 • Sustainable urban development • Environmental sustainability	1
URP 2641	Rural and regional planning	• Link specific knowledge to spatial plans and policies; • Be aware of the role of the political and institutional context of planning; • Relate spatial development theory to rural and regional development policy and practice.	16	URP 1641		1	1
URP 2644	Planning for infrastructure development	• Link knowledge to spatial policies, basic infrastructure and plans; • Be able to develop criteria for design of basic infrastructure in the spatial context of planning; • Be aware of the role of basic physical and line infrastructure in settlement areas.	16	URP 1641		1	1

Year 3							
Module Code	Name	Description/Outcomes	Credits	Prerequisites	NQF level	Extent of GI inclusion	Extent of transdisciplinarity
URP 3645	Computers in planning	• To operate a CAD program; • Critically evaluate and analyse the raw data for the preparation of plans in the computer; • To convert the information from the research into cadastral data; • To store, retrieve, export, import and be able to present the data in different forms.	16	URP 2642	7	1	1

URP 3644	Planning law	• Understand the moral and ethical framework for planning; • Apply knowledge of institutional and political context of planning to planning legislation and procedures; • Ability to interpret normative principles of planning law for socially and environmentally sensitive decision making.	16	URP 3541		2 • Environmentally sensitive decision making	2 • Legislation and procedures
URP 3546	Urban design	• Investigate, analyse, synthesize planning themes in order to contribute to the preparation of plans; • Develop an environmentally sensitive orientation, • Appreciate efficiency in resource use; • Grasp principles of environmental design and how they apply to new development and redevelopment projects, • Develop concept and detailed design skills; • Prepare technically accurate plans and socially sensitive and relevant proposals; • Understand and act within professional ethics.	16	URP 2542		2 • Environmentally sensitive orientation • Environmental design	1
URP 3646	Research methods for planners	• Appreciate the role/use of collecting, analysis, organization and critical evaluation of information; • Understand and creatively apply theoretical knowledge of the natural and built environments, social, economic, political and developmental environments to the design and management of planned interventions; • Cherish the diversity of views and ideologies; • Understand and act within professional ethics.	16	URP 2643		1	1

Year 4							
Module Code	Name	Description/Outcomes	Credits	Prerequisites	NQF level	Extent of GI inclusion	Extent of transdisciplinarity
URP 4740	Supervised research project	• Collect quantitative and qualitative data, analyse, order and critically evaluate planning information at various levels from supervised scientific research; • Link knowledge to policies and spatial plans; • Synthesize and apply theoretical and conceptual planning knowledge to action; • Make presentation of dissertation and assignments, and projects, etc.	16	URP 3643	8	1	1
URP 4561	Integrated development studies	• Investigate, analyse and synthesize planning themes in order to contribute to preparation of realistic plans; • Link planning proposals to institutional development processes; • Invoke appropriate participatory processes with stakeholders and communities; • Infuse appropriate monitoring and evaluation	16	URP 3543		1	2 • Institutional development • Participatory processes

		mechanisms in plan preparation; • Set targets and realistic budgets for project management; • Grasp the notion of integration in planning activity; • Develop an environmentally sensitive orientation; • Understand and act within professional ethics.					
URP 4562	Professional planning and practice ethics	Act within the moral and ethical framework of planning in terms of: • Social justice and equal opportunity; • Appreciate efficiency in resource use; • Develop an environmentally sensitive orientation; • Understand and act within professional ethics; • Run a planning office efficiently; • Apply knowledge of political and institutional context of planning to a given situation.	16	URP 3542		1	2 • Social justice • Political context
URP 4563	Transportation and energy planning	• To undertake investigations, analysis and design of homes, work places, mobility and transport modes (including their integration) with energy efficiency, reduction of friction and the environment in mind; • Contribute to the preparation and design of plans, formulation of policies touching on Energy use, Mobility, Transportation and Land use within the community; • Understand the synergy between Land uses and Transportation; various transport modes and their efficiency (cost, energy use, etc.); • Be sensitive to the location of land uses (and its density) and impacts on the environment; • Appreciate efficiency in energy uses in all its ramifications (home, work, etc.).	16	URP 3543		1	2 • Formulation of policies • Transportation • Energy use
URP 4564	Discourses in urban and regional planning theory	• Understand and creatively apply theoretical knowledge of the natural and built environments, social, economic, political and developmental environments to the design and management of planned interventions; • Appreciate the diversity of views and ideologies; • Link robust theoretical debate and evaluate their influences to planning practice; • Understand and act within professional ethics.	16	URP 3542		1	1
URP 4661	Case studies in sustainable settlement planning	• To investigate, analyse, synthesize planning themes in order to contribute to the preparation of plans; • Develop an environmentally sensitive orientation; • Appreciate principles responsible for successful best practice cases in sustainable settlement planning; • Adapt best practice cases to improving settlement planning practice in South Africa; • Identify internet sites for research into all aspects of integrated and sustainable settlement planning;	16	URP 3541		1	1

		• Grasp the notion of integration and sustainability in planning; • Understand and act within professional ethics.					
URP 4662	Project design and management	• Identify development needs; • Design development programs or projects; • Understand what a project cycle is and how to implement development programs or projects; • Monitor and control development resources; • Evaluate programs and project outcomes.	16	URP 3644; URP 3645; URP 3546; URP 3646		1	1
URP 4664	Housing studio	• Understand the provision of housing through the price system; • Housing policy frameworks for different housing markets; • Economics of rent control and other tenure system; • Impact of rent control and housing subsidies; • Collect, analyse, synthesize and evaluate of information on property development in order to contribute to preparation of plans; • Understand the interaction between informal and formal processes of housing supply.	16	URP 4543		1	1

Source: Own construction from UNIVEN Yearbook (2016)

5.2.3.1 Summary of UNIVEN planning curriculum

In Table 5-7 below it can be seen that while references to GI are limited, the following modules that are offered as part of the Town and Regional Planning (B. Town and Regional Planning) programme of UNIVEN do include elements of GI:

- URP 1541 (Introduction to society and planning) – 16 credits
- URP 1543 (Settlement forms and urban history) – 16 credits
- URP 2543 (Introduction to urban planning) – 16 credits
- URP 3644 (Planning law) – 16 credits
- URP 3546 (Urban design) – 16 credits

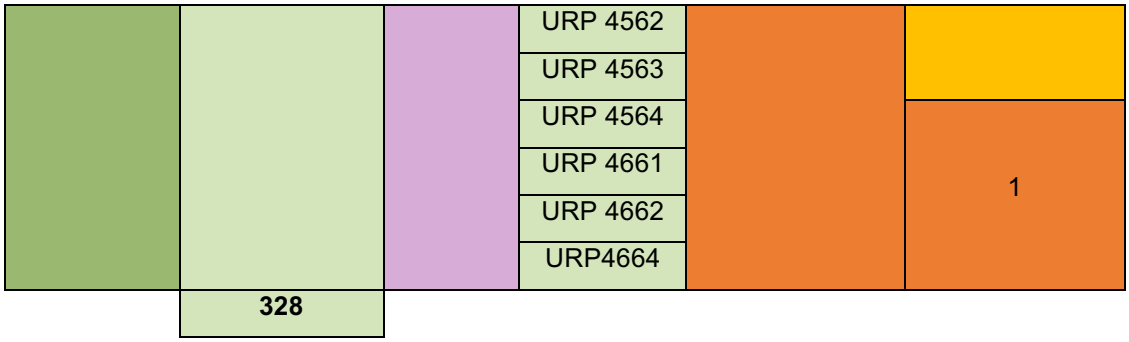
In terms of the inclusion of trans-disciplinary elements, the following modules make reference thereto:

- Introduction to society and planning (URP 1514) – 16 credits
- Planning law (URP 3644) – 16 credits
- Integrated development studies (URP 4561) – 16 credits
- Professional planning and practice ethics (URP 4562) – 16 credits
- Transportation and energy planning (URP 4563) – 16 credits

Table 5-7 below summarises the findings of the evaluation of the UNIVEN planning curricula.

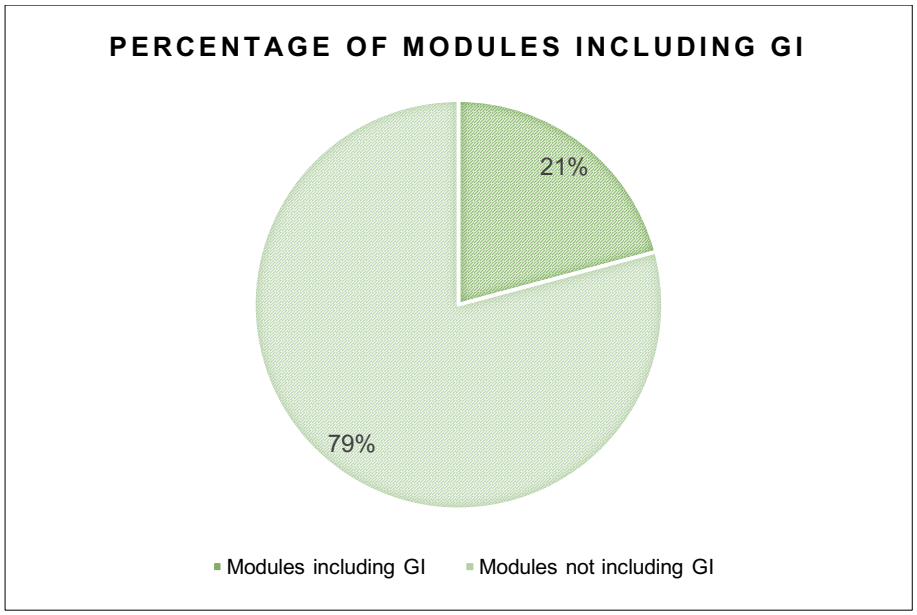
Table 5-7: Summary of GI and transdisciplinary incorporation in UP planning curriculum

Year of study	Credits per year of study	NQF level	Module code	Extent of GI inclusion	Extent of transdisciplinarity
1	64	5	URP 1641	1	2
			URP 1643		1
			URP 1541	2	
			URP 1543		
2	48	6	URP 2641	1	1
			URP 2644		
			URP 2543	2	
3	64	7	URP 3645	1	1
			URP 3646		2
			URP 3644	2	1
			URP 3546		
4	152	8	URP 4740	1	1
			URP 4561		2



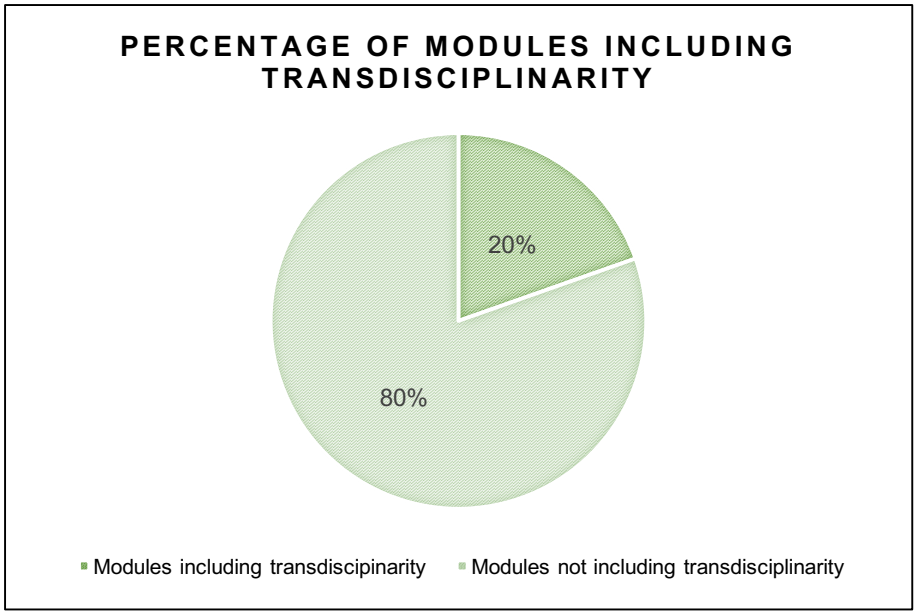
Source: Own construction (2017)

Accordingly, of the 328 course credits, 48 credits (15% of the curriculum) include references to GI. This is illustrated in Graph 5-5 below.



Graph 5-5: Representation of modules including GI at UNIVEN
Source: Own construction (2017)

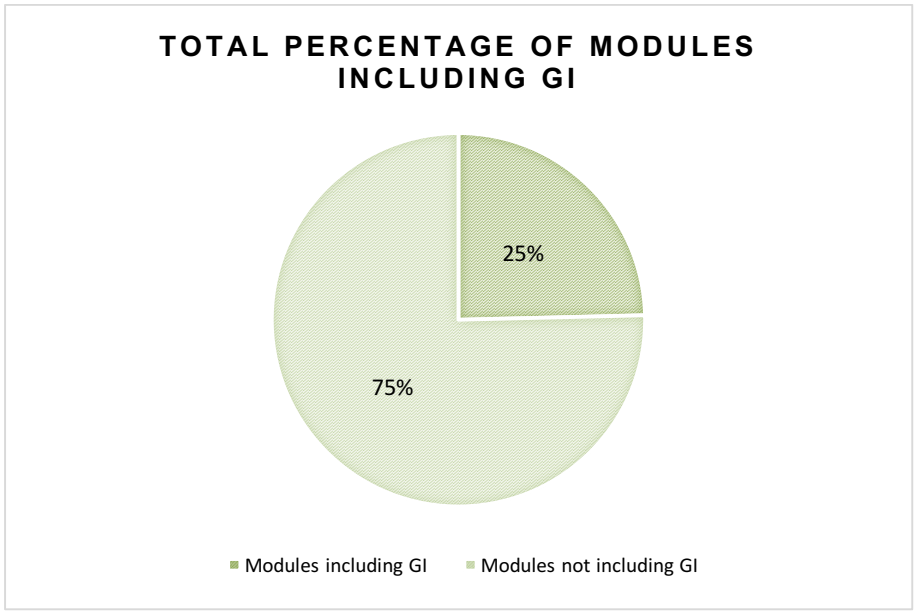
Graph 5-6 shows that five modules include trans-disciplinary elements and amount to 80 credits (20% of the curriculum), identified as modules that include transdisciplinarity to some extent.



Graph 5-6: Representation of modules including transdisciplinary elements at UNIVEN
Source: Own construction (2017)

5.3 Conclusion

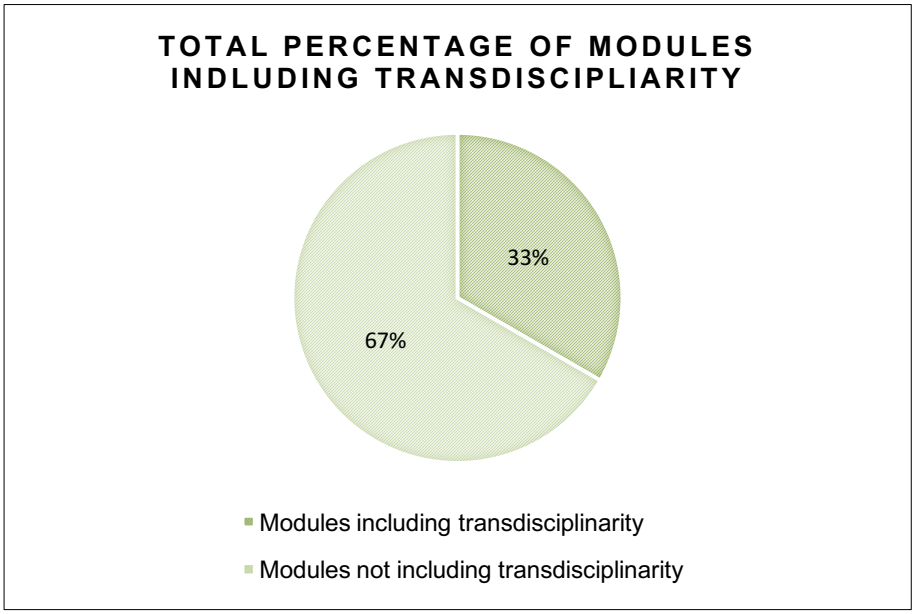
Through the comparison of the yearbooks of the three purposefully selected institutions it is evident that there is limited incorporation of GI in planning curricula, constituting, on average, merely 25% of the total modules, as can be seen on Graph 5-7 below. The SACPLAN competencies report (SACPLAN, 2014b) could contribute in this regard to align different planning curricula and enhance the inclusion of GI in planning programmes, as it makes specific reference to environmental planning and management and stresses the importance of planners having knowledge thereof.



Graph 5-7: Total percentage of modules including GI among selected institutions

Source: Own construction (2017)

Although there are no clear guidelines for the inclusion of transdisciplinary elements as part of planning curricula, planning is considered fundamentally transdisciplinary (c.f. 2.9). The fact that the inclusion of transdisciplinary elements in the curricula of all three planning schools evaluated was found to be very limited (refer to Graph 5-8 below) would suggest that appropriate changes should be made in tertiary planning education.



Graph 5-8: Total percentage of modules including transdisciplinarity among selected institutions
Source: Own construction

The following chapter will evaluate the perspective of planning professionals with regard to the need and importance of including GI as part of planning curricula, based on their own experiences in practice.

CHAPTER 6 – EVALUATION OF CURRENT PRACTICAL GI APPLICATION APPROACHES

6.1 Points of departure

As mentioned in Chapter 1 quantitative research methods were employed for this second phase of the empirical investigation. This chapter aims to answer the following research question:

- To what extent is GI currently being used by planners?

In addition to answering the question above this chapter also attempts to fulfil the following objectives as stated in Chapter 1 (c.f. 1.4):

- To evaluate current application approaches relating to GI in order to outline academic perception and importance of GI;
- To evaluate the current application and implementation of GI in practice by considering viewpoints of purposefully selected professional planners.

Accordingly, the methodology, followed by quantitative investigation research approach and findings will be discussed.

6.2 Methodology employed

The data used in the quantitative empirical investigation were gained by means of a research questionnaire. The questionnaire was compiled by making use of Google Forms in order to ease the circulation thereof among the selected respondents.

Due to the fact that this investigation was reliant on expert perspectives the questionnaire was circulated among purposefully selected practicing planners and 40 completed questionnaires were returned. The purpose of the questionnaire was to capture the viewpoints of planning practitioners on the importance, role and current application of GI in spatial planning practice as well as determine the GI education received by planners at tertiary level.

6.3 Quantitative investigation – Structured questionnaire

6.3.1 Structure of questionnaire

As mentioned in Chapter 1 (c.f. 1.5.2.2.1), the questionnaire consists of four categories. Each of these categories (demographic data, understanding of GI, GI education, application of GI), as well as the questions contained therein and graphic representations of their outcomes, will be discussed in detail in the following sections in this chapter.

6.3.2 Section 1 – Demographic data

The first section of the questionnaire aimed to obtain the demographic data of the purposefully selected respondents. Question 1 (What is your main province of employment?) and Question 2 (What is your main sector of employment?) were asked to determine the location and sector of respondents' current occupation, seeing as it could possibly be an impacting factor on frequency of GI use, linked to municipal-specific policies and legislation, as well as planning frameworks employed in these areas.

As illustrated in Figure 6-1 below, Question 3 consisted of three subsections, each concerning inquiring into general tertiary education. All three of these questions considered the tertiary planning education and the correlation with the understanding of GI among planners.

Question 4 (Which SACPLAN registration applies to you?) was asked to determine whether the respondents' different levels of registration could indicate a variance in knowledge of GI and frequency of GI application in practice. Similar to Question 4, Question 5 (How many years of experience do you have?) was asked to identify a connection between respondents' experience and regularity of GI use.

The conceptual framework of the demographic data is depicted in Figure 6-1, and the findings thereof captured accordingly.

