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Identifying transport policy gaps in student travel demand management in South Africa

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Background: Travel demand in higher education precincts is derived from the affordability of university education, the availability of student accommodation on- or off-campus and the manner in which university mobility is managed.

Objectives: This article described the transport policy environment for student travel behaviour through the process of integrated policy analysis (PIPA) with the primary aim of outlining the major directions of student mobility management from peer-reviewed literature.

Method: Gaps in the South African transport policy environment were identified for university student mobility as a result of the official policy position neglecting the segment and 7 of 26 public universities acting upon these markets without enabling legislation.

Results: It was found that measures associated with managing travel demand demarcate mobility management practices. Through the literature, the article found that (1) the policy environment lags behind university interventions, which resonate with international evidence; (2) international evidence reveals that multiple directions for managing travel demand for university precincts; and (3) there is a need to reform the mobility and access policies for university precincts in South Africa (SA).

Conclusion: In essence, the literature review presented heterogenous contexts and techniques to specify mobility and access problems and redress them. This enhanced the quality of policy design, evaluation and implementation particularly for integrated transport planning in SA. The primary limit of this study was that it is a policy review, relying heavily on secondary data to set the scene for future research.

Keywords: travel demand management; student mobility; policy analysis; transport policy; transport planning.

Introduction

Travel demand in higher education precincts is derived from the affordability of university education, the availability of student accommodation on- or off-campus and the manner in which university mobility is managed. Leveraging on the interplay between the three factors, this study contributes to the role of student mobility management within the context of increased access to higher education institutions and subsequent travel demand.

Fee-free higher education

Financing higher education is heterogeneous in sub-Saharan Africa, but South Africa's (SA) cost-sharing model wherein upfront tuition fees are expected was unpopular and underpinned by a means-tested approach to student loans (Johnstone 2006). Inducing accessible higher education requires trade-offs between higher education fee increment structures and government capitation for a fairly distributed student loan programme (Wangenge-Ouma & Cloete 2008). Country-wide protests dubbed *#FeesMustFall* initiated a downward pressure on university fees as a result of a fee-capping mechanism (DHET 2017), a decade after the policy debates had emerged. The fee-capping mechanism contains the increment of public university fees in 26 South African institutions in pursuit of affordable education, without it fees would rise concomitantly with the gradually increasing costs of universities' day-to-day business. This falls under the premise of the *Fee-free higher education and training* policy for means tested households, which is defined as (National Treasury 2018):

> A government policy on higher education and training that makes provision for full-cost-of-study bursaries to students below a specified household-income threshold, covering tuition fees, prescribed study material, meals, and a certain level of accommodation and/or travel allowances. (p. 173)

With the initial debate around the cost of study is concluded, the lag effect of greater access to education for poor households should be anticipated. This effect implies larger student populations who would require physical accommodation and concomitant transport planning and travel demand management (TDM) efforts.

## Rising student population and housing demand

University student travel demand in the local area is derived from the population of students accommodated by higher education institutions on-site. Between 2010 and 2014, the annual growth rate of the university student population was 3% with nearly 6 60 000 full time students (DHET 2016). By 2015, full-time student enrolments reached 1.13 million and later rose to 1.4 million in 2016 (DHET 2018b) – and thus the growing at a rate faster than university students can be accommodated by university housing. Figure 1 presents the most recent statistics on university student housing. It purports that only 23% of the university students were accommodated through university housing in 2010 – the remaining were living *off-campus* and probably commuting.