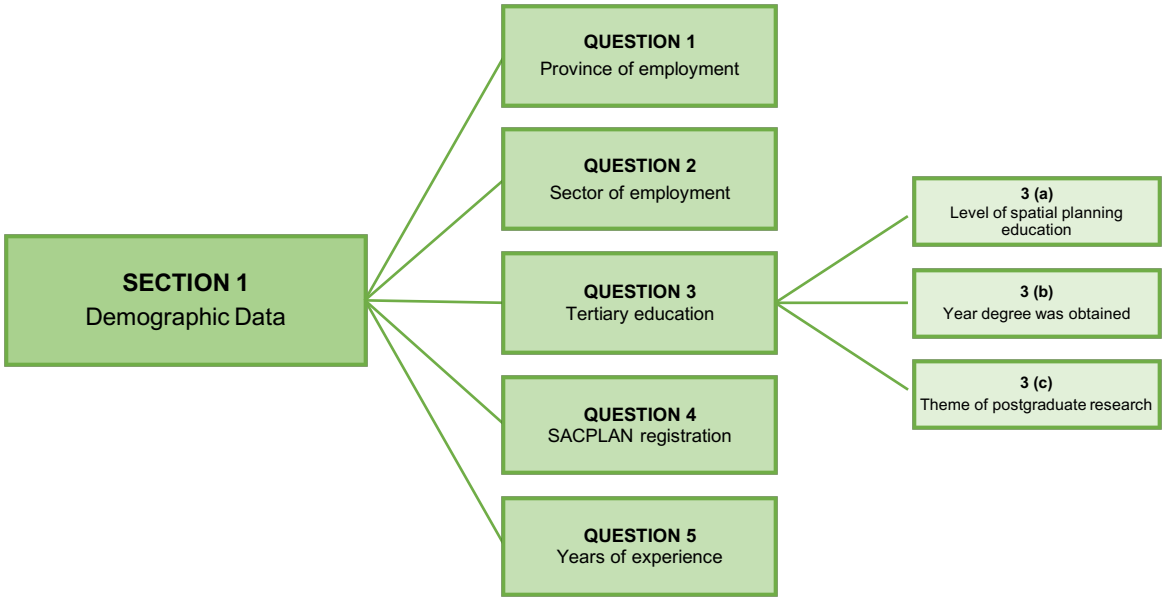
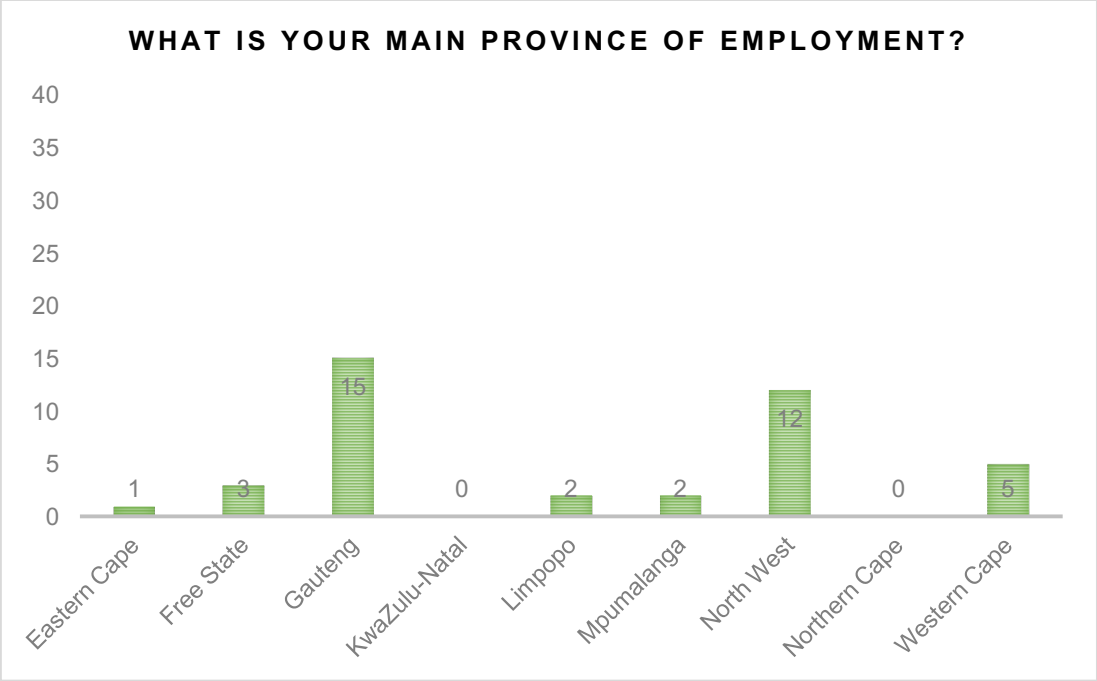


Figure 6-1: Conceptual structure of Section 1 of research questionnaire
Source: Own construction (2017)

6.3.2.1 Respondents' main province of employment

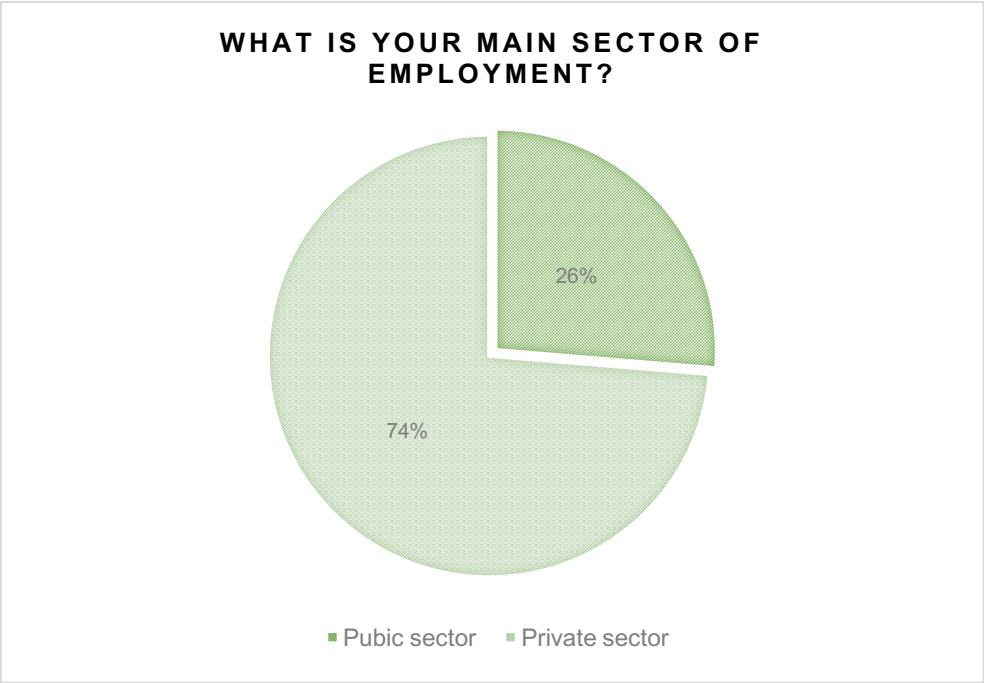
Graph 6-1 below shows the location of the respondents' main province of employment. It can be seen that the sample of 40 planners represented, 7 provinces. The graph indicates that the majority of the respondents are employed in the Gauteng province. Since all provinces are not represented in the sample of respondents, this could be considered a limitation of this research.



Graph 6-1: Representatives from each province
Source: Own construction from questionnaire data (2017)

6.3.2.2 Respondents'' main sector of employment

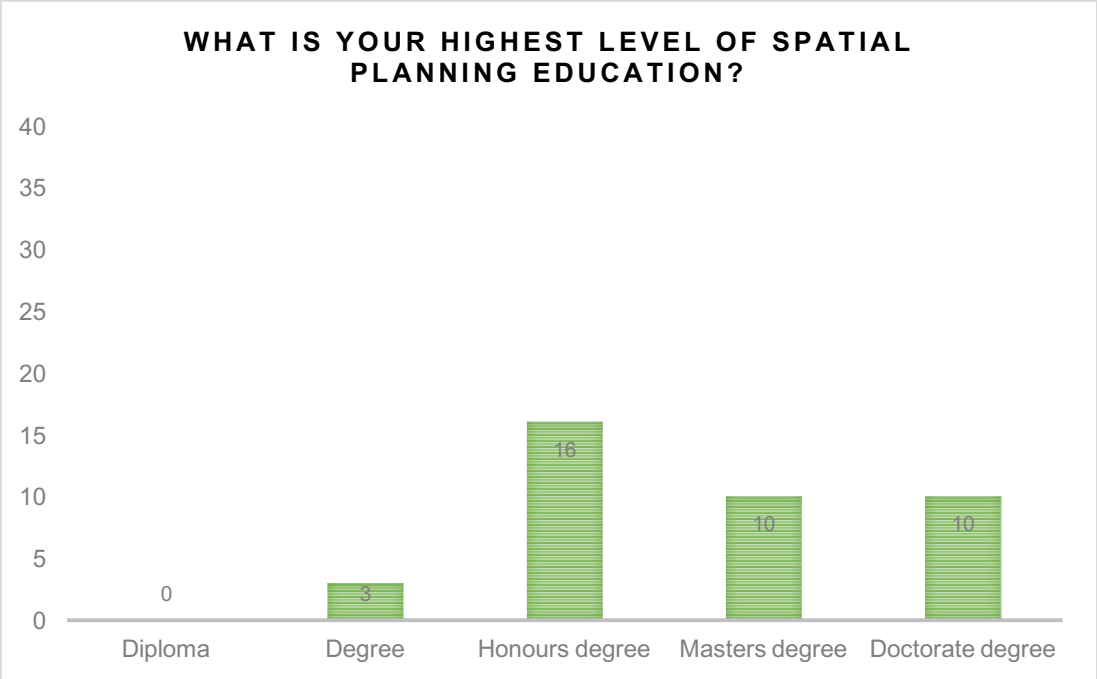
Of the 40 respondents, 38 indicated a sector of employment. Graph 6-2 visually illustrates the division of employment between the public and private sectors. It can be seen that the majority of the respondents (28) are employed in the private sector, while the remaining 10 respondents are employed in the public sector.



Graph 6-2: Representatives from each sector
Source: Own construction from questionnaire data (2017)

6.3.2.3 Respondents' highest level of spatial planning education

39 respondents indicated their highest level of spatial planning education, illustrated in Graph 6-3. It is evident that the majority of the respondents have honours degrees and another 51.3% post-graduate degrees.

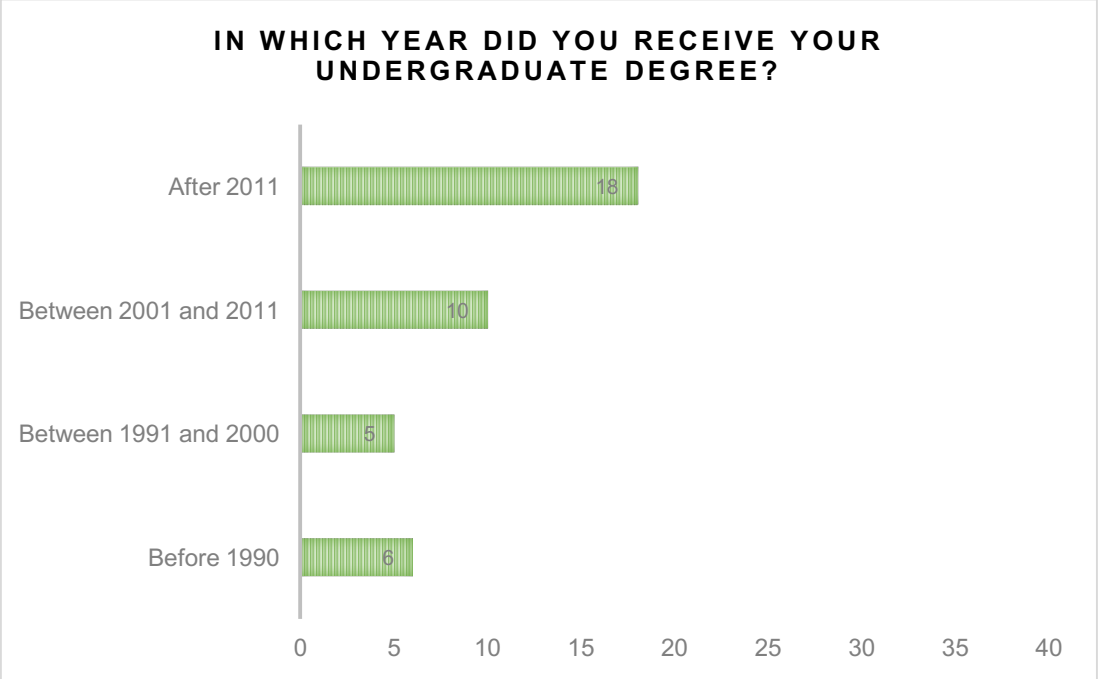


Graph 6-3: Respondents highest level of spatial planning education

Source: Own construction from questionnaire data (2017)

6.3.2.4 Year in which respondents received undergraduate degree

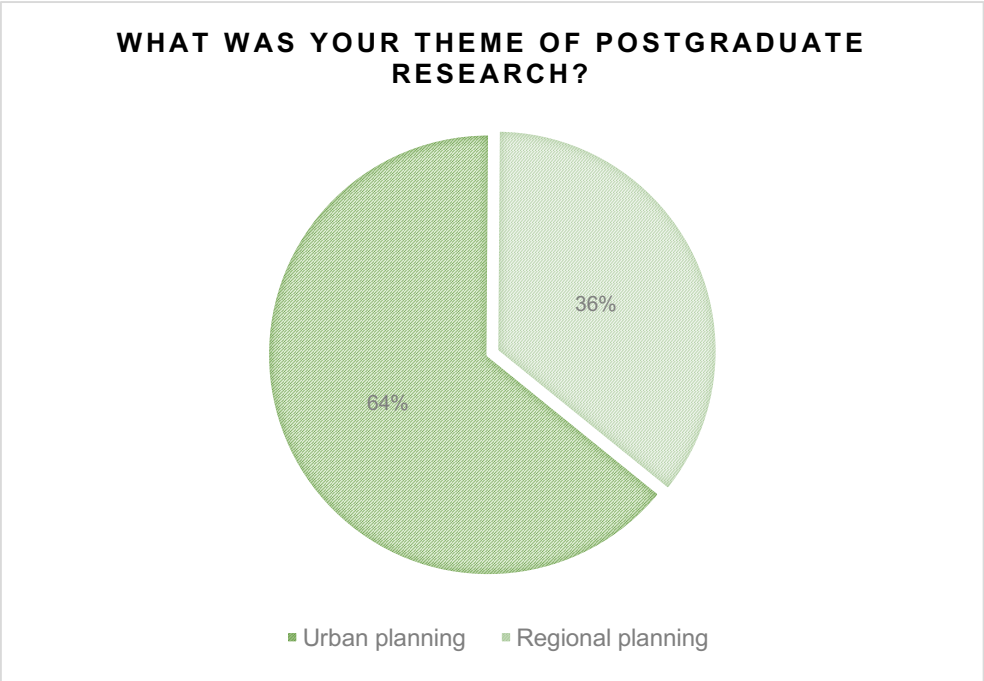
Based upon the observations evident from Graph 6-4 below, it is clear that 46% (18 of the 40 respondents) of respondents obtained undergraduate degrees after 2011.



Graph 6-4: Year in which respondents received undergraduate degrees
Source: Own construction from questionnaire data (2017)

6.3.2.5 Respondents' theme of postgraduate research

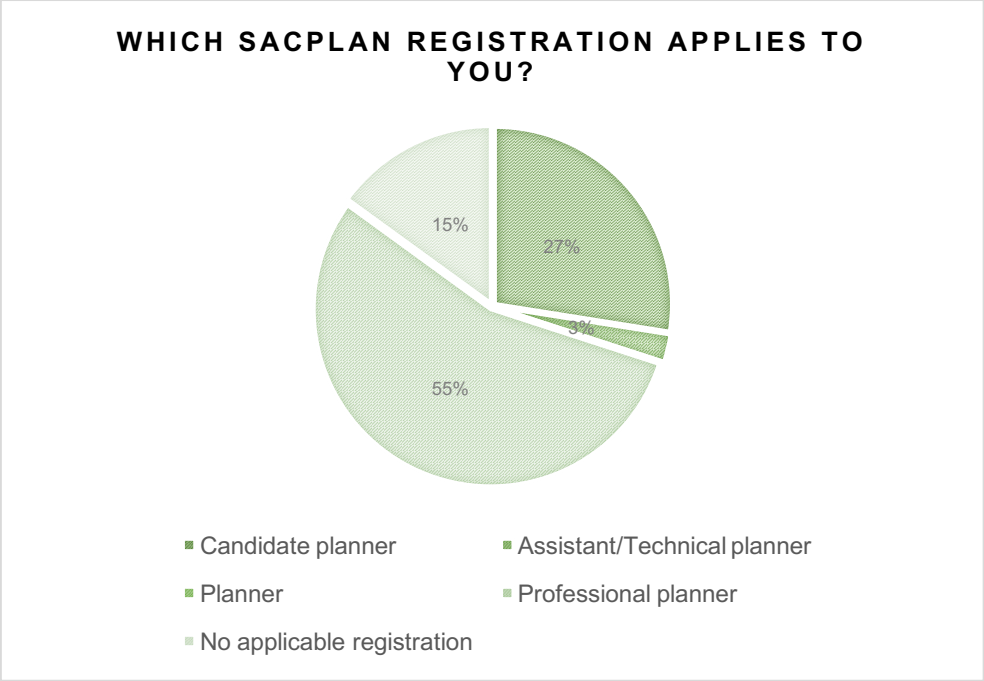
Graph 6-5 shows that, out of the respondents that indicated to have completed postgraduate research, 64% (18 respondents) indicated that their research theme related to urban planning, and 36% indicated that their research topic related to regional planning.



Graph 6-5: Respondents' theme of postgraduate research
Source: Own construction from questionnaire data (2017)

6.3.2.6 Respondents' SACPLAN registration

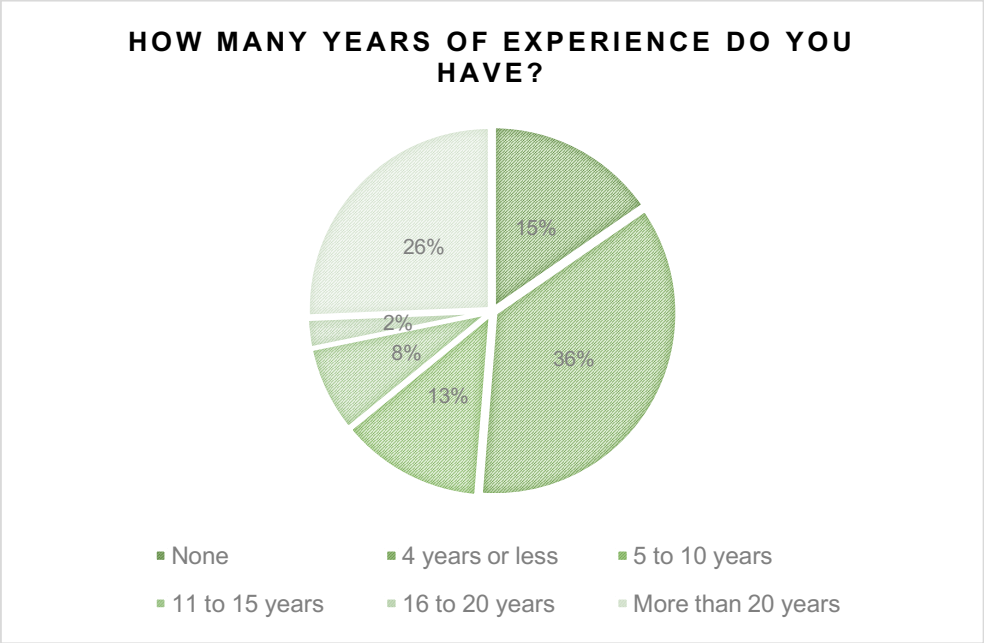
Graph 6-6 shows the category of registration of respective respondents. From the graph, it is clear that most of the respondents are registered as professional planners (55%).



Graph 6-6: Respondents' SACPLAN registration
Source: Own construction from questionnaire data (2017)

6.3.2.7 Respondents' years of experience

Graph 6-7 shows the years of experience of the respective respondents. The graph shows that the majority of the respondents (36%) are planners with less than 4 years of experience. 26% of the respondents have more than 20 years of experience. The remaining categories are none (2%), 5 – 10 years (13%), 11 – 15 years (8%) and 16 – 20 years (15%).



Graph 6-7: Respondents' years of experience
Source: Own construction from questionnaire data (2017)

6.3.3 Section 2 – Understanding of GI

The questions in the second section of the questionnaire were formulated to determine the general understanding of GI among planners. This section consists of two main questions, each of which is divided further into two sub-questions, as can be seen in Figure 6-2 below.

Question 6(a) (Indicate the extent of your understanding of GI) was asked to determine the general understanding of GI among the respondents, while Question 6(b) (Define GI to the best of your knowledge) was asked to determine objectively the respondents' actual knowledge of GI. By making use of this mode of questioning a comparison could be made between the perceived knowledge of GI among planners and their actual understanding thereof.

Question 7(a) (How would you rank the importance of GI within spatial planning?) was asked to gain insight regarding the importance of GI as part of spatial planning approaches, as this could further inform how much emphasis should be placed on GI education approaches. Question 7(b)

(Elaborate on the ranking given in Question 7(a)), was included as a follow-up question to gather additional insight on the significance of GI within the realm of spatial planning.

The conceptual framework of section 2 of the questionnaire is illustrated in Figure 6-2 and the findings thereof discussed accordingly.

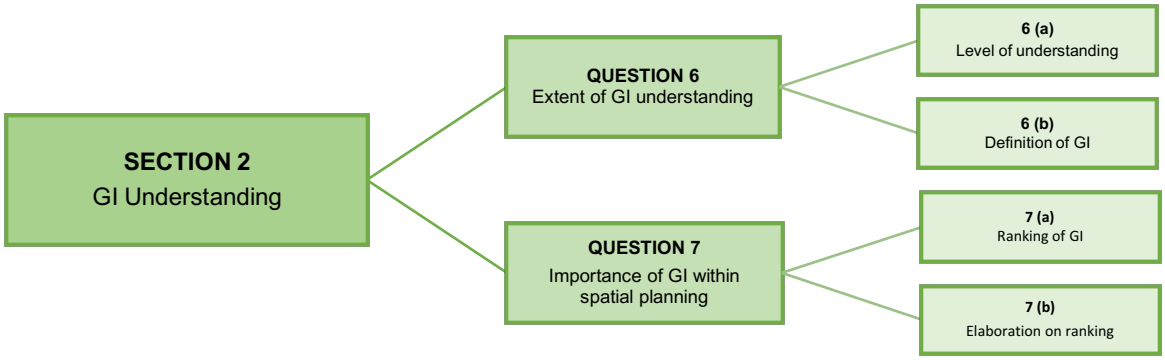
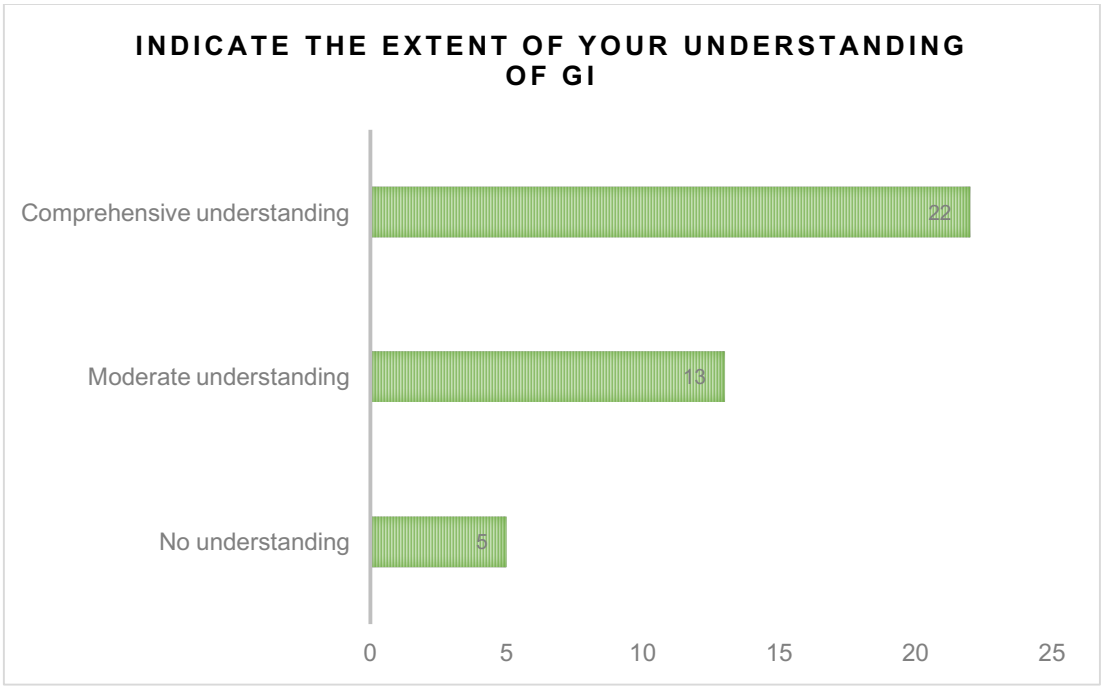


Figure 6-2: Conceptual structure of Section 2 of research questionnaire
Source: Own construction (2017)

6.3.3.1 Respondents' extent of GI understanding

As indicated in Graph 6-8 below, 22 respondents claimed to have a comprehensive understanding of GI. 55% of the respondents professed having a wide-ranging knowledge of GI.



Graph 6-8: Respondents' extent of GI understanding
Source: Own construction from questionnaire data (2017)

6.3.3.2 Respondents' definition of GI

Question 6(b) requested respondents to provide their own definition (interpretation) of GI. Table 6-1 below presents all definitions given. Each of these definitions was compared with the definition of GI formulated in Chapter 3 (c.f. 3.4) for the purpose of this research. Based on the level of correlation with the formulated definition, each respondent's definition was rated on a scale of 1 to 3. A ranking of 1 indicated the lowest correlation and a ranking of 3 indicated a high correlation. For illustrational purposes a corresponding colour is awarded to each rating (Rating 1 – red, Rating 2 – yellow, Rating 3 – green).

Table 6-1: Definitions of GI as provided by respondents

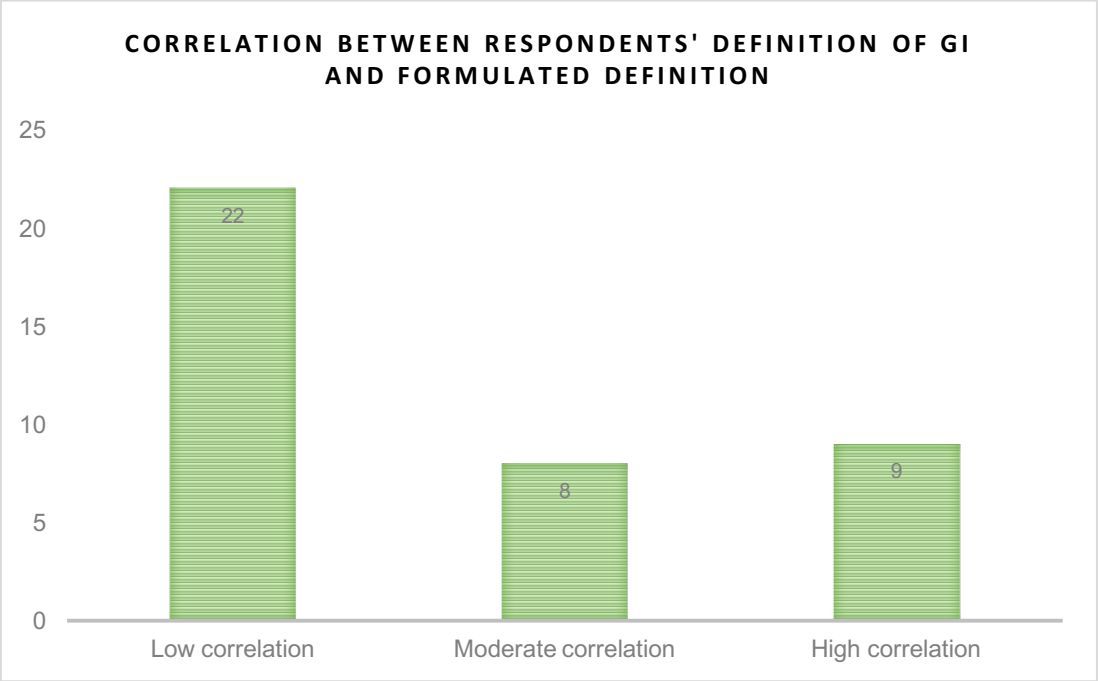
Definition provided by respondent	Rating
Green infrastructure uses the natural environment in a way that it maximises its functions and seeks to put procedures in place to assure the protection of the natural environment in an urban context.	2
Green infrastructure makes use of natural systems (green and blue) to provide ecosystem services as an alternative or in conjunction with grey infrastructure.	2
GI is an approach to more sustainable urban development by making use of green initiatives (such as roof gardens) as opposed to conventional methods. GI takes into account the impact developments have on the environment and attempts to mitigate environmental pressures through small-scale local initiatives	3
GI - Green infrastructure relates to more sustainable infrastructure, i.e. Water saving infrastructure, solar panels, etc.	1
Green infrastructure is an approach to urban planning that aids in the conservation of the environment within a city's borders. For example, water management that protects, restores, or mimics the natural water cycle. Green infrastructure is effective, economical, and enhances community safety and quality of life. It means planting trees and restoring wetlands, rather than building a costly new water treatment plant.	3
GI is an approach to manage and restore some of natural processes and enhancing nature to create healthier and resilient urban environments through a network of naturally functioning ecosystems and the integration thereof into the built environment.	3
Use of natural elements to support grey infrastructure.	1
Sustainable planning of resources, infrastructure and land.	1
Green infrastructure is a network of multi-functional green space, both new and existing, both rural and urban, which supports the natural and ecological processes and is integral to the health and quality of life of sustainable communities.	3
Renewable energy; water scarce technology; low environmental impact and small carbon footprint	1
Infrastructure that reduces carbon emissions	1
Green infrastructure offers a contemporary approach to the conceptualisation and management of landscape resources	1
The conservation of surface runoff.	1
It is a combination of ecosystem services (cleaning water and air, removing rainwater etc.) and ecological infrastructure without which urban systems could not function. It includes open spaces and street trees, water courses and wetlands.	2
GI is the provision of relevant and appropriate infrastructure to the benefit of the community at new and innovative measures. Does not only look at standard provision of green open spaces etc. but also at the provision and of utilization of standard civil infrastructure within the green environment.	2
Green Infrastructure refers to the incorporation/integration of sustainable natural systems/eco systems (may it be water, temperature, botanically, solar orientated) into the built environment.	2
GI makes use of natural (both blue and green) features to deliver ecosystem services with or in the place of grey infrastructure.	1
Infrastructure that supports environmental sustainability.	1
Practice of managing water and weather impacts by building with nature.	1

Environmentally and resource sensitive/neutral, where GI is a 'branded' term trying to steer social conscience left of centre (socio-political), transitioning infrastructure design from a towards zero waste aspiration (environmental) whilst having a nuance of cost saving (financial) for the end user.	3
More sustainable and environmentally friendly alternatives for conventional infrastructure, such as renewable energy etc.	1
Inter-connected / combination of natural and ecological systems comprising open space systems, biodiversity areas, landscapes etc., which in combination through appropriate management provide a service and strategic functions in terms of conservation/protection or a possible economic asset.	3
Integration and accommodation of ecological systems with the urban environment.	2
An approach to harness ecosystem services provided by natural systems to meet some of the service and infrastructure needs of society. GI is the network of ecological features (e.g. trees, plants, wetlands, parks, gardens, and man-made green-grey design solutions such as constructed wetlands and green roofs) that deliver ecosystem services to society for flood attenuation, water purification and control, food production and climate regulation.	3
Infrastructure that is built in order for it to be more sustainable and better for the environment.	1
Designing and building with the natural environment and natural element as much as possible to have the least possible impact on the ecosystem of a particular environment.	1
Green infrastructure is applying natural resources in the best way possible to minimise the usage of electricity by using the sun for solar energy. This helps to promote less spending on electricity in households and by companies.	1
Green infrastructure is a way of saving the environment when developing, and incorporating sustainable development.	1
Ahern et al., (2014:256) define GI as "spatially and functionally integrated systems and networks of protected landscapes supported with protected, artificial and hybrid infrastructures of built landscapes that provide multiple, complementary ecosystems and landscape functions to the public, in support of sustainability" *Benedict and Mc Mahon (2012:3) referring to GI as the "interconnected green-space network (including natural areas and features, public and private conservation land, working lands with conservation values, and other protected open spaces) that is planned and managed for its natural resource values and for the associated benefits to human populations".*	3
Infrastructure that is more ecologically sensitive, and which makes use of clean and alternative sources.	1
In two words: nett zero. No depletion of natural capital, cumulative from individual buildings to total urban areas, including technologies such as off-grid energy, ecological storm water management, water demand management, green building construction, cradle to grave waste management, smart neighbourhoods, etc.	2
Infrastructure that enables and enhances the utilisation and development of green technologies.	1
Infrastructure that preserves the future of the planet	1
The organised set of natural and constructed environmental arrangements, green spaces and other landscape features. It includes planted and indigenous trees, wetlands, parks, green open spaces and original grassland and woodlands, as well as possible building and street level design involvements that incorporate vegetation. Together these resources form an infrastructure network providing services and strategic functions in the same way as traditional grey infrastructure.	3
Since buildings and infrastructure are becoming higher and denser, there is a need for additional green spaces, or innovative green space ideas, to be incorporated within the buildings (on top, around etc.). To enhance public open spaces by planting trees and protecting wetlands.	1
The application of innovative infrastructure that increases the sustainability and resilience of a city.	1
GI refers to green spaces as part of the entire infrastructure of a human settlement, and is usually a link of integrated green spaces that together enhance environmental sustainability in cities.	1

Source: Own construction from questionnaire data (2017)

Graph 6-9 visually illustrates the manner in which the definitions (provided by 39 out of the 40 respondents) captured in the table above correspond to the definition used as barometer for this study.

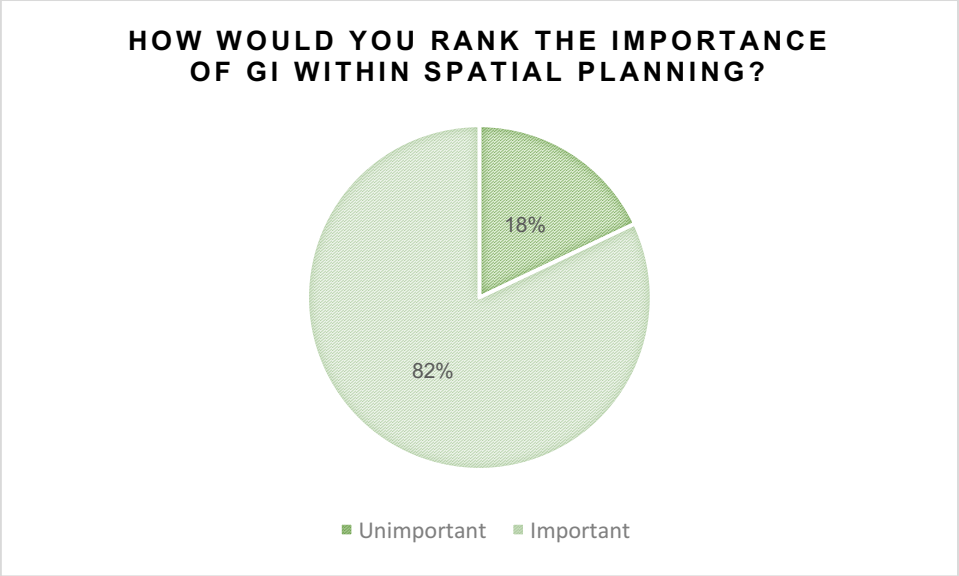
Although the findings from Question 6(a) showed that 55% of respondents claimed to have a comprehensive knowledge of GI, only 9 provided definitions that were rated as rating 3, indicating a high level of correlation with the formulated definition. This finding confirms that there is in fact a misconception of GI among planners since 22 of the respondents provided a low correlation definition, implying these stakeholders do not comprehend the concept of GI. This contradicts the findings of 6.2.3.1 where 55% respondents claimed to have a comprehensive understanding.



Graph 6-9: Correlation between respondents' definition of GI and formulated definition
Source: Own construction from questionnaire data (2017)

6.3.3.3 Importance of GI within spatial planning

Graph 6-10 clearly shows that the majority of the respondents (82% in total) regard GI as important within spatial planning.



Graph 6-10: Importance of GI within spatial planning
Source: Own construction from questionnaire data (2017)

6.3.3.4 Explanation on respondents' opinions on importance of GI within spatial planning

To gain further insight into the respondents' perspective of the importance of GI within spatial planning (as captured in Question 7(a)), respondents were asked to elaborate on the ranking given. The explanations on the elaboration are captured in Table 6-2 below and are included in this section to gain a greater perspective on how planners believe GI should fit into spatial planning.

Table 6-2: Elaboration on ranking given at Question 7(a)

Elaboration on ranking given at Question 7(a)
GI is an important consideration and knowledge area in spatial planning as GI networks must be planned, accommodated and integrated in planning decisions.
Sustainable development is often seen as having large input costs, whereas smaller initiatives such as GI could ultimately make a large contribution to long-term sustainability.
The normal sustainability triangle leads us to think that the economy, environment and society are intertwined when, in fact, the economy and society are reliant on the environment and the environment should therefore receive attention to benefit the economy and society in the long run.
It is of importance to note, however, it is an expensive approach to planning and could fail when these methods are to be implemented in lower cost residential areas. As the money would rather be better allocated to more servicing options or even community amenities.
It embraces sustainable urban forms and quality of life concepts that are the core focus of spatial planning
To support urban sustainability and resilience.
In a water scarce country, planning for sustainable use of water is very important. With regard to electricity and the current instability, with regard to current energy resources, sustainable sources and utilization thereof, it is also important in the long term as well as from day-to-day. In order to protect high potential agricultural land, urban development should also be guided and planned for sustainability.
Sustainable environmental planning, development and management revolves around the intelligent management and utilisation of GI for the benefit of the current generation without compromising future generations' ability to enjoy the same benefits if not more from our planetary resource boundary limitations.
What is planned and allowed in terms of land use plays a determining role in the application; restriction and encouraging of GI.