Numerous reports reveal that students' living conditions are in many cases poor, unregulated, unaffordable and overcrowded through subletting (Legodi 2019; Njilo 2019). Student accommodation has grown into a large business with the emergence of infrastructure-based trends, digital market places and large national grants. One infrastructure trend facilitated by the Inkunzi Wealth Group aims to provide 20 000 beds within 15 years through the Ithubalethu Fund that raises capital from secure investments open to the public at R5000.00 or more (Bulbulia 2019; Khumalo 2019a, 2019b). In this programme, student housing is priced at R3000.00 per bed per month, which is still higher than the average monthly student spend. The accommodation crises has also boomed into shared technology platforms that serve as accommodation market places, such as Student Accommodation and DigsConnect.com that has expanded through a R12 million venture capital injection (De Villiers 2019). A national level response is the Department of Higher Education and Training directing R1.1 billion (US$ 78 million) to student housing development through the Student Housing Infrastructure Programme (SHIP) to 17 institutions of higher learning, which will eventually reach R4.1 billion in the medium term (DHET 2018a). Whilst these initiatives are underway, their effect remains to be seen in the long run, and they seem disconnected from the transport and land-use interactions. The current line of argument in SA is focused on the relationship between universities space and place to narrate development through housing, liveability and urban planning (eds. Bank, Cloete & Van Schalkwyk 2018; Peterson, Addie & Bank 2019). Little emphasis is placed on mobility, access and the approaches to transport planning and managing travel demand at university precincts.

Travel demand and student mobility gap in South Africa

The upward pressure on the demand for higher education is confronted with a lack of policy infrastructure to manage the concomitant travel demand. Based on the South African Trip Data Manual, university students are estimated to generate 1.9 daily trips, with a peaking factor of 0.11 and an hourly trip rate of 0.21 (COTO 2012). A simple estimation of daily trips by university students purports a growth from 1 million to 1.8 million between 2009 and 2016, with public university trips in 2014 ranging from 11 660 at Rhodes University (RU) to 80 530 at the North West University (three sites), or 77 000
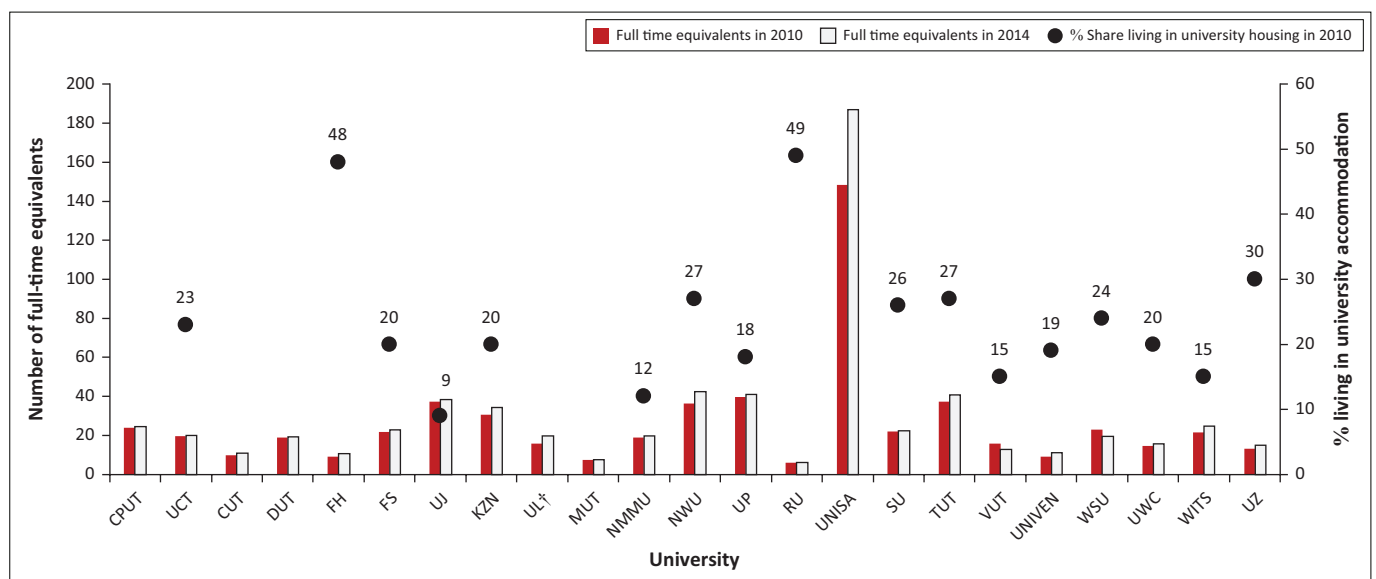
Source: Please see the full reference list of the article, DHET, 2016, *Statistics on post-school education and training in South Africa: 2014*, Department of Higher Education and Training, Pretoria. DHET, 2016, *Statistics on post-school education and training in South Africa: 2014*, Department of Higher Education and Training, Pretoria, for more information.

FIGURE 1: South African University students' population and accommodation by higher education institution.

CPUT, Cape Peninsula University of Technology; UCT, University of Cape Town; CUT, Central University of Technology; DUT, Durban University of Technology; FH, University of Fort Hare; FS, University of Free State; UJ, University of Johannesburg; KZN, University of KwaZulu Natal; UL, University of Limpopo; MUT, Mangosuthu University of Technology; NMMU, Nelson Mandela Metropolitan University; NWU, North-West University; UP= University of Pretoria; RU= Rhodes University; UNISA= University of South Africa; SU, Stellenbosch University; TUT, Tshwane University of Technology; VUT, Vaal University of Technology; UNIVEN, University of Venda; WSU, Walter Sisulu University; UWC, University of the Western Cape; WITS, University of the Witwatersrand, Johannesburg; UZ, University of Zululand.

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at the University of Pretoria (UP), a one-site public university. This influx of student travel, housing and lifestyle demand in university towns and precincts may increase traffic, densities and in the long run increase the well-being in an area – if well managed. When poorly managed, this in turn is likely to increase the generalised cost of travel, property prices and development – potentially pricing out students and local residents. Few studies in SA present evidence of student mobility and access issues. One focused on students at the University of Johannesburg (Mbara & Celliers 2013) and the two on the UP (Du Toit 2013; Venter et al. 2019). There is a gap in literature about student mobility in SA compared to the breadth and extent of international evidence.

International evidence suggests there have been multiple interventions that universities implement to manage travel demand. Universities have influential impacts on local development and prestige (Rotaris & Danielis 2014), but they generate negative externalities in access, mobility and the environment when not managed properly (Davison, Ahern & Hine 2015; Rotaris & Danielis 2014). When universities develop and local areas complement this, the relationship induces increases in travel demand across various modes and land uses. Around the world, a number of universities have partnerships with transport authorities and transport companies, and some appoint a mobility manager to coordinate the public–private and institutional network efforts of managing travel demand (Aoun et al. 2013; Boyd et al. 2003; Gurrutxaga et al. 2017; Longo, Medeossi & Padoano 2015; Rotaris & Danielis 2014). Integrated approaches to this issue resulted in the emergence of official mobility management positions, multi-stakeholder projects and initiatives across numerous universities (Boyd et al. 2003; Gurrutxaga et al. 2017; Longo et al. 2015; Rotaris & Danielis 2015; Zhou 2016; Zhou, Wang & Wu 2018). In SA, efforts are limited to at least 7 of the 26 public universities with developed and publicised university student and staff transport services. This takes place with limited policy support within the context of post-school education.