The carbon footprint of cities is not a major contributor to climate change.
It is part of the red book prescriptions, but is not as important as sewerage and road planning.
Without the services provided by green infrastructure people cannot survive.
The standard thinking of GI needs to be addressed as a new planning phenomenon with new challenges and a new platform set for rethinking the provision of and implementation of GI within an urban environment.
As all things in planning, we need to strike a balance.
Spatial planning is vital to the implementation of GI.
Spatial planning encompasses strategic forward planning. Environmental resilience of regions will become non-negotiable. Planning must therefore be proactive in this regard.
Important in the 'man and biosphere approach' to spatial planning, difficult to reintroduce when gone and, as such, protection is needed for future impacts.
Need to be future ready.
More on the engineering side of development. Although planners can include the "idea/plan" of such infrastructure in a development, the financial feasibility and engineering (the exact specifications of the type of infrastructure that suite the specific environment/region) is determined by someone other than the planner.
Integration of GI in spatial planning as an amenity element, structuring element, economic element and conservation/ protection element.
As part of God's creation, Man's command is to rule over the earth, which means that he must respect and preserve creation as ruler of creation - with the clear emphasis that creation is not greater than humanity.
The provision of basic municipal services is critical to any high density development for primary service delivery. GI would be used to support basic and bulk service provision and will depend on the natural environment, population numbers and finances for the implementation of such systems. The long term maintenance, monitoring and implementation to connect Green Infrastructure into a network will be necessary. Proving the financial cost or benefit will be interesting.
I think that planners should focus on providing sustainable solutions to spatial planning. We need to look after our environment and therefore need to look at alternative solutions to problems.
It is important because it helps people spend less on what they are already spending on.
GI can benefit the environment and our way of life.
GI is mostly known for multi-functionality, as it moves past human control and the boundaries thereof.
Offers opportunity to balance social, economic and environmental needs.
We cannot continue the way we are: grey infrastructure and building approach. It just is not sustainable. We have to change to green design and a circular economy.
I think it should be considered as important, but as things stand it is not really considered as an integral part of spatial planning.
Preservation and re-use is better than more waste.
It creates general awareness of pollution, increases water tables by rainwater not going to waste, reduces floods, creates a more positive light environment, etc.
A wetland should be protected by not building within the restricted area even though clients require more units. The municipality and environmental departments should remain strict about this concept.
Sustainability and urban resilience are growing themes in the academia and public sector entities. Integrating the differing paradigms of green infrastructure inherent to various disciplines involved in planning is the challenge to efficient implementation of GI.
Planning for green spaces is often ignored in the spatial planning for settlements. GI provides an enhanced focus and guidance in doing this in current days.
Important to contribute towards urban sustainability.
There are existing natural service areas, for example swamp lands, within a region that provide important services in the natural environment. These natural services must be utilized and protected when designing sustainable developments.

Source: Own construction from questionnaire data (2017)

6.3.4 Section 3 – GI education

The data obtained from Question 8 (To what extent was GI included as part of your tertiary education?) were regarded as a basic indicator of education regarding GI at tertiary level within spatial planning curricula.

Question 9 and its sub-questions were formulated to assess the needs and to make possible recommendations on improving training and education initiatives regarding GI at tertiary level. Question 9(a) (Do you feel there is a need to improve tertiary education regarding GI?) was asked to establish whether already practising planners are of the opinion that there is a gap in GI education that needs to be addressed. Since Question 9(a) was a 'Yes/No' question, Question 9(b) (Please elaborate on the answer given in Question 9(a)) was asked to understand better respondents' viewpoints on why they deemed an improvement of GI education necessary, as well as to gain insight on how this improvement could possibly be made.

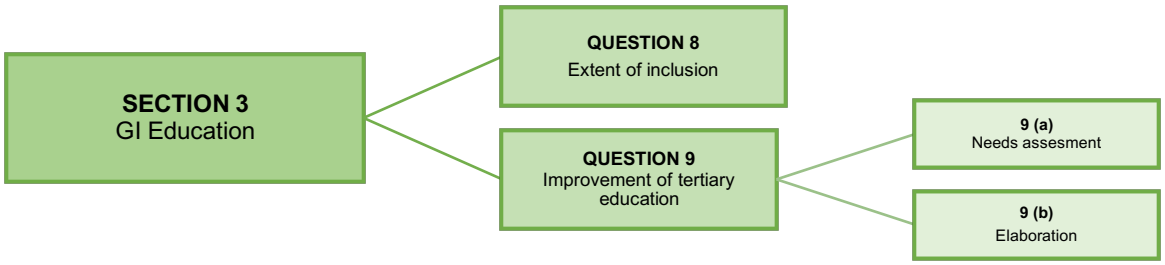
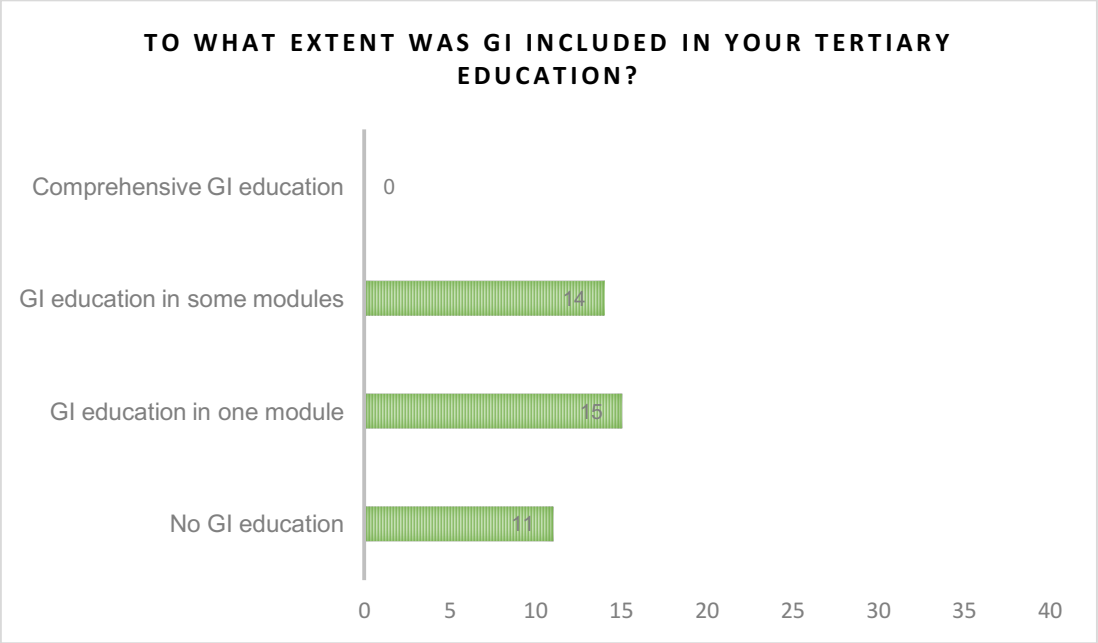


Figure 6-3: Conceptual structure of Section 3 of research questionnaire
Source: Own construction (2017)

6.3.4.1 Extent of GI inclusion in respondents' tertiary education

Graph 6-11 shows that 29 respondents received some form of GI education. Only 14 respondents received education that included GI in some modules. 15 respondents' education included GI in only one module at tertiary level. Further, it can be see that none of the respondents received comprehensive GI education, which could undermine the successful application of GI. This further emphasises the lack of GI education at the tertiary level.

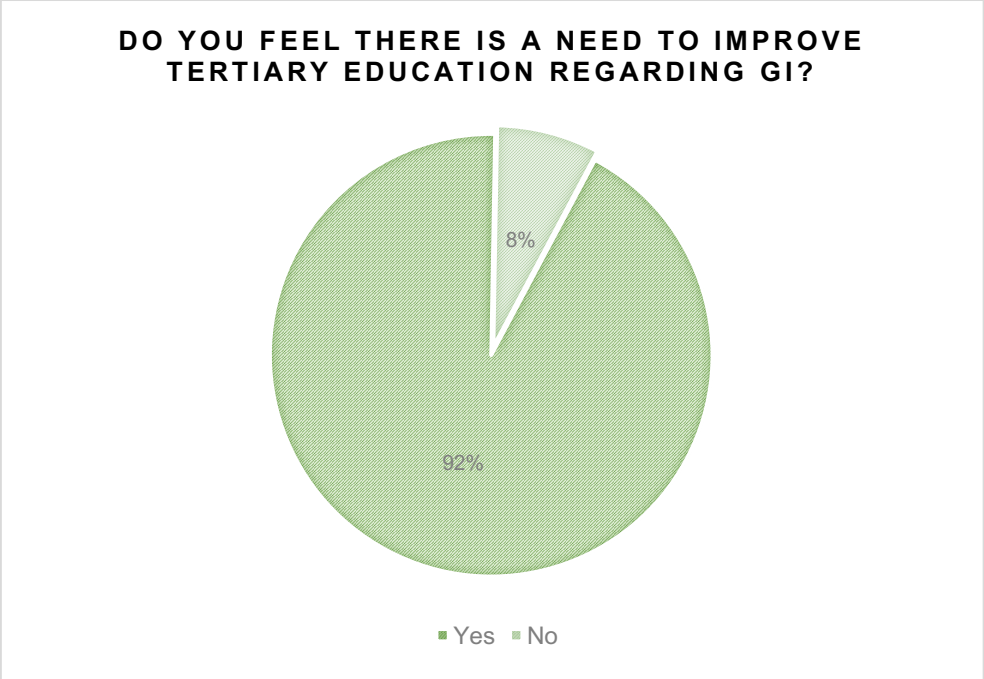


Graph 6-11: Extent of GI inclusion in respondents' tertiary planning education
Source: Own construction from questionnaire data (2017)

6.3.4.2 Need to improve tertiary education regarding GI

While the empirical data gathered thus far indicate that there is indeed a lack of tertiary education regarding GI, Question 11 was asked to establish the respondents view thereof and if they would opt for improvement of tertiary education regarding GI.

It is apparent from Graph 6-12 below that, in general, there is a need to improve GI education at tertiary level, since 92% of respondents were of the that opinion.



Graph 6-12: Need for improvement of tertiary education regarding GI
Source: Own construction from questionnaire data (2017)

6.3.4.3 Elaboration on need for tertiary education regarding GI

In addition to asking whether respondents felt that there is a need to improve tertiary GI education, respondents were also asked to elaborate on their answers. The elaborations are captured in the tables below. Table 6-3 contains comments by respondents who felt that there is a need to improve tertiary GI education.

Table 6-3: Elaboration on agreement with Question 9(a)

Elaboration on agreement with Question 9(a)
The essential role of GI in planning is unclear and has not been successfully explored within tertiary education or academic research. This definitely requires further study, particularly in the case of specific approaches, since there is a lack of standard guidance for doing so. I believe that academics must focus more on local studies within the South African context that will address this issue.
GI should be included either in a branch of civil engineering modules or as a module on its own.
Very little attention is given to a tool that all planners should be aware of - small efforts within large developments could reap countless benefits - of which most planners are not informed about.
Since South Africa is not making extensive use of GI, it will not be a field picked up after studying. It is rather a field that should be mastered whilst studying to ensure that the students become the change once they enter the workplace.
The world is changing and cities are becoming the norm for where people live, so why not plan accordingly and provide a better living environment.
It would help urban planners to solve urban and climatic challenges by building with nature. In essence, a natural ecosystem is a spatial element.
Important mind-shift to traditional approaches of city planning.
Yes, as some to no practical implementation skills are provided on an educational level, the practical implementation in the work place fades to the background and no meaningful difference can be made by planners.
In my training it was a mixture of GI from global, national, and regional to local level. This I believe is a good approach to ensure that policy and theory are reduced to practice, application and project interventions.

With limited resources; an increase in population and urbanisation; and an environment in distress, it is a planning imperative regardless of the conventions; agenda's and policies applicable.
The role of green infrastructure in dealing with one of the major issues facing the planet - global warming - is absolutely critical.
The whole planning environment has changed in the last 20 years. Planning needs to be rethought and remodelled to keep up with latest international principles and doctrine.
Current planning education is extremely lacking - not addressing practical and implementable tools for planners to distinct themselves in the built environment. Green Infrastructure could be a tool that distinguishes planners from other professions.
GI should be covered with the same attention given to traditional grey infrastructure planning.
Although not exclusive, the man and biosphere approach to spatial planning should be taught to introduce sustainable development principles and practice.
Including a full understanding of asset management and infrastructure spending and budgeting within local authorities. The crux lies in being able to influence the change management/transition from business as usual to future state and what role the current infrastructure asset will play in this exit strategy, use and 'green' aspiration.
I consider it important that Planners take back their original role meaning that environmental consultants and the processes linked to EIA's currently dominate land use planning which resulted from irresponsible town planners in terms GI in the past i.e. 1970-80's. This dual system paralyses the economy of the country and causes unnecessary red tape- with responsible land use, planning these two processes can be consolidated into one streamlined process.
It will be important to position GI in a profession (town planning, engineering or environmental) which will be able to give effect to the implementation of such systems. On a tertiary level I would be more interested in legislative measures that necessitate the implementation of GI. Otherwise, it will remain a "nice to have" subject. I will also be interested in how to measure the success, financial costs and savings of GI.
I think it is important to start implementing a module on GI from the first year of tertiary education. The sooner we as planners start thinking about "thinking green" the better.
The future is green infrastructure and the world is moving to a more sustainable approach to living. Green Infrastructure would form the core of this approach to living. But the teaching of GI should not be limited to tertiary education, but should be taught in secondary and primary levels of education also.
Well, I think don't think planners apply GI when they start working otherwise a number of improvements would have already been placed in South Africa.
It is necessary to inform people about it, otherwise there will be no sustainable development taking place because nobody is aware of GI.
A ground-breaking conceptual underpinning for GI planning integration is resilience thinking.
Irrespective of "green infrastructure", there exists a total lack in planning education in respect of bulk- and link- infrastructure planning and design.
As far as I know, GI has been included in planning courses but I get the idea that it is being covered very superficially. I cannot say for sure because I do not have close contact with any planning school currently.
The reason why it doesn't feature in current planning practices and considerations is probably because the importance thereof and how it links to spatial planning is not instilled as part of one's tertiary education.
There is a need to update current information because it is a concept that is more practiced in SA the last few years.
I have a vague background on what it is, and what I learned at University - but I think we should incorporate this in our daily practice and have practical examples within the borders of South Africa - which we can relate to.
Urban sustainability and resilience is growing in importance.
The only time I had to do with GI was when I had to do my own research on it for my master's degree - I am aware that a undergraduate module that include GI started after I finished my studies, however, if GI is to be included in the future of spatial planning in SA, it needs to be included more in education from an early stage.
In general I believe more can be done at tertiary education level to communicate the importance of developing sustainable regions and cities.

Source: Own construction from questionnaire data (2017)

Comments made by respondents who were of the opinion that GI education should not be improved are captured in Table 6-4.

Table 6-4: Elaboration on disagreement with Question 9(a)

Elaboration on disagreement with Question 9(a)
There is proof that the science on which climate change is based is inaccurate.
The red book prescriptions are sufficient.
Planners only need to know what GI is and that it can potentially be implemented in the development. Again, financial and engineering elements have to be considered, which are not part of the planners' scope of work.
To a certain extent GI education can be viewed as a specialized field. Keep in mind there are a number of management tools inclusive of norms and standards available. Spatial planning remains a multi-sector approach which requires specialist inputs.

Source: Own construction from questionnaire data (2017)

6.3.5 Section 4 – Application of GI

The fourth and final section of the questionnaire concerns the application of GI. Figure 6-4 below shows that this section consists of three questions, two of which are each further divided into multiple sub-questions.

Question 10 (What is your frequency of GI use as practitioner?) considered regularity of GI use among respondents. Question 12(a) was asked in order to determine general use of GI in practice among the respondents. The main purpose of Question 12(b) was to determine the correlation between the practical application of GI and what is being taught at tertiary level. This question is linked to Question 10 in Section 3 of the questionnaire. With the data gathered from both Questions 10 and 12(b) recommendations will be made regarding education of GI based on how it is being applied in practice.

Question 13 (Was the GI education you received at tertiary level sufficient in comparison with the frequency of its use?) is asked supplementary to the previous questions discussed. This question is also asked in order to make recommendations regarding GI education.

To comprehend better the respondents' perspective of the need for improved GI education, Question 14 (A more comprehensive education regarding GI would lead to an increase in the frequency of its use) was posed and respondents' could either agree or disagree with this statement.

While the previous section of the questionnaire assessed the needs of planners in terms of tertiary education, Question 15 was included as part of the questionnaire to determine the needs of already practising planners and their education in GI. Respondents could either agree or disagree with Question 15(a) (There is a need to educate practicing planners to improve their understanding of GI) and state reasons for agreement by answering Question 15(b) (If you agreed

with the statement at Question 15(a), please suggest ways in which you would improve the understanding of GI among practicing planners). If respondents disagreed with Question 15(a) the follow-up question was Question 15(c) (If you disagreed with the statement at Question 15(a), please state why.) Figure 6-4 below illustrates this section conceptually.

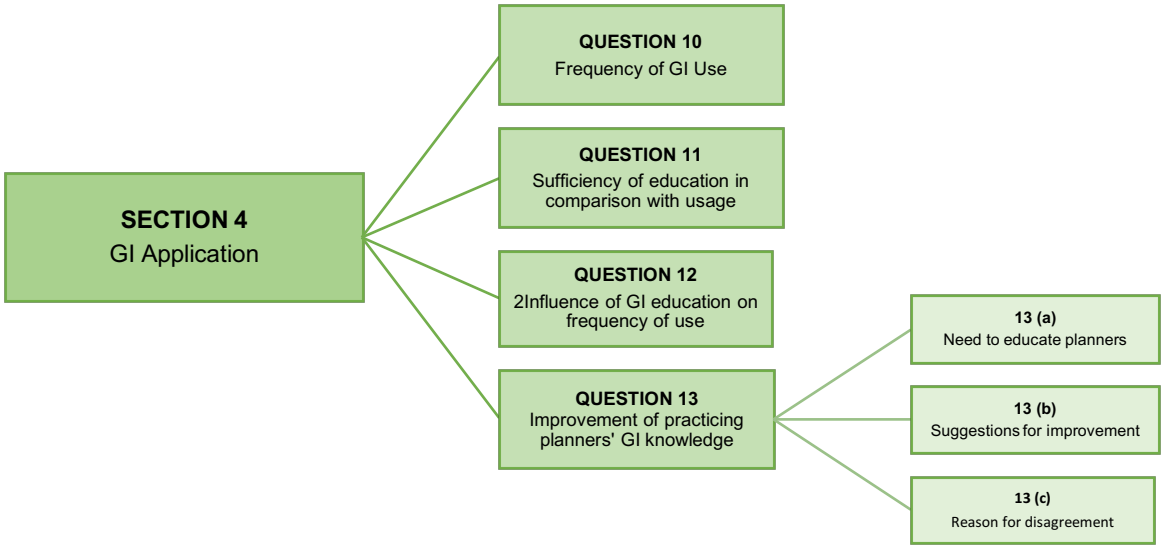
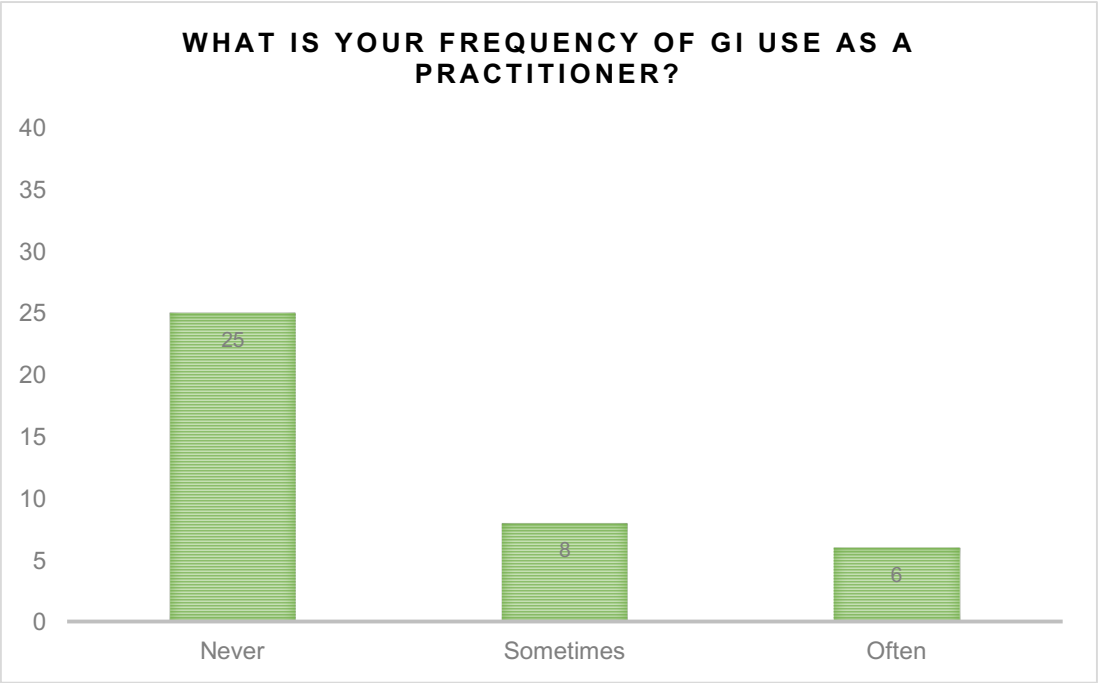