The general consensus in literature is that student mobility is unique compared to the general public and requires deliberate travel demand measures. Some studies postulate that the impact of travel mode choices during education may influence future travel preferences of the students post-schooling (Muromachi 2017). Studies in university settings purport that the uptake of sustainable mobility alternatives (Cattaneo et al. 2018; Zhou 2016) and sharing solutions (Rotaris, Danielis & Maltese 2019) is dependent on how preferences are structured not only in terms of pricing and constraints but also with respect to information, attitudes, societal norms and liberties afforded by income, location and other factors. In view of the evolution of transport planning from the four-step model, to activity-based planning, trip chaining behaviour and now life-oriented behaviour research, it is more evident that demographics and preferences evolve over time, and so do individual's behavioural inclinations towards performing certain actions (Zhang & Van Acker 2017). University student mobility as an area of study seems to require more travel behaviour research that goes well beyond choice by delving into how preferences are structured through a psychological theory. This exacerbates the range of transport policy and planning interventions necessary to appropriately manage student mobility travel demand.
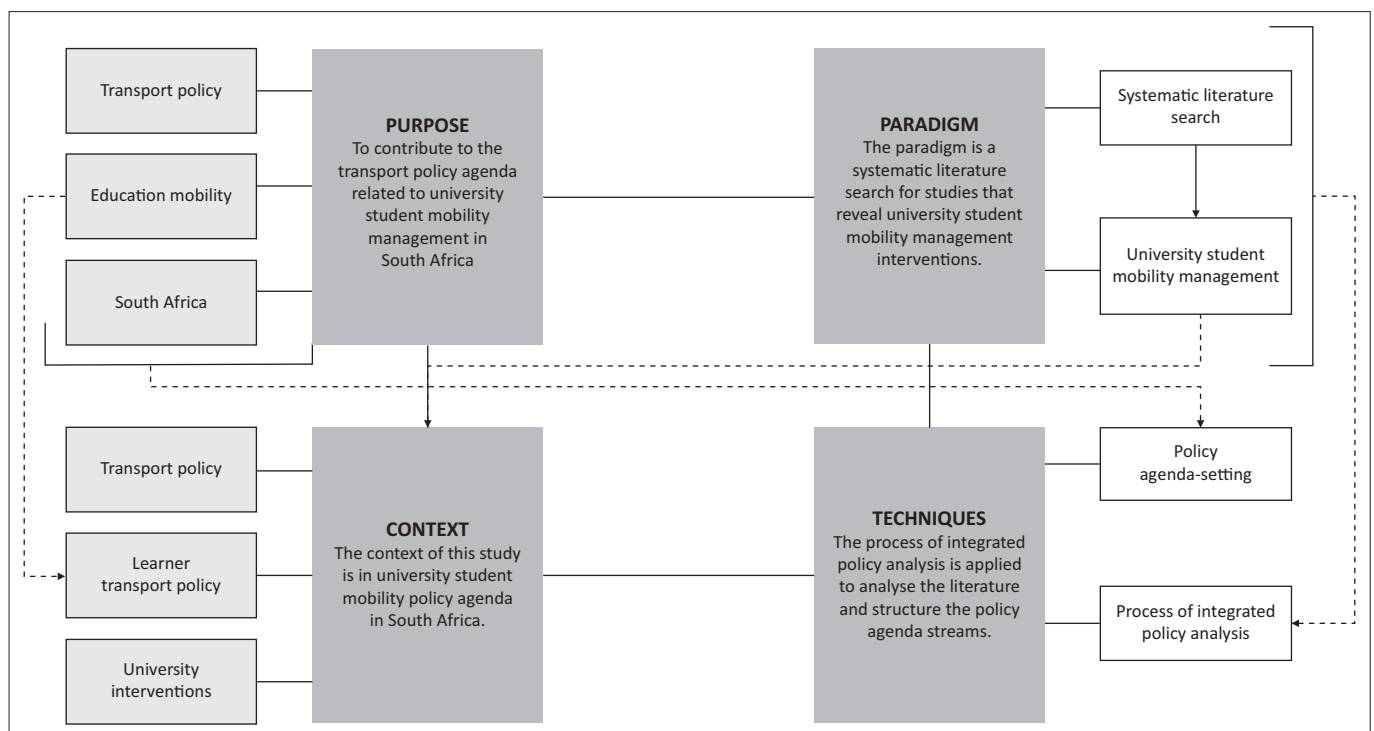

FIGURE 2: Research design.

Purpose of this study

The demand for transport is derived, and changes in the determinants of demand such as increasingly affordable universities and the rising demand for student accommodation shift the demand for travel and could change land uses. Whilst international evidence reveals that various TDM policies have been implemented to manage university students' travel demand, there is limited evidence in SA. The primary goal of this study is to contribute to setting a transport research policy agenda related to university student mobility management in SA. By applying a policy analytical framework, this goal is achieved through the following three main objectives:

- identifying research gaps through a literature review of university student mobility research applicable in SA
- analyse the literature through the process of integrated policy analysis (PIPA)
- identify methodologies, interventions recommendations and proposed programmes to inform the policy agenda for student mobility management in SA.

Research design

As illustrated in Figure 2, the research design applied in this article follows the *purpose, paradigm, context* and *technique* framework (Blanche, Durrheim & Painter 2006:37). With the purpose of the study focused specifically on reviewing best practices in student mobility, the paradigm used is a systematic literature review applied through the PIPA as the primary technique. This is applied within the context of university student mobility policy, but largely the agenda-setting phase of the policy-making process.

The article is structured as follows. Firstly, literatures about managing student mobility internationally and in SA are reviewed. This is followed by a review of policy literature enveloping the education-related mobility environment in SA. The research method is described and results are presented and discussed. Finally, this article draws conclusions for student mobility management in SA and directions for future research.

# Approaches to managing university student mobility

Policy context for university student mobility in South Africa

Internationally, education-related transport policies outline vehicle, driver and user policies that are administered by local authorities. Some are applicable for 'school age children' such as in the United Kingdom, their focus is on sustainable transport for children and young people with travel planning and TDM case studies included in the policy (DfE-UK 2019a). South Australia's approach covers the key issues mentioned above, but also includes specific responsibilities for schools and other stakeholders (DfE-SA 2020). In the United States, education-related transport policy is applicable for all education mobility services from school going children to university students regulated as commercial services (for-hire) and non-commercial services (only used by students and they do not pay for the service) (FMCSA 2017). In the United Kingdom, a separate policy for 'post-16' education-related transport and travel support empowers the local authorities to facilitate the provision of appropriate services and pursue sustainable mobility approaches to the policy problem (DfE-UK 2019b). Policy provisions for education-related transport in SA are reflected in the National Learner Transport Policy (LTP), which is oriented towards learners in the basic education sector (ages 5–18 years) (Government Gazette 2014). The lack of evidence related to the university students' segment in SA is problematic because the level of service needs, mode preferences and travel demand dynamics of a growing travelling population remain limited. As a result, the policy sphere lacks appropriate tools to guide university's efforts to manage travel demand, consistent with international practice and responsive to emerging policy issues.