Figure 6-4: Conceptual structure of Section 4 of research questionnaire
Source: Own construction (2017)

6.3.5.1 Respondents' frequency of GI use

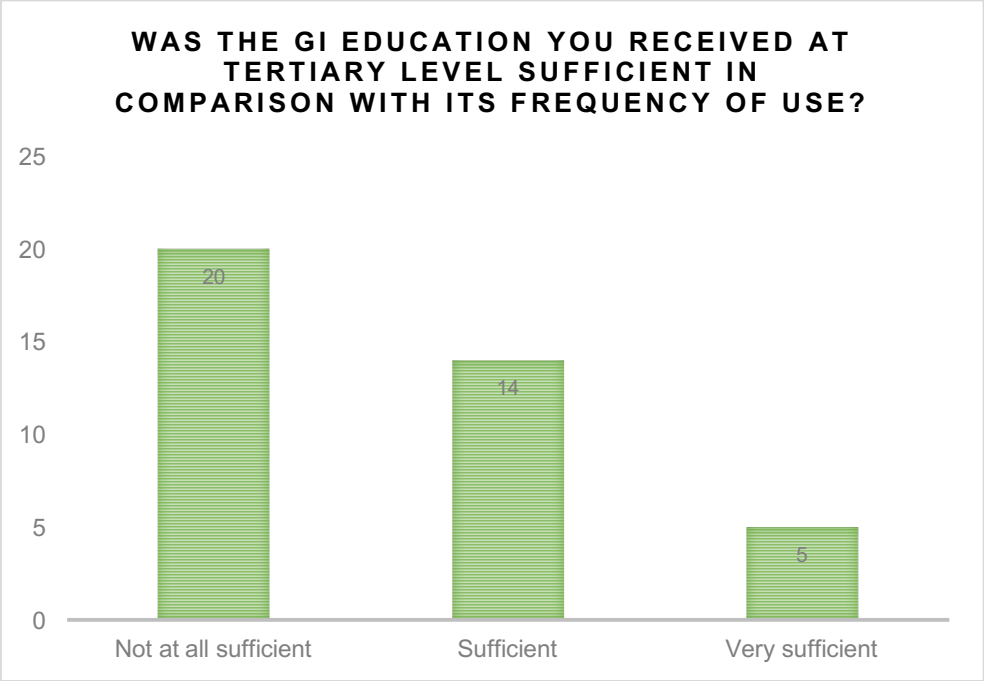
Although the data from Question 8(a) clearly show that GI is regarded as important within spatial planning, Graph 6-13 indicates that the majority of the respondents (62,5% of the respondents) never make use of GI. In addition to not receiving sufficient education on the subject, this lack of use could also be due to the misconception that planners have of what constitutes GI.



Graph 6-13: Respondents' frequency of GI use
Source: Own construction from questionnaire data (2017)

6.3.5.2 Sufficiency of respondents' GI education received in comparison with use

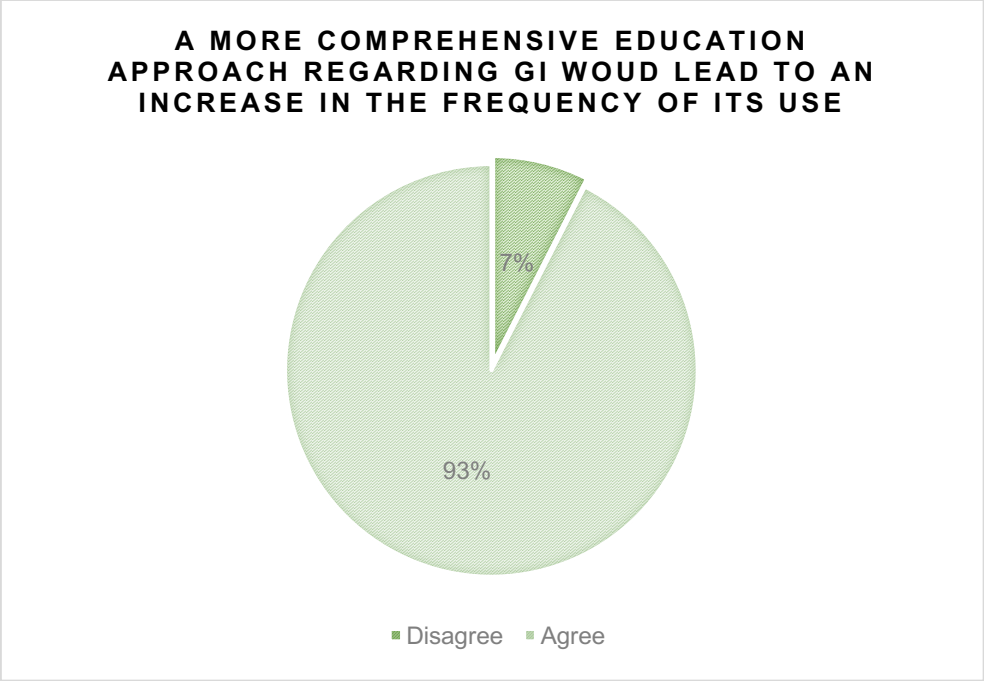
Graph 6-14 indicates that the general opinion amongst the respondents is that the GI education that was received is not sufficient, regardless of frequency of use.



Graph 6-14: Sufficiency of respondents' GI education received in comparison with use
Source: Own construction from questionnaire data (2017)

6.3.5.3 Influence of comprehensiveness of GI education on frequency of its use

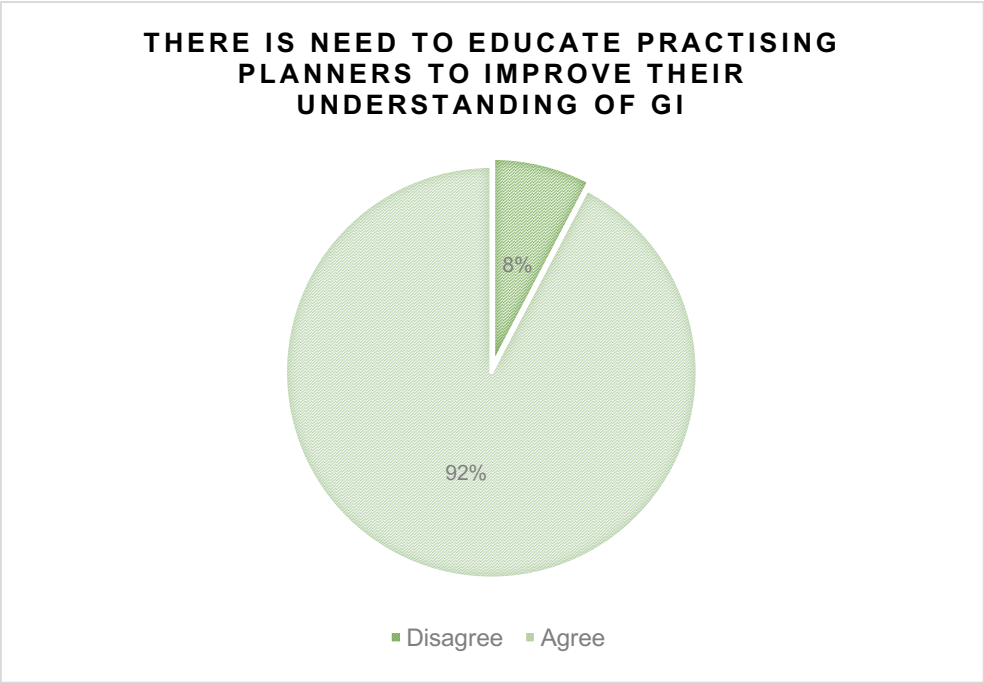
As shown in Graph 6-15 below, the vast majority of the respondents agree with the statement that more comprehensive education on GI would lead to an increase in the frequency of its use. This finding shows that there is need to improve GI education in order to enhance its application in practice.



Graph 6-15: Influence of comprehensiveness of GI education on frequency of its use
Source: Own construction from questionnaire data (2017)

6.3.5.4 Need to educate practising planners to improve their GI understanding

Considering all the questions discussed in this chapter, it is evident that there is a lack of tertiary education regarding GI. Graph 6-16 shows that the lack of GI education is not only limited to the need to improve tertiary education but there is also a need to educate practising planners to improve their knowledge of GI. 36 respondents agreed with the statement made in Question 15(a).



Graph 6-16: Need to educate practising planners to improve their GI understanding
Source: Own construction from questionnaire data (2017)

6.3.5.5 Suggestions for improving GI understanding among practising planners

Question 15(b) was asked to allow respondents to make suggestions on ways to improve the GI knowledge of practising planners. All the suggestions are captured in Table 6-5 below. These suggestions will serve as a point of departure for recommendations to be made regarding continuous professional development concerning GI.

Table 6-5: Suggestions for improvement of GI understanding among practising planners as made by respondents

Suggestions for improving GI knowledge of practising planners
Planners must start looking at the South African approach to GI planning, specifically with respect to the role of state and non-state role players, in facilitating the successful development and implementation of such an approach. A conference on the subject of GI is also not a bad idea.
Training, workshops, lectures.
As part of CPD of SACPLAN members, a short course in GI could help practising planners to incorporate such measures into developments.
It should form a more integral part of SDFS and IDPS. It should be discussed at workshops. An active Facebook account could also assist in this regard.
Provide short courses that would improve their knowledge on GI, however, it will not solve the problem as many planners are set in their ways
Design a training course.
Continued Professional Development-courses.
Practical workshops with real-time projects.
Refresher courses, post-graduate diploma courses, manuals and Seminars/Workshops.
CPD training; conferences; regional seminars; on-line newsletter.
GI is of general importance but not critical.
The red book must be taught, but it is sufficient.

Application in projects, from layouts and spatial development frameworks to land use management issues.
Need more interaction between private, public and research. Private practice does not allow the luxury of research and we need to be informed and educated about said trends.
SACPLAN - the professional body responsible for the improvement and development of the profession (my opinion, you would have to check their mandate) would be a good platform to inform registered planners. This way SACPLAN as an organisation could start to instil skills and identity within planners. The engineering society (ECSA) and the Architecture society (SACAP) already do this with great success.
Seminars, compulsory training, more emphasis on GI from government
Workshops.
Courses in spatial planning with infrastructure. Case studies of water management in Netherlands.
CPD short courses where public/private sector experience is shared with practical examples.
Sustainability remains the key consideration, similarly elements of Green Economy, Green energy etc.
More information and accredited course through SACPLAN etc.
I would think that a congress might help, where you invite practising planners to the event. They can then be informed on what GI entails and the benefits thereof. At the event there can also be stands with companies currently doing this. They can market their things.
Annually seminars with examples of where and how GI has saved time and money for developers and the implementation thereof have been successful.
Through conferences and workshops. Provide people with a certificate of attendance which they can indicate on their CV's.
Socio-ecology vs strategic spatial planning systems should be a course for at least three years in forms of GIS modelling, Microstation drawing and especially the fundamental principal knowledge surrounding geography, ecology, human livelihood development, infrastructure development and up to date case studies of grey-green continuum.
Offer infrastructure design and capital expenditure planning.
It is more than a 'speciality subject' - it is a way of thinking. So, besides being taught by ecological engineers (if at all) on the provision of 'green services', the philosophy of GI must be embedded in every course content.
Include it as part of tertiary education and provide post graduate studies on the topic, including in job training.
Workshops.
Set students out to their hometowns to find and identify examples used by their government. If they know what they are looking for they will find it easier.
Workshops to be held to incorporate in daily practice.
Comprehensive modules on tertiary level.
It can be included in national spatial planning policies. Compulsory seminars and conferences can be held on GI. Practising planners can get private training sessions on GI within the company (Universities that currently provide education on GI can establish agreements with private companies to provide training on GI).
International best practices should be evaluated.
To provide compulsory training once every 2-3 years for all registered practising planners that are registered with SACPLAN.

Source: Own construction from questionnaire data (2017)

6.3.5.6 Reasons for opposing improvement of GI understanding among practising planners

Respondents were given the option to disagree with the statement made at Question 15(a) and were subsequently asked to state reasons for their disagreement. Table 6-5 shows all the

reasons given for deeming an improvement of GI understanding among practising planners unnecessary.

Table 6-6: Reasons for opposing improvement of GI understanding among practising planners as made by respondents

Reasons for opposing improvement of GI understanding among practising planners
Planners simply need to know that there is potential GI to be included in developments; the engineers and financial members of the team are the ones that must be more informed in order to include such infrastructure in the actual design/building phase.
The implementation of GI will become the responsibility of Municipalities, Metros and Provincial Departments. Private land owners and property developers can only be required to comply with GI measures if the necessary legislation exists. Municipalities can adopt a policy or guideline in that regard, but it will have to be driven from an engineering point of view.
I don't think it's a matter not understanding it; it's just a matter of GI not being practised enough. I think if it is being practised a lot then it would be a common practice.

Source: Own construction from questionnaire data (2017)

6.3.6 Cross-tabulation of statistical findings

In order to analyse further the data gathered from the questionnaire, specific questions from each section of the questionnaire were selected and their results cross-tabulated to determine the relationship between the several variables. The conceptual structure of all included cross-tabulations can be seen in Figure 6-5 below. The remainder of this chapter elaborates on each of these cross-tabulations by discussing the reasoning for cross-tabulating the selected questions, as well as discussing the statistical findings thereof in the context of this research.

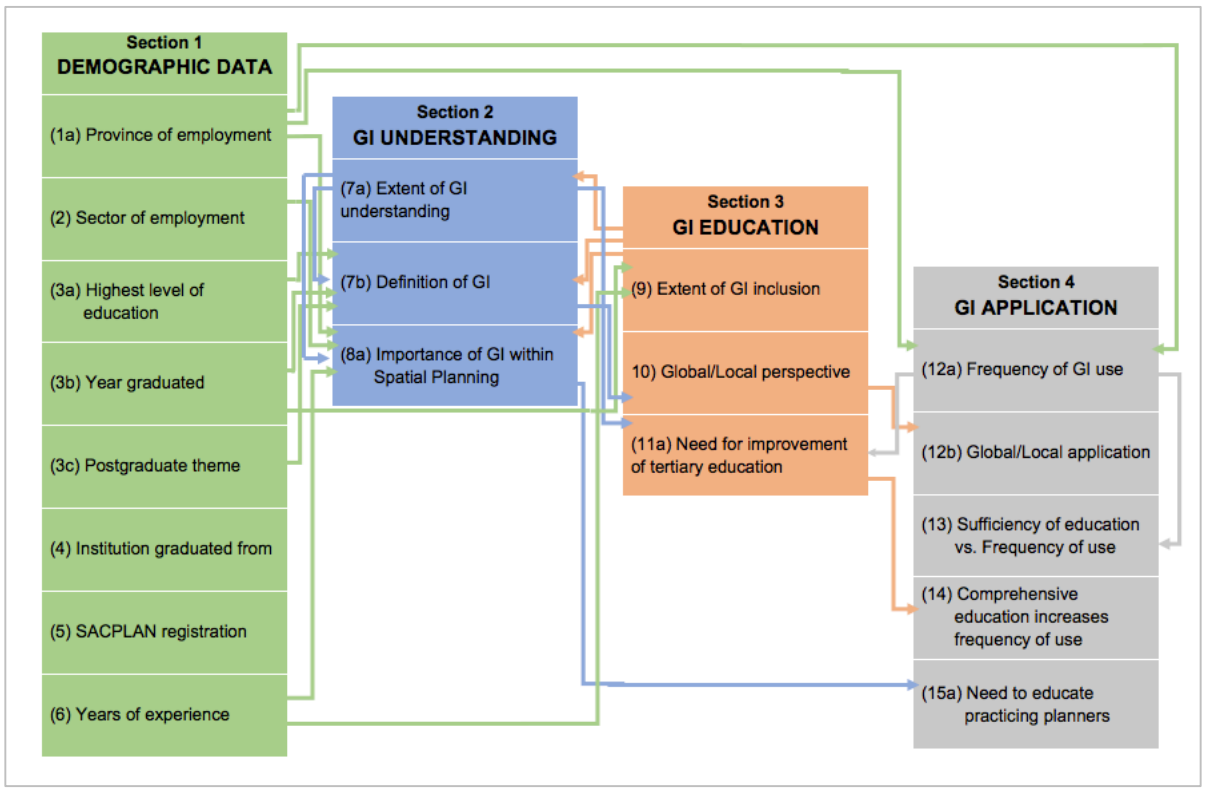


Figure 6-5: Conceptual structure of cross-tabulations

Source: Own construction (2017)

As part of the statistical interpretation the Cramer's V test values are discussed. These values determine the effect size and practical significance of the associations, with V ~ 0,5 indicating a large effect or practical significant association; a medium effect or practical visible significant association is indicated by V ~ 0,3; and small effect or practical non-significant association indicated by V ~ 0,1 (Ellis & Steyn, 2003:52).

For the purpose of this research a convenience sample was used instead of a random sample and therefore P-values will not be interpreted but are reported for the sake of completeness.

6.3.6.1 Cross-tabulation 1 – Frequency of GI use as per province

In an attempt to determine which province in South Africa employs GI most frequently, Question 1 (What is your main province of employment?) was cross tabulated with Question 12(a) (What is your frequency of GI use as practitioner?). Table 6-7 below indicates that, in general, very few provinces (linked to the province of employment of the included respondents) make use of GI.

Table 6-7: Correlation between frequency of GI use and province of employment

		Question 10 What is your frequency of GI use as practitioner?			Total
		Never	Sometimes	Often	
Question 1 What is your main province of employment?	EC	0 (0%)	1 (100%)	0 (0%)	1 (100%)
	FS	1 (33,3%)	0 (0%)	2 (66,7%)	3 (100%)
	GAU	9 (64,3%)	4 (28,6%)	1 (7,1)	14 (100%)
	KZN	0 (0%)	0 (0%)	0 (0%)	0 (0%)
	L	1 (50%)	0 (50%)	1 (50%)	2 (100%)
	MP	2 (100%)	0 (0%)	0 (0%)	2 (100%)
	NW	9 (75%)	2 (16,7%)	1 (8,3%)	12 (100%)
	NC	0 (0%)	0 (0%)	0 (0%)	0 (0%)
	WC	3 (60%)	1 (20%)	1 (20%)	5 (100%)
Total		25 (64,1%)	8 (20,5%)	6 (15,4%)	39 (100%)

Source: Own construction (2017)

The data in Table 6-8 below show that out of a sample of 40 cases, 39 were valid in this cross-tabulation. A medium effect or practical visible significant association was evident (V = 0,439).

Table 6-8: Associations between province of employment and frequency of GI use

Cross Tabulation	Question reference	Number of valid cases (N)	Chi-Square test	Cramer's V test value	Cramer's V test approx. sig.
Frequency of GI use per province	Q1 with Q10	39 (97,5%)	0,239	0,439	0,239

Source: Own construction (2017)

6.3.6.2 Cross-tabulation 2 – Importance of GI within sectors of employment

Question 2 (What is your main sector of employment?) was cross-tabulated with Question 7(a) (How would you rank the importance of GI within spatial planning?) in order to determine how the respondents employed in the different sectors rank the importance of GI within spatial planning. This cross-tabulation could offer insight into which sector drives the application of GI in practice and to an extent, the role and importance of GI, based on how important it is regarded within the specific sector.

The data captured in Table 6-9 below illustrate that respondents of both sectors (public and private) regarded GI as important.

Table 6-9: Correlation between importance of GI and sector of employment

		Question 7 (a) How would you rank the importance of GI within spatial planning?			
		Unimportant	Moderately important	Very important	Total
Question 2 What is your main sector of employment?	Public Sector	0 (0%)	2 (22,2%)	7 (77,8%)	9 (100%)
	Private Sector	0 (0%)	5 (17,9%)	23 (81,1%)	28 (100%)
Total		0 (0%)	7 (18,9%)	30 (100%)	37 (100%)

Source: Own construction (2017)

From Table 6-10 below, it is evident that a small effect was evident when taking the Cramer's V test value into account (V = 0,048) for this cross-tabulation for the 37 valid cases. Although there is no practical significance evident in the outcome of this cross-tabulation, the data gathered still indicate that GI is regarded as important among both the sectors of employment, with the vast majority (77.8% and 81.1%) agreeing with this statement.

Table 6-10: Associations between sector of employment and importance of GI

Cross Tabulation	Question reference	Number of valid cases (N)	Chi-Square test	Cramer's V test value	Cramer's V test approx. sig.

Frequency of GI use per sector	Q2 with Q7(a)	37 (92,5%)	0,771	0,048	0,771

Source: Own construction (2017)

6.3.6.3 Cross-tabulation 3 – Frequency of GI use per sector

Building upon Cross-Tabulation 2 in Section 6.6.2.2 which considered the public and private sectors perception towards GI, this cross-tabulation attempted to determine which sector most often uses GI. These results could indicate the link between perception and practical implementation. Therefore, Question 2 (What is your main sector of employment?) was cross-tabulated with Question 10 (What is your frequency of GI use as a practitioner?).

Table 6-11 below illustrates that the bulk of the respondents (70% from the public sector and 67% from the private sector) never use GI. This lack of usage could be due to limited education on GI (it can be seen that most of the respondents were of the opinion that their GI education was considered to be insufficient, as can be seen in Graph 6-15 in Section 6.2.5.3) and thus restricting the knowledge of the concept to apply it successfully in practice. This however, contradicts the findings on 6.6.2.2 where stakeholders of both private and public sectors agreed on the importance of GI. The importance is not carried over into the practical planning environment.

Table 6-11: Correlation between frequency of GI use and sector of employment

		Question 10 What is your frequency of GI use as a practitioner?			
		Never	Sometimes	Often	Total
Question 2 What is your main sector of employment?	Public sector	7 (70%)	1 (10%)	2 (20%)	10 (100%)
	Private sector	17 (63%)	7 25,9%)	3 (11,1%)	27 (100%)
Total		24 (64,9%)	8 (21,6%)	5 (13,5%)	37 (100%)

Source: Own construction (2017)

The Cramer's V test value (V = 0,190) from Table 6-12 below shows that there is a small effect in terms of the associations between the cross-tabulated questions and that there were 37 valid cases considered.

Table 6-12: Association between frequency of GI use and sector of employment

Cross Tabulation	Question reference	Number of valid cases (N)	Chi-Square test	Cramer's V test value	Cramer's V test approx. sig.

Frequency of GI use and sector of employment	Q2 with Q10	37 (92,5%)	0,512	0,190	0,512

Source: Own construction (2017)

6.3.6.4 Cross-tabulation 4 – Highest level of spatial planning education and definition of GI

To determine if the type of degree held by the respondents had an influence on the knowledge of GI, Question 3(a) (What is your highest level of spatial planning education?) was cross-tabulated with Question 6(b) (Define GI to the best of your knowledge). As explained in Section 6.2.3.2 of this chapter, the definitions provided by respondents for Question 3(a) were ranked according to level of correlation with the definition formulated in Chapter 3 of this research (c.f. 3.4).

From Table 6-13 it can be seen that there is in fact no correlation between level of spatial planning degree and professed knowledge of GI, implying that a progression in spatial panning education does not necessarily improve knowledge of GI.

Table 6-13: Correlation between highest level of spatial planning education and definition of GI

		Question 6(b) Define GI to the best of your knowledge			Total
		Low correlation with definition	Moderate correlation with definition	High correlation with definition	
Question 3(a) What is your highest level of spatial planning education?	Diploma	0 (0%)	0 (0%)	0 (0%)	0 (0%)
	Degree	0 (0%)	2 (66,7%)	1 (33,3%)	3 (100%)
	Honours degree	9 (60%)	3 (20%)	3 (20%)	15 (100%)
	Master's degree	7 (70%)	1 (10%)	2 (20%)	10 (100%)
	Doctorate degree	5 (50%)	2 (20%)	3 (30%)	10 (100%)
Total		21 (55,3%)	8 (21,1%)	9 (23,7%)	38 (100%)

Source: Own construction (2017)

From the 38 valid cases the Cramer's test value (V = 0,284) shows that there is a small practical significance association present, as illustrated in Table 6-14 below. Overall, this result calls for the review of current planning education approaches and the level of inclusion of GI.

Table 6-14: Association between highest level of spatial planning degree and definition of GI

Cross Tabulation	Question reference	Number of valid cases (N)	Chi-Square test	Cramer's V test value	Cramer's V test approx. sig.
Degree and definition of GI	Q3(a) with Q6(b)	38 (95%)	0,407	0,284	0,407

Source: Own construction (2017)

6.3.6.5 Cross-tabulation 5 – Year in which undergraduate degree was received and definition of GI

This section considered the association between the year respondents obtained undergraduate degrees and their definition of GI provided for the purpose of the questionnaire. In order to draw conclusions regarding curricula development and the level of GI inclusion in academic programmes, since its increasing importance in practice in recent years, Question 3(b) (In which year did you receive your undergraduate degree?) was cross-tabulated with Question 6(b) (Define GI to the best of your knowledge) to determine whether a paradigm shift has occurred in terms of including GI as part of tertiary education as time has passed.

Table 6-15 illustrates a decline in knowledge of GI (based on the definitions provided by the respondents) over the course of time, with 44,4% of respondents receiving undergraduate degrees between 2001 and 2010 and 66,7% of respondents receiving undergraduate degrees after 2011, both providing low correlating definitions for GI. Since GI became more prominent and important in recent years, it was expected that the knowledge of GI would also increase over years, but the results contradicted this.

Table 6-15: Correlation between year in which undergraduate degree was received and definition of GI

		Question 6(b) Define GI to the best of your knowledge			Total
		Low correlation with definition	Moderate correlation with definition	High correlation with definition	
Question 3(b) In which year did you receive your undergraduate degree?	Before 1990	3 (50%)	2 (33,3%)	1 (16,7%)	6 (100%)
	Between 1991 and 2000	2 (40%)	1 (20%)	2 (40%)	5 (100%)
	Between 2001 and 2010	4 (44,4%)	1 (11,1%)	4 (44,4%)	9 (100%)
	After 2011	12 (66,7%)	4 (22,2%)	2 (11,1%)	18 (100%)
Total		21 (55,3%)	8 (21,1%)	9 (23,7%)	38 (100%)

Source: Own construction (2017)

For this cross-tabulation there were 38 valid cases and a small practical significance was present since V = 0.224, as can be seen in Table 6-16. The findings of this cross-tabulation illustrated a definite gap to be filled in the tertiary education of planners with respect to GI. This is especially pertinent considering the recent discourse and importance of GI, which has become a hype in spatial planning.

Table 6-16: Association between year in which undergraduate degree was received and definition of GI

Cross Tabulation	Question reference	Number of valid cases (N)	Chi-Square test	Cramer's V test value	Cramer's V test approx. sig.
Year graduated and definition of GI	Q3(b) with Q6(b)	38 (95%)	0,591	0,224	0,591

Source: Own construction (2017)

6.3.6.6 Cross-tabulation 6 – Year in which undergraduate degree was received and extent of GI inclusion in tertiary education

To substantiate the findings of cross-tabulation 5, cross-tabulation 6 considered the year in which the undergraduate degree was obtained in accordance with the participants' own raking of the level of GI education they received as part of their tertiary training. Question 3(b) (In which year did you receive your undergraduate degree?) was therefore cross-tabulated with Question 8 (To what extent was GI included in your tertiary education?).

The findings captured in Table 6-17 below represented similar findings to Table 6-15, where there was no evident increase in GI education over the recent years, with none of the respondents who obtained undergraduate degrees after 2011 indicating that they received comprehensive GI education.

Table 6-17: Correlation between year in which undergraduate degree was received and extent of GI inclusion in tertiary education

		Question 8 To what extent was GI included in your tertiary education?				Total
		No GI education	GI education in one module	GI education in some modules	Comprehensive GI education	
Question 3(b) In which year did you receive your undergraduate degree?	Before 1990	3 (50%)	2 (33,3%)	1 (16,7%)	0 (0%)	6 (100%)
	Between 1991 and 2000	1 (20%)	1 (20%)	3 (60%)	0 (0%)	5 (100%)
	Between 2001 and 2010	4 (40%)	5 (50%)	1 (10%)	0 (0%)	10 (100%)

	After 2011	3 (16,7%)	6 (33,3%	9 (50%)	0 (0%)	18 (100%)
Total		11 (28,2%)	14 (35,9%)	14 (35,9%)	0 (0%)	39 (100%)

Source: Own construction (2017)

Out of this cross-tabulation there were 39 valid cases which were considered and the Cramer's V test value (V = 0,315) illustrates that medium effect or practical visible significant association is present, as seen in Table 6-18 below. The findings of this cross-tabulation show that, although there has been a slight increase in GI education in general, there is still a gap for the inclusion of comprehensive modules solely dedicated to GI education as part of spatial planning education, to ensure that planners are well equipped to apply GI successfully as part of spatial planning approaches.

Table 6-18: Association between year graduated and extent of GI inclusion in education

Cross Tabulation	Question reference	Number of valid cases (N)	Chi-Square test	Cramer's V test value	Cramer's V test approx. sig.
Year graduated and extent of GI inclusion in education	Q3(b) with Q8	39 (97.5%)	0,260	0,315	0,260

Source: Own construction (2017)

6.3.6.7 Cross-tabulation 7 – Theme of postgraduate research and definition of GI

In an attempt to refine further the findings of the inclusion of GI on a tertiary level, with specific reference to urban planning versus regional planning, Question 3(c) (If you did obtain any postgraduate spatial planning degree/s, what was the theme of your postgraduate research?) was cross-tabulated with Question 6(b) (Define GI to the best of your knowledge). Only respondents who completed post-graduate research were considered in this cross tabulation.

Since GI is regarded to be used more frequently as part of urban planning, it could be assumed that respondents who did postgraduate research on spatial planning would have more knowledge of GI. Table 6-16 shows that, regardless of the topic of postgraduate research, most respondents (66,7% who did postgraduate research in urban planning and 70% who did postgraduate research in regional planning) provided definitions that had low correlation with the definition formulated.

Table 6-19: Correlation between theme of post graduate research and definition of GI

	Question 6(b) Define GI to the best of your knowledge	Total

		Low correlation with definition	Moderate correlation with definition	High correlation with definition	
Question 3(c) What was the theme of your postgraduate research?	Urban Planning	12 (66,7%)	2 (11,1%)	4 (22,2%)	18 (100%)
	Regional Planning	7 (70%)	1 (10%)	2 (20%)	10 (100%)
Total		19 (67,9%)	3 (10,7%)	6 (21,4%)	28 (100%)

Source: Own construction (2017)

The Cramer's Test value (V = 0,034) illustrated a small practical significance present from the 28 valid cases in this cross-tabulation, as can be seen in Table 6-20 below.

Table 6-20: Association between theme of postgraduate research and definition of GI

Cross Tabulation	Question reference	Number of valid cases (N)	Chi-Square test	Cramer's V test value	Cramer's V test approx. sig.
Postgraduate research and definition of GI	Q3(c) with Q6(b)	28 (70%)	0,984	0,034	0,984

Source: Own construction (2017)

6.3.6.8 Cross-tabulation 8 – Years of experience and the perception of the importance of GI within spatial planning

Cross-tabulation 8 attempted to determine whether the perception of GI among planners is influenced by their experience. Question 6 (How many years of experience do you have?) was cross-tabulated with Question 7(a) (How would you rank the importance of GI within spatial planning?).

Table 6-21 shows that years of experience did not have a significant influence on the participant's perspective of GI. However, from the limited sample it is evident that respondents with 11 to 20 years all considered GI as very important.

Table 6-21: Correlation between years of experience and the importance of GI within spatial planning

		Question 7(a) How would you rank the importance of GI within spatial planning?			Total
		Unimportant	Moderately important	Very important	
Question 6	None	0 (0%)	1 (20%)	4 (80%)	5 (100%)

	4 years or less	0 (0%)	2 (14,3%)	12 (85,7%)	14 (100%)
	5-10 years	0 (0%)	2 (40%)	3 (60%)	5 (100%)
	11-15 years	0 (0%)	0 (0%)	3 (100%)	3 (100%)
	16-20 years	0 (0%)	0 (0%)	1 (100%)	1 (100%)
	21 years or more	0 (0%)	2 (20%)	8 (80%)	10 (100%)
Total		0 (0%)	7 (18,4%)	31 (81,6%)	38 (100%)

Source: Own construction (2017)

Table 6-22 shows that from the 38 valid cases in this cross-tabulation the Cramer's V test value is equal to 0,263, which is indicative of a small association.

Table 6-22: Association between years of experience and the importance of GI within spatial planning

Cross Tabulation	Question reference	Number of valid cases (N)	Chi-Square test	Cramer's V test value	Cramer's V test approx. sig.
Years of experience and the importance of GI within spatial planning	Q6 with Q7(a)	38 (95%)	0,756	0,263	0,756

Source: Own construction (2017)

6.3.6.9 Cross-tabulation 9 – Years of experience and extent of GI inclusion in tertiary education

Cross-tabulation 9 was conducted to substantiate the findings of cross-tabulations 5 and 6 and to determine the curriculum transformation and inclusion of GI within tertiary education over recent years. Question 5 (How many years of experience do you have?) was cross-tabulated with Question 8 (To what extent was GI included in your tertiary education?).

The assumption was that, since GI has lately become a more prominent topic in planning, the inclusion of GI as part of tertiary education would have increased over recent years, in line with the practical reality. Table 6-23 below contradicts this assumption. No participant indicated having received comprehensive GI education, and only 50% of respondents having 4 years or less experience indicated that GI was included in some tertiary planning modules.

Table 6-23: Correlation between years of experience and extent of GI inclusion in tertiary education

	Question 8 To what extent was GI included in your tertiary education?	

		No GI education	GI education in one module	GI included in some modules	Comprehensive GI education	Total
Question 5 How many years of experience do you have?	None	0 (0%)	3 (50%)	3 (50%)	0 (0%)	6 (100%)
	4 years or less	3 (21,4%)	4 (28,6%)	7 (50%)	0 (0%)	14 (100%)
	5-10 years	2 (40%)	3 (60%)	0 (0%)	0 (0%)	5 (100%)
	11-15 years	2 (66,7%)	1 (33,3%)	0 (0%)	0 (0%)	3 (100%)
	16-20 years	1 (100%)	0 (0%)	0 (0%)	0 (0%)	1 (100%)
	21 years or more	3 (30%)	3 (30%)	4 (40%)	0 (0%)	10 (100%)
Total		11 (28,2%)	14 (35,9%)	14 (35,9%)	0 (0%)	39 (100%)

Source: Own construction (2017)

Cross-tabulation 9 further shows that from the 39 valid cases the Cramer's V test value indicates that a practical visible effect (V = 0,938).

Table 6-24: Association between years of experience and extent of GI inclusion in tertiary education

Cross Tabulation	Question reference	Number of valid cases (N)	Chi-Square test	Cramer's V test value	Cramer's V test approx. sig.
Years of experience and extent of GI inclusion in tertiary education	Q5 with Q8	39 (97,5%)	0,300	0,389	0,300

Source: Own construction (2017)

6.3.6.10 Cross-tabulation 10 – Extent of GI understanding and definition of GI

To comprehend fully the perceived understanding that planners have of GI, Question 6(a) (What is your extent of GI understanding?) was cross-tabulated with Question 6(b) (Define GI to the best of your knowledge).

Table 6-25 shows that of the 21 respondents that claimed to have a comprehensive understanding of GI, only 5 (23,1%) provided a definition that had a high correlation with the definition formulated and used as a barometer for this research (c.f. 3.4)

This finding confirms that there is, in fact, a misconception of GI among planners.

Table 6-25: Correlation between GI understanding and definition of GI

	Question 6(b) Define GI to the best of your knowledge	

		Low correlation with definition	Moderate correlation with definition	High correlation with definition	Total
Question 6(a) What is your extent of GI understanding?	No understanding	4 (80%)	1 (20%)	0 (0%)	5 (100%)
	Moderate understanding	7 (53,8%)	2 (15,4%)	4 (30,8%)	13 (100%)
	Comprehensive understanding	11 (52,4%)	5 (23,8%)	5 (23,8%)	21 (100%)
Total		22 (56,4%)	8 (20,5%)	9 (23,1%)	39 (100%)

Source: Own construction (2017)

From the 39 valid cases for this cross-tabulation, the Cramer's V test value was equal to 0,173. This indicates that there is a small practical effect present.

Table 6-26: Association between extent of GI understanding and definition of GI

Cross Tabulation	Question reference	Number of valid cases (N)	Chi-Square test	Cramer's V test value	Cramer's V test approx. sig.
Extent of GI understanding and definition of GI	Q6(a) with Q6(b)	39 (97,5%)	0,674	0,173	0,674

Source: Own construction (2017)

6.3.6.11 Cross-tabulation 11 – Extent of GI understanding and extent of GI inclusion in tertiary education

To determine whether the respondents' understanding of GI is due to the extent of GI inclusion in their tertiary education, Question 6(a) (What is your extent of GI understanding?) was cross-tabulated with Question 8 (To what extent was GI included in your tertiary education?).

Table 6-27 reveals that there is a definite misconception and misunderstanding of GI among planners, since large quantities of respondents that indicated to have received either GI education in one module or GI education in some modules still only had little to no understanding of the concept. This cross-tabulation also indicates that respondents who indicated to having comprehensive understanding of GI indicated to receiving more comprehensive GI education.

Table 6-27: Correlation between extent of GI understanding and extent of GI inclusion in tertiary education

		Question 8 To what extent was GI included in your tertiary education?				Total
		No GI education	GI education in one module	GI education in some modules	Comprehensive GI education	
Question 6(a) What is your extent of GI understanding?	No understanding	1 (20%)	2 (40%)	2 (40%)	0 (0%)	5 (100%)
	Moderate understanding	5 (38,5%)	6 (46,2%)	2 (15,4%)	0 (0%)	13 (100%)
	Comprehensive understanding	5 (22,7%)	7 (31,8%)	10 (45,5%)	0 (0%)	22 (100%)
Total		11 (27,7%)	15 (37,5%)	14 (35%)	0 (0%)	40 (100%)

Source: Own construction (2017)

Although the Cramer's V test value indicates a small effect present (V = 0,208), the findings of this cross-tabulation should not be disregarded .They serve as an indication that either GI education on tertiary level is not up to standard or that the concept is misunderstood by planners.

Table 6-28: Association between extent of GI understanding and extent of GI inclusion on tertiary level

Cross Tabulation	Question reference	Number of valid cases (N)	Chi-Square test	Cramer's V test value	Cramer's V test approx. sig.
Extent of GI understanding and extent of GI inclusion on tertiary education	Q6(a) with Q8	40 (100%)	0,484	0,208	0,484

Source: Own construction (2017)

6.3.6.12 Cross-tabulation 12 – Extent of GI understanding and the need to improve tertiary education regarding GI

To determine whether respondents who indicated that they have little or no understanding of GI feel that there is a need to improve tertiary education regarding GI, Question 6(a) (What is your extent of GI understanding?) was cross-tabulated with Question 9(a) (Do you feel there is a need to improve tertiary education regarding GI?).

Table 6-29 shows that, regardless of level of GI understanding, the vast majority of respondents were of the opinion that there was, in fact, a need to improve tertiary education relating to GI.

Table 6-29: Correlation between extent of GI understanding and the need to improve tertiary education regarding GI

		Question 9(a) You feel there is a need to improve tertiary education regarding GI?		Total
		Yes	No	
Question 6(a) What is your extent of GI understanding?	No understanding	5 (100%)	0 (0%)	5 (100%)
	Moderate understanding	12 (93,2%)	1 (7,7%)	13 (100%)
	Comprehensive understanding	20 (90,9%)	2 (9,1%)	22 (100%)
Total		37 (92,5%)	3 (7,5%)	40 (100%)

Source: Own construction (2017)

From the 40 valid cases in this cross-tabulation a Cramer's test value of 0,110 was reported. Similar to Cross-tabulation 11, the findings of this cross-tabulation should not be disregarded as they serve as an indicator that the general consensus among practising planners is that GI education on tertiary level should be improved.

Table 6-30: Association between the extent of GI understanding and the need to improve tertiary education regarding GI

Cross Tabulation	Question reference	Number of valid cases (N)	Chi-Square test	Cramer's V test value	Cramer's V test approx. sig.
Extent of GI understanding and need to improve tertiary education regarding GI	Q6(a) with Q9(a)	40 (100%)	0,784	0,110	0,784

Source: Own construction (2017)

6.3.6.13 Cross-tabulation 13 – Definition of GI and the need to improve tertiary education regarding GI

In an attempt to substantiate cross-tabulation 12, Question 6(b) (Define GI to the best of your knowledge) was cross-tabulated with Question 9(a) (Do you feel there is a need to improve tertiary education regarding GI?). This was to determine whether respondents who had sufficient knowledge of GI based on research are of the opinion that tertiary education of GI should be improved (if the definitions with a high correlation to the definition formulated for this research are

regarded as correct and that the respondents who provided them have sufficient knowledge on the subject of GI).

In agreement with the results of cross-tabulation 12, the results of cross-tabulation 13 (Table 6-31) illustrate that, generally, all respondents (including respondents who provided high correlating definitions) were of the opinion that tertiary GI education requires improvement. It is further evident that the number of respondents who did not identify a need to improve GI education increased as their knowledge (correlation to definition of GI) decreased. The informed respondents (high correlation) were all (100%) in favour of the improvement at tertiary level.

Table 6-31: Correlation between the definition of GI and the need to improve tertiary education regarding GI

		Question 9(a) Do you feel there is a need to improve tertiary education regarding GI?		
		Yes	No	Total
Question 6(b) Define GI to the best of your knowledge	Low correlation with definition	20 (90,9%)	2 (9,1%)	22 (100%)
	Moderate correlation with definition	7 (87,5%)	1 (12,5%)	8 (100%)
	High correlation with definition	9 (100%)	0 (0%)	9 (100%)
Total		36 (92,3%)	3 (7,7%)	39 (100%)

Source: Own construction (2017)

With V = 0,166 a small effect was reported within the 39 valid cases included for this cross-tabulation.

Table 6-32: Association between the definition of GI and the need to improve tertiary education regarding GI

Cross Tabulation	Question reference	Number of valid cases (N)	Chi-Square test	Cramer's V test value	Cramer's V test approx. sig.
Definition of GI and need to improve tertiary education regarding GI	Q6(b) with Q9(a)	39 (97,5%)	0,585	0,166	0,585

Source: Own construction (2017)

6.3.6.14 Cross-tabulation 14 – Importance of GI within spatial planning and the need to educate planners to improve knowledge of GI

To determine whether respondents who indicated GI as important within spatial planning also think that there is a need to educate practising planners in GI, Question 7(a) (How would you rank the importance of GI within spatial planning?) was cross-tabulated with Question 13(a)

(Agreement with statement that there is a need to educate practising planners to improve their understanding of GI).

Table 6-33 shows that all respondents regarded GI either as moderately important or very important and that the majority of each of these categories agreed with the statement that there is a need to educate practising planners to improve their knowledge of GI. 93.8% of respondents who consider GI very important, agree that there is a need to educate practising planners to improve their understanding of GI to ensure that the application of GI in practice can occur more frequently and more successfully.

Table 6-33: Correlation between the importance of GI within spatial planning and the need to educate planners to improve knowledge of GI

		Question 13(a) There is a need to educate practising planners to improve their understanding of GI		Total
		Disagree	Agree	
Question 7(a) How would you rank the importance of GI within spatial planning?	Unimportant	0 (0%)	0 (0%)	0 (0%)
	Moderately important	1 (16,7%)	5 (83,3%)	6 (100%)
	Very important	2 (6,3%)	30 (93,8%)	32 (100%)
Total		3 (7,9%)	35 (92,1%)	38 (100%)

Source: Own construction (2017)

Table 6-34 illustrates that for this cross-tabulation there were 38 valid cases that were considered and that a small effect was visible (V = 0,141).

Table 6-34: Association between importance of GI within spatial planning and need to educate planners to improve knowledge of GI

Cross Tabulation	Question reference	Number of valid cases (N)	Chi-Square test	Cramer's V test value	Cramer's V test approx. sig.
Importance of GI within spatial planning and need to educate planners to improve knowledge of GI	Q7 with Q13(a)	38 (95%)	0,385	0,141	0,385

Source: Own construction (2017)

6.3.6.15 Cross-tabulation 15 – Improvement of tertiary education and increase in frequency of GI use

In order to determine whether an improvement of tertiary GI education and how this improvement could lead to increasing the frequency of GI use in practice, Question 9(a) (Do you feel there is a need to improve tertiary education regarding GI?) was cross-tabulated with Question 13(b) (Agreement with statement that a more comprehensive education regarding GI would lead to an increase in the frequency of its use).

From Table 3-35 it is deduced that 91.9% of respondents who were of the opinion that an improvement of tertiary education was deemed necessary. They also agreed that a more comprehensive education could lead to more frequent GI use in practice. Upon studying the table below it can also be seen that even the respondents who did not feel that an improvement of tertiary GI education was necessary, agreed with the statement that more comprehensive education regarding GI would lead to an increase in the frequency of its use.

Table 6-35: Correlation between improvement of tertiary education and increase in frequency of GI use

		Question 13 A more comprehensive education regarding GI would lead to an increase in the frequency of its use		Total
		Disagree	Agree	
Question 9(a) Do you feel there is a need to improve tertiary education regarding GI?	Yes	3 (8,1%)	34 (91,9%)	37 (100%)
	No	0 (0,0%)	3 (100%)	3 (100%)
Total		3 (7,5%)	37 (92,5%)	40 (100%)

Source: Own construction (2017)

For this cross-tabulation there were 40 cases considered and a Cramer's V test value of 0,018 was reported, indicating a small effect.

Table 6-36: Association between improvement of tertiary education and increase in frequency of GI use

Cross Tabulation	Question reference	Number of valid cases (N)	Chi-Square test	Cramer's V test value	Cramer's V test approx. sig.
improvement of tertiary education and increase in	Q9 with Q13	40 (100%)	0,608	0,018	0,608

frequency of GI use					

Source: Own construction (2017)

6.3.6.16 Cross-tabulation 16 – Frequency of GI use and comprehensive GI education

The respondents' current frequency of GI use in practice was compared with their viewpoint on whether improved GI education could lead to its more frequent use. Thus, Question 10 (What is your current frequency of GI use as practitioner?) was cross-tabulated with Question 13 (Agreement with whether a more comprehensive education regarding GI would lead to an increase in the frequency of its use).

Table 6-37 below shows that the vast majority of respondents were of the opinion that a more comprehensive education regarding GI would lead to an increase in the frequency of its use, regardless of their current use of GI as practitioners. 100% of respondents that often use GI in practice agree that GI education could increase the frequency of GI use in practice, while 87.5% of respondents who sometimes use GI in practices agree. Ironically 92% of respondents, who never use GI in practice, also agree to the assumption that GI application could be enhanced through GI education.

Table 6-37: Correlation between frequency of GI use and comprehensive GI education

		Question 13 A more comprehensive education regarding GI would lead to an increase in the frequency of its use		
		Disagree	Agree	Total
Question 10 What is your frequency of GI use as practitioner?	Never	2 (8%)	23 (92%)	25 (100%)
	Sometimes	1 (12,5%)	7 (87,5%)	8 (100%)
	Often	0 (0%)	6 (100%)	6 (100%)
Total		3 (7,7%)	36 (92,3%)	39 (100%)

Source: Own construction (2017)

The Cramer's V test value for this cross-tabulation indicates a small effect (V = 0,140), as seen in Table 6-41.

Table 6-38: Association between frequency of GI use and comprehensive GI education

Cross Tabulation	Question reference	Number of valid cases (N)	Chi-Square test	Cramer's V test value	Cramer's V test approx. sig.
Frequency of GI use and comprehensive GI education	Q10 with Q13	39 (97,5%)	0,683	0,140	0,683

Source: Own construction (2017)

6.3.7 Conclusion

There is a misconception and misunderstanding among planners as to what constitutes GI in terms of spatial planning, as evident from the data gathered from the questionnaires where 55% of the respondents indicated having a comprehensive knowledge of GI, but only 12% respondents were able to formulate a definition of GI that had a high level of correlation with the definition of GI formulated for this research, the most prominent finding of this chapter could be . The statistical analysis considered different education levels, different provinces of employment, private sector versus public sector employment and different levels of experience as professional planners, but none of these criteria illustrated a difference in terms of the understanding of GI. Based on the statistical analysis and interpretation it can be concluded that most professional planners do not comprehend the notion of GI and that there is scope for improvement of such within the planning profession.

This chapter further concluded on the broad importance of GI as part of spatial planning, as evident by the general consensus among the respondents included in this research. All purposefully selected respondents considered GI as highly important and indicated a need for GI to be included as part of spatial planning practices to enhance the promotion of sustainable and resilient developments.

In terms of GI education, none of the respondents indicated to have received comprehensive GI education. The majority of the respondents were of the opinion that tertiary planning education of GI needs to be improved and that there is a demand that needs to be addressed.

The findings of this chapter indicate that although GI has multiple advantages and is regarded as an important spatial planning approach, it is not frequently applied in practice since only 12% of the respondents indicated to making frequent use of GI as spatial planning practitioners. Once more, a gap in terms of GI education was identified due to the fact that 93% of respondents were of the opinion that a more comprehensive education approach regarding GI would lead to an increase in the frequency of its use and that there was a dire in practice. As such, all respondents

indicated the need to further educate planners already practising to improve their understanding of GI.

CHAPTER 7 - CONCLUSIONS

7.1 Points of departure

This chapter draws on the theoretical investigation and empirical investigation presented in preceding sections, in an attempt to conclude on the most important findings and make research specific recommendations in line with the research objectives. This chapter consists of five thematic sections, specifically selected in line with the aims of this research, as mentioned in Chapter 1 of this study (c.f. 1.3). The thematic sections of this chapter include the notion of transdisciplinary thinking and planning; transdisciplinary planning and GI; transdisciplinary planning education and the South African approach; an evaluation of current planning education approaches; and an evaluation of current practical GI application approaches as explained accordingly.

7.2 The notion of transdisciplinary thinking and planning

Youngquist (2009:19) pondered whether green infrastructure would be a "fleeting fashion" comparable with other strategies within city planning that have "come and gone", with the full potential of such infrastructure in fostering sustainable development embedded in spatial planning approaches being unfulfilled.

This research concluded that a primary challenge to the successful implementation of green infrastructure in South African urban spaces relates to the misconception and misunderstanding of green infrastructure among the various disciplines and professionals involved in its application. In this regard, the complexity of the concept and the wide-ranging definitions and contexts of application have resulted in the arising need for practical integration of the extensive elements inherent to green infrastructure implementation within local spatial planning approaches.

The key to comprehensive green infrastructure implementation and the subsequent unlocking of the potential of green infrastructure to enhance the sustainability of urban areas, is attributed to trans-disciplinary thinking, the development of which is reliant on trans-disciplinary education embedded in spatial planning curricula in tertiary institutions.

In order to comprehend transdisciplinarity fully, the distinction between the various planes of disciplinary interaction needs to be made. Table 7-1 holds the most prominent definitions of each of these planes of interaction.

Table 7-1: Planes of disciplinary interaction

Disciplinarity	Takes place within the boundaries of currently recognised academic disciplines, while fully appreciating the artificial nature of these bounds and

	the fact that they are dynamic. The research activity is orientated towards one specific goal: looking for an answer to a specific question.
Multidisciplinarity	Involves different academic disciplines that relate to a shared goal, but within disciplinary boundaries in order to create new integrative knowledge and theory. The research process progresses as parallel disciplinary efforts without integration.
Interdisciplinarity	Involves several unrelated academic disciplines in a way that focusses them to cross subject boundaries. The concerned disciplines integrate disciplinary knowledge in order to create new knowledge and theory and achieve a common research goal. Unrelated means that they have contrasting research paradigms.
Transdisciplinarity	Involves academic researchers from different, unrelated disciplines as well as non-academic participants, such as land managers, user groups and the general public, to create new knowledge and theory and research a common question. Transdisciplinarity combines interdisciplinarity with a participatory approach.

Source: Compiled from Tress et al. (2005:488)

Disciplinarity is defined as the interaction between individually defined bodies of knowledge within an existing discipline, interaction that acknowledges the dynamic nature of the disciplinary divide and the limitations to rigid knowledge borders within said disciplines.

Multidisciplinarity, on the other hand, represents the interaction between various disciplines. This interaction is, however, limited to individual parts, with the objective of the interaction solely to solve a predetermined challenge. Accordingly, in the process of solving said problem, each discipline utilises individual research paradigms and methodologies. Due to the limited nature of interaction with multidisciplinarity, complex problem-solving remains a challenge. This necessitates ever-increasing interaction between disciplines, and the eventual intersection of respective bodies of knowledge inherent to individual disciplines. Russel *et al.* (2005:35) calls this intersection “interdisciplinarity”.

Where multidisciplinarity and interdisciplinarity refer to increased interaction between complementary aspects of respective disciplines, transdisciplinarity proposes the “integration of two contradictory movements of disciplinary thinking” (Ramadier, 2004:424) through the “incorporation and fusion of content, theory, and methodology from various disciplines” (Russel, 2005:35). The objective of transdisciplinarity is to solve “multifaceted and multidimensional” problems that require comprehensive “overlap” of different knowledge systems (c.f. 2.2.4). Therefore, transdisciplinarity transgresses the boundaries of individual disciplines, catalysing new knowledge production and problem-solving capabilities. The latter characteristic distinguishes transdisciplinarity from other forms of disciplinary interaction. This product of transdisciplinarity is “the development of cohesive knowledge among science and society”, and shared understanding and problem-solving capabilities between various role players (Tress *et al*., 2005:484).

While transdisciplinarity presents opportunities for complex problem-solving to real world challenges, there are various challenges inherent to successful transdisciplinary execution,

including integration, reflection, and paradox (c.f. 2.3.2). Integration challenges stem from complexities in integrating differing epistemologies, theories, application, and contexts of different disciplines. In addressing this integration problem, Ramadier (2004) suggests fostering coherent knowledge, rather than multilateral unity among the disciplines (c.f. 2.3.2.1). As per the complexity of problem-solving through transdisciplinarity, both personal and comparative reflection by role-players is paramount to identify common values and "deconstruct and rebuild knowledges through exposure" to other methodologies and practices (c.f. 2.3.2.2). Paradoxes in transdisciplinarity are to be studied and embraced as part-and-parcel of the intersection of wide-ranging disciplines with diverse bodies of knowledge (c.f. 2.3.2.3).

The complexity of problems solved through this instrument necessitates the participation of various stakeholders. Therefore, a fundamental component of transdisciplinarity is recognising the different expertise of the various role players involved in the process. Through this exercise the "silos" of the distinctive disciplines are integrated to increase knowledge production and problem-solving (c.f. 2.4).

Transdisciplinarity is of cardinal importance in addressing pressing, complex and real world challenges. It intersects diverse bodies of knowledge and leads to the development of new knowledge with the objective of solving a sole, predetermined problem. Transdisciplinary thinking might hold the key to solving complex urban and spatial problems of contemporary cities and regions.

7.3 Considering transdisciplinary planning and GI

The concept of GI has developed quite considerably over time (c.f. 3.2), with its definition now becoming vague. The various elements and functions of GI (and the lack of singular definition) implies that the concept is often misunderstood. Mell (2010:39) considers GI to a part of a greater ecological network that links different ecological features ranging from specific landscape qualities to broader, more typical uses of 'green spaces'. As such consensus needs to be achieved regarding the appropriate definition of GI (as derived from the various disciplines and functions inherent to GI). There are recurring themes in most definitions of GI: these elements include access, spatial variance, multi-functionality, natural and human benefits, biodiversity, sustainability and connectivity (c.f. 3.4).

For the purpose of this research GI was defined through a theory-based sampling method as "all natural and man-made ecological systems, which integrate the built environment and ecosystem services with resilient landscapes supporting ecological, economic and human interests by maintaining and promoting connectivity, while improving the quality of the environment" (c.f. 3.4). Furthermore, this definition was used as a barometer to determine the manner in which users of

GI (professional planners and related disciplines in this sense) understand and apply GI in practice, to determine conclusively the extent, and further needs of GI education and training on tertiary level.

To understand further the complexity of GI and the link to transdisciplinary planning, the multitude of benefits of GI on different levels were also considered (c.f. 3.5). Foster et al. (2011:35) argues that "net-value of enhanced social, environmental, and economic resilience from green-infrastructure will be at the core of resilient communities in a climate changed future", implying that it should form an integral part of broader spatial planning approaches. This in itself implies a transdisciplinary approach.

Since the successful development and, eventually, consequent implementation of GI lie with the inputs and cooperation of its various role players (Mell, 2010:39), education relating to GI and the planning thereof should also be fundamentally transdisciplinary and should consider all related role players.

7.4 Considering transdisciplinary planning education and the South African approach

The Green-value-gap is the theoretical construct to state the difference in terms of green value, as perceived from different perspectives. To enhance mutual understanding between two or more disciplines and to interpret green value from different perspectives, proper education and training initiatives need to be in place to ensure that tertiary planning education in general includes GI as a crucial part thereof (c.f. 4.2). Although the value of GI is challenging to determine in monetary terms, the more frequent application thereof would lead to more economic benefits being accessible. However, for the application of GI to increase, the education approaches relating to the concept need to be improved to ensure that GI is properly implemented in practice.

A measure that can be taken to ensure that GI education is improved is to make use of transdisciplinary education and training methods. Hammer and Söderqvist (2001:1) suggested that this be done by, either incorporating more transdisciplinary elements to current modules on offer by having external lecturers, seminars and discussions from other disciplines, or by developing exercises in which students from various disciplines are granted the opportunity to complete a joint task. Alternatively, full transdisciplinary modules can be developed.

The South African reality suggests that planning education and curricula development should be aligned with SACPLAN Competencies and Standards to ensure that tertiary training initiatives adhere to the corporate body's regulations and specifications. Within these set competencies and standards lie the fundamentals to enhance transdisciplinary thinking and planning. There is however a need to define the concept of GI from a spatial planning perspective, which would imply relevant training and education approaches that relate to GI and planning.

The need for further education and training regarding the concept of GI as part of broader spatial planning was substantiated by the findings of the empirical study, which highlighted the requirement of further training and education linked to GI approaches. The lack of GI inclusion in the present planning curricula (referencing the three purposefully selected case studies and planning schools in South Africa), is confirmed by the perspectives of professional planners showing interest to receive further information regarding GI approaches and the importance thereof within the current planning reality. Current South African planning education approaches have scope to include transdisciplinary thinking and planning, especially when introducing GI into mainstream spatial planning.

7.5 Evaluation of current planning education approaches

Upon studying the regulations and guidelines for curricula development as stipulated by SACPLAN it was evident that the inclusion of 'Environmental Management and Planning' is compulsory and considered a core competency of a planning curricula (cf. 5.2). The evaluation of the curricula (as contained in the yearbooks) of the purposefully selected university's (North West University, University of Pretoria, and University of Venda) revealed that neither GI, nor transdisciplinarity are currently not sufficiently included in the tertiary education of planners, as represented in Table 7-2 and Table 7-3 below.

Table 7-2: Summary of GI inclusion of modules offered by NWU, UP and UNVEN

University	Total planning modules offered	Modules including GI	Percentage of GI inclusion
NWU	20	3	13%
UP	31	8	21%
UNIVEN	19	5	21%

Source: Own construction (2017)

Considering the table above it is apparent that there is limited GI inclusion as part of local tertiary training and education. This illustrates scope to improve the extent of GI inclusion as part of spatial planning education to ensure that planners have the much needed knowledge to apply GI successfully in practice, to achieve sustainability and resilience in developments.

Table 7-3: Summary of transdisciplinary inclusion of modules offered by NWU, UP and UNVEN

University	Total planning modules offered	Modules including transdisciplinarity	Percentage of GI inclusion
NWU	20	8	40%
UP	31	10	32%

UNIVEN	19	5	42%

Source: Own construction (2017)

In comparison with the extent of GI inclusion as part of spatial planning education, transdisciplinarity is included to a somewhat greater extent in the purposefully selected cases, but there is still definite room for improvement, as can be seen on Table 7-3 above. Transdisciplinary education is needed, not only because spatial planning is transdisciplinary in nature, but also to ensure that planning students are well equipped to be valuable contributors to transdisciplinary working environments when entering practice.

7.6 Evaluation of current practical GI application approaches

In order to collect data for use in this phase of the empirical investigation, an online questionnaire was circulated among 40 purposefully selected practicing planners. The questionnaire consisted of 4 sections, each section addressing a specific theme. The sections and questions are captured in Table 7-4 below:

Table 7-4: Sections and questions contained in research questionnaire

Section	Questions and sub-questions	
Section 1 Demographic data	Question 1	What is your main province of employment?
	Question 2	What is your main sector of employment?
	Question 3	3(a) What is your highest level of spatial planning education?
		3(b) In which year did you receive your undergraduate degree?
		3(c) If you did obtain any postgraduate degree/s what was the theme or your research?
	Question 4	Which SACPLAN registration applies to you?
	Question 5	How many years of experience do you have?
Section 2 Understanding of GI	Question 6	6(a) Indicate the extent of your understanding of GI?
		6(b) According to your answer in Question 7 (a), please define GI to the best of your knowledge.
	Question 7	7(a) How would you rank the importance of GI within spatial planning?
		7(b) Please elaborate on the ranking given in Question 7(a).
Section 3 GI education	Question 8	To what extent was GI included in your tertiary education?
	Question 9	9(a) Do you feel there is a need to improve tertiary education regarding GI
		9(b) Please elaborate on the answer given in Question 9(a)
Section 4 Application of	Question 10	What is your frequency of GI use as a practitioner?
	Question 11	Was the GI education you received at tertiary level sufficient in comparison to the frequency of its use?

	Question 12	A more comprehensive education reading GI would lead to an increase in the frequency of its use.
	Question 13	13(a) There is a need to education practicing planners to improve their understanding of GI.
		13(b) If you agreed with the statement made at Question 13(a), please suggest ways in which you would improve the understanding of GI among practicing planners.
		13(c) If you disagreed with the statement made at Question 13(a), please state why.

Source: Own construction (2017)

The frequencies of the collected data were analysed and most prominent findings are captured in Table 7-5 below.

Table 7-5: Most prominent findings of research questionnaire

Section	Questions and sub-questions		Most prominent findings
Section 1	Question 1		• 40 respondents indicated a province of employment • 7 provinces represented • 15 respondents employed in Gauteng • 12 respondents employed in North West
	Question 2		• 38 respondents indicated a sector of employment • 28 respondents are employed in the private sector • 10 respondents are employed in the public sector
	Question 3	3(a)	• 39 respondents indicated highest level of spatial planning education • 16 respondents have honours degrees • 10 respondents have masters' degrees • 10 respondents have doctoral degrees
		3(b)	• 39 respondents indicated year in which undergraduate degree was obtained • 18 respondents obtained undergraduate degrees after 2011 • 10 respondents obtained undergraduate degrees between 2001 and 2011 • 5 respondents obtained undergraduate degrees between 1991 and 2000 • 6 respondents obtained undergraduate degrees after 1990
		3(c)	• 28 respondents indicated theme of postgraduate research • 18 respondents conducted post graduate research relating to urban planning • 10 respondents conducted research relating to regional planning
	Question 4		• 40 respondents indicated SACPLAN registration • 6 respondents have applicable registration • 11 respondents are registered as candidate planners • 1 respondent is registered as a technical/assistant planner • 22 respondents are registered as professional planners
	Question 5		• 39 respondents indicated years of experience • 6 respondents have no experience as practicing planners • 14 respondents have 4 years or less experience • 5 respondents have 5 to 10 years of experience • 3 respondents have 11 to 15 years of experience • 1 respondent has 16 to 20 years of experience

			• 10 respondents have 21 or more years of experience
Section 2	Question 6	6(a)	• 40 respondents indicated understanding of GI • 5 respondents indicated having no understanding of GI • 13 respondents indicated having a moderate understanding of GI • 22 respondents indicated having a comprehensive understanding of GI
		6(b)	• 39 respondents provided definitions for GI • 22 definitions had a low level of correlation with the definition formulated for this research • 8 definitions had a moderate level of correlation with the definition formulated for this research • 9 definitions had a high level of correlation with the definition formulated for this research
	Question 7	8(a)	• 39 respondents ranked the importance of GI within spatial planning • 7 respondents ranked GI as unimportant within spatial planning • 22 respondents ranked GI as important within spatial planning
Section 3	Question 8		• 40 respondents indicated extent of GI inclusion in their tertiary education • 11 respondents indicated having received no GI education • 15 respondents indicated having received GI education in some modules • 14 respondents indicated having received comprehensive GI education
	Question 9	9(a)	• 40 respondents indicated their viewpoint on improving tertiary education regarding GI • 37 respondents deemed an improvement of tertiary GI education necessary • 3 respondents deemed an improvement of tertiary GI education unnecessary
Section 4	Question 10		• 39 respondents indicated their frequency of GI use as practitioners • 25 respondents indicated never making use of GI • 8 respondents indicated sometimes making use of GI • 6 respondents indicated often making use of GI
	Question 11		• 39 respondents indicated the sufficiency of their tertiary GI education in comparison with its use • 20 respondents indicated that the tertiary GI education received was not at all sufficient in comparison with its frequency of use • 14 respondents indicated that the tertiary GI education received was sufficient in comparison with its frequency of use • 5 respondents indicated that the tertiary GI education received was very sufficient in comparison with its frequency of use
	Question 12		• 40 respondents provided a response to the statement • 3 respondents indicated that a more comprehensive education regarding GI would not lead to an increase in the frequency of its use • 37 respondents indicated that a more comprehensive education regarding GI would lead to an increase in the frequency of its use
	Question 13	13(a)	• 39 respondents provided a response to the statement

			• 3 respondents deemed it unnecessary to educate already practising planners to improve their knowledge of GI • 36 respondents deemed it necessary to educate already practicing planners to improve their knowledge of GI

Source: Own construction (2017)

The qualitative empirical investigation indicated that there is a misunderstanding and misinterpretation of the definition of GI among planners. This finding is in agreement with the statement made in Chapter 1 of this research which indicated that the subjective understanding of GI among its variety of users has led to the formulation of countless definitions (cf. 1.2).

With the data obtained from a professional questionnaire, it was evident that the majority of planners claimed to know what GI is, while 12,5% stated to have no knowledge of the concept and 13,5%of respondents claimed to have moderate knowledge concerning GI. By employing the definition for GI formulated for the purpose of this research as an indicator, the evaluation of the understanding and interpretation of GI among the planners who claimed to have knowledge of GI, showed that 55% of them incorrectly interpreted the concept. This finding indicates that there are multiple shortcomings in terms of what constitutes GI among planners. The results obtained from the questionnaire illuminated the need for a universal accepted definition of GI to be adopted, in the context of planning.

In terms of GI application, in general, current use of GI in practice is very limited since 62,5% of respondents indicating never making use of GI as planning practitioners. Furthermore, 92,5% of respondents indicated that improved education regarding GI would lead to an increase in the frequency of its use. This finding once more highlights the need for an improved and more inclusive approach to GI in tertiary planning education.

In order to analyse further the data gathered from the questionnaire, selected questions with significant findings were cross-tabulated to determine the relationship between several variables. The reasons for cross-tabulations and associations found within each cross-tabulation are explained in Table 7-6 below.

Table 7-6: Cross-tabulation correlation and associations

Cross tabulation	Questions cross-tabulated	Reason for cross-tabulation	(Research findings) Correlation/ Association
1	Q1 with Q10	• To determine which province employs GI most frequently	• Very few provinces make use of GI • Medium effect / practical visible significant association • V = 0,439
2	Q2 with Q7(a)	• To determine how respondents employed in different sectors	• Respondents from both the public and private sector regard GI as important

		rank the importance of GI within spatial planning	• Small effect / practical non-significant association • V = 0,048
3	Q2 with Q10	• To determine which sector most often uses GI	• Majority of respondents from both the public and private sector never use GI • Small effect / practical non-significant association • V = 0,190
4	Q3(a) with Q6(b)	• To determine if type of degree influenced knowledge of GI	• No correlation between level of degree and knowledge of GI • Small effect / practical non-significant association • V = 0,284
5	Q3(b) with Q6(b)	• To determine whether a paradigm shift regarding GI as part of tertiary education has occurred over time	• A decline in GI knowledge has occurred • Small effect / practical non-significant association • V = 0,224
6	Q3(b) with Q8	• To determine whether inclusion of GI as part of tertiary spatial planning education has increased over time	• No increase on GI knowledge has occurred • Small effect / practical non-significant association • V = 0,315
7	Q3(c) with Q6(b)	• To refine further the inclusion of GI as part of education at tertiary level	• Regardless of theme of postgraduate research, most respondents provided a definition with a low correlation to formulated definition • Small effect / practical non-significant association • V = 0,034
8	Q5 with Q7(a)	• To determine whether the perception of GI among planners is influenced by the amount of experience that they have	• Experience did not have a significant influence on participant's perspective of GI • Small effect / practical non-significant association • V = 0,263
9	Q5 with Q8	• To determine the curriculum transformation and inclusion of GI within tertiary education over recent years	• No respondent indicated to having received comprehensive GI education • Small effect / practical non-significant association • V = 0,938
10	Q6(a) with Q6(b)	• To comprehend the perceived understanding that planners have of GI in comparison to their actual knowledge based on the provided definitions	• There is a definite misconception and misunderstanding of GI among planners • Small effect / practical non-significant association • V = 0,173
11	Q6(a) with Q8	• To determine whether respondents' understanding of GI is due to the extent of GI inclusion as part of their tertiary education	• There is a definite misconception and misunderstanding of GI among planners • Small effect / practical non-significant association • V = 0,208
12	Q6(a) with Q9(a)	• To determine whether respondents who indicated that they have little or no	• Regardless of level of level of understanding the majority of respondents were of the opinion

		understanding of GI feel that there is a need to improve tertiary education regarding GI	that there is a need to improve tertiary education relating to GI • Small effect / practical non-significant association • V = 0,110
13	Q6(b) with 9(a)	• To determine whether respondents who had sufficient knowledge of GI based on research were of the opinion that the tertiary education thereof should be improved	• All respondents were of the opinion that tertiary GI education requires improvement • Small effect / practical non-significant association • V = 0,166
14	Q7(a) with Q13(a)	• To determine whether respondents who indicated GI as important within spatial planning also think that there is a need to educate practising planners in GI	• All respondents regarded GI as important and were in agreement that there is a need to educate practicing planners to improve their knowledge of GI • Small effect / practical non-significant association • V = 0,141
15	Q9(a) with Q12	• To determine whether improvement of GI education is necessary and how it would lead to an increase in the frequency of its use	• The majority of respondents indicated that an improvement of GI education is necessary and it would lead to an increase in the frequency of its use • Small effect / practical non-significant association • V = 0,018
16	Q10 with Q12	• To compare current frequency of GI use to viewpoint on whether improved GI education would lead to increase of GI use	• Majority of respondents indicated that improved education to GI would lead to increase in its usage • Small effect / practical non-significant association • V = 0,140

Source: Own construction (2017)

The cross-tabulation of the statistical findings of the questionnaire illustrated that most experts in the Spatial Planning discipline and related disciplines do not comprehend the scope, function, form and context of GI, regardless of respondents' sector or province of employment, years of experience, level of spatial planning degree obtained and current frequency of GI use in practice.

In terms of current application, GI is not sufficiently being used in practice in comparison with the benefits that it offers. The cross-tabulations have shown that this is mainly due to the inadequate GI education received by the respondents. Since all respondents were of the opinion that the frequency of GI use would increase if improved education on the concept was offered, this once more indicates a gap in tertiary education that needs to be addressed by ensuring that GI is included to a much greater extent as part of tertiary spatial planning education.

The following chapter aims to identify planning recommendations to guide the shortcomings identified above and to strengthen the case for transdisciplinary thinking, especially in terms of GI and planning education.

CHAPTER 8 - RECOMMENDATIONS

8.1 Points of departure

Based on the conclusions drawn in Chapter 7, this chapter aims to provide recommendations to guide the implementation of GI as part of local GI approaches within urban planning curricula. Thus, this chapter will include recommendations associated with the definition of GI, the use and necessity of GI as part of urban planning approaches as well as suitable education approaches to enhance the familiarity and application of GI in practice. The sections below stipulate these recommendations, organised according to the aforementioned categories.

8.2 Enhance transdisciplinary thinking and planning

Contemporary urban planning approaches seek to balance a myriad of planning objectives and address a variety of complex urban problems. The notion of spatial planning is fundamentally transdisciplinary in nature. With recent emphasis on sustainability and resilience, the complexity of spatial planning has increased even more. Traditional silo-planning approaches would not be able to provide solutions for cross-disciplinary problems. Enhanced transdisciplinary thinking and collaboration would need to be enforced. Therefore, both the education and practices thereof should be treated as such. Planning education should initiate such transdisciplinary thinking and prepare future planners to consider a variety of (related) disciplines when planning urban and regional areas. Curricula development and transformation should also acknowledge these (related) disciplines throughout the teaching-learning process to ensure that planners have sufficient knowledge of various fields of importance (such as ecology, economics, geography etc.), and skills to facilitate the successful implementation thereof in practice is done in a manner that constitutes transdisciplinarity. Transdisciplinary thinking might hold the key to solving complex urban and spatial problems of contemporary cities and regions and should thus be explored by the planning profession.

8.3 Contextualise GI in terms of spatial planning from a transdisciplinary perspective

This research considered numerous definitions of GI as formulated by various disciplines. The concept of GI should be contextualised in terms of spatial planning to ensure the successful implementation thereof, and a transdisciplinary approach would contribute in this regard to ensure that the form, function and context of GI be fully understood. As such, this research recommends a spatial planning approach. Therefore, it is recommended that a clearsingular and concise definition for GI, specifically in terms of the planning context, to be formulated. The formulation of a standardised definition of GI will prevent future confusion regarding the understanding of the

concept and subsequently promote its successful implementation, resulting in a variety of by-products for cities and communities.

By making use of theory based sampling as part of a qualitative enquiry, this research proposes to define GI as “All natural and man-made ecological systems, which integrate the built environment and ecosystem services with resilient landscapes supporting ecological, economic and human interests by maintaining and promoting connectivity, while improving the quality of the environment”.

To better enhance the application of GI in practice, all practicing planners should be aware of the role and importance of GI. This would entail that education at tertiary level and as part of continuous professional development be addressed and improved according to development trends.

Methods of educating practicing planners through means of continuous professional development should be explored in terms of short courses, conferences, seminars, creating platforms for greater interaction between public and private sectors in terms of research regarding GI and its implementation in spatial planning.

8.4 Explore transdisciplinary planning to transform current education approaches

Education approaches should attempt to include transdisciplinary planning as part of teaching-learning strategies. The SACPLAN Competencies and Standards can be used as a point of departure in this regard and should form part of the planning curricula transformation.

The concept of GI was considered in this research to illustrate the need for a transdisciplinary planning approach. GI is not demarcated to one specific discipline but relies on the input and understanding of various disciplines and stakeholders to ensure successful implementation thereof in practice. Thus, such transdisciplinary thinking and planning should guide the transformation of current education approaches in an attempt to prepare future planners for the transdisciplinary environment in which they will operate. To integrate GI more fully in planning approaches, the definition, importance, usage, and links with the planning profession need to be identified and integrated as part of planning curricula.

The SACPLAN Competencies and Standards can be used as points of departure to introduce GI and transdisciplinarity as an essential part of planning curricula. By making use of the modules proposed by SACPLAN in the Competencies and Standards report, numerous opportunities to include GI in education can be identified.

In addition to promoting the need and importance of GI, local training and education should aim to promote consciousness of the benefits of GI as part of broader planning approaches. Further research and investigation are recommended to identify more clearly the most appropriate and advantageous methods of incorporating GI in this manner. The integration of GI with spatial planning, as well as the inclusion of GI as part of other competencies, needs to be explored further. This research serves as a point of departure to illustrate the need and importance transdisciplinarity, especially relating to GI as part of the 'Environmental Planning and Management' competency as set by SACPLAN.

In essence, transdisciplinary planning should be explored to transform current education approaches. Transdisciplinary cooperation in teaching and learning should be enhanced in order to search for innovative solutions to address challenges of urban and rural landscapes. Such transdisciplinary planning approaches would also raise a strong awareness of the global and local context that shape planning and in which planning considerations inform context-based solutions. Further proposal to transform current education approaches include:

- Expand community-based projects within teaching-learning objectives
- Augment global and local exposure to cross-cultural experiences within education approaches
- Enhance work-based learning where students are exposed to transdisciplinary projects
- Facilitate continuous learning to strengthen transdisciplinary in planning

8.5 Build a stronger case for transdisciplinary thinking within planning education

To enhance the current application of GI in spatial planning approaches, the education thereof (both at tertiary level and as part of continuous professional development) needs to be addressed and improved.

Methods of educating practising planners through means of continuous professional development could include short courses, conferences, and seminars, creating platforms for greater interaction between public and private sectors in terms of research regarding GI and its implementation in spatial planning.

Recommendations that this research makes in terms of contributing to the planning profession in general are:

- Planning education should prepare future planners to address complex urban and rural problems.
- Planners need to comprehend multi-disciplinary, cross-disciplinary and trans-disciplinary planning opportunities and challenges.

- Planning need to balance a wide range of needs of different stakeholders, cultures, economies and environmental-context's in a systematic thinking process.
- Appropriate education approaches is needed to prepare future planners to think and plan in a transdisciplinary manner.
- Current education approaches is limited in terms of transdisciplinary scope and should be transformed to include new development trends such as GI
- The inclusion of green infrastructure as part of tertiary education would strengthen the application thereof in practice and probably relate to more successful implementation of GI in urban and rural areas. However, current reality suggests that planning professionals are not familiar with the concept of GI and adequate education (and further learning opportunities) should be considered to address the knowledge-gap in practice.
- The professional body SACPLAN could provide valuable insights to guide the development of planning curricula in this sense.
- The transfer of knowledge in planning education should be effective and carefully considered. Different teaching methodologies should be considered to ensure optimal transfer of knowledge within urban and regional planning education. More research should be conducted to substantiate this statement.
- Transdisciplinary thinking is a scarce skill that urban and regional planners should master. transdisciplinary thinking should thus form a crucial part of planning education.

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