Policy definition of learner- or student-related mobility

There is a lack of specific legislation that enables effective administration and management of post-school education mobility and access exacerbates the problem. In Section 44 of the National Land Transport Transition Act, the conveyance of learners, students, teachers and lecturers is regarded as a public transport service (Government Gazette 2000). Services that involve the transportation of learners, students and/or educators to tours related to cultural, sports and education activities are exempt from requiring an operating licence. According to Section 53(1)g–i of the *National Land Transport Act* No. 5 of 2009, this exemption applies for vehicles that the institutions own or outsource through an agreement, and the trip purpose is associated with the core business of the institution (Government Gazette 2009). The only policy that addresses education-related mobility is the LTP, which is limited to learners aged 5–18 (Government Gazette 2014). From an economic regulatory perspective, policies tend to be subject to interpretation, and this requires 'an analysis of practical, as opposed to ideal' regulation (Joskow & Rose 1989). Whilst the policy is clear, one interpretation could be that the services are for tours and activities in vehicles that the institutions own or outsource – not daily scheduled transport. Another interpretation maybe that outsourced operators who serve university students and staff exclusively for daily commutes operate parallel to existing public transport services. Some universities have opted to vincorporate local operators into their scheduled transport for students and staff; University of Cape Town's (UCT) Jammie Shuttle is a prime example. However, what about the institutions that have not adopted a policy interpretation or lack the capacity to do so? Formulating an evidence-based policy around student mobility and access may inform decisions in practice.
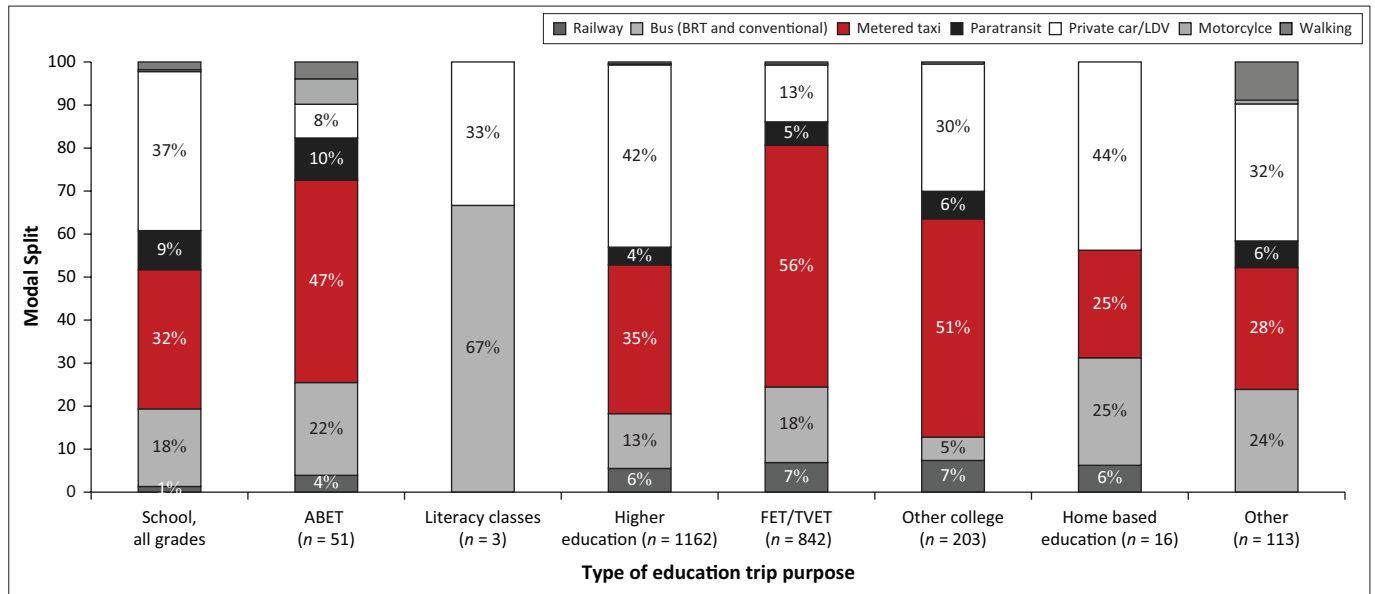
Source: StatsSA, 2014. *National household travel survey*, Statistics South Africa, Pretoria.
ABET, adult basic education and training; FET, further education and training; TVET, technical vocational education and training; BRT, bus rapid transit; LDV, light delivery vehicle.
FIGURE 3: Modal split for education trips on a national level (*n* = 12 880).

Analysing education-related transport policy in South Africa

Public policy is conceptualised as follows (De Coning & Wissink 2013):

> A public sector statement of intent, including sometimes a more detailed program of action, to give effect to selected normative and empirical goals in order to improve or resolve perceived problems and needs in society in a specific way, thereby achieving desired changes in that society. (p. 7)

Extending the existing policy outputs may result into inefficient policy decisions. The LTP aims to: 'meet the mobility needs of learners through the provision of a safe, secure, reliable and affordable learner transport service to support social development and enhance future economic growth' with the long-term aim to 'ensure that learner transport is integrated with mainstream public transport services according to the [Integrated Public Transport Network] in both rural and urban areas' (DoT 2015). The LTP provisions missing the post-school education sphere purport that as pecuniary access to higher education is improved, the induced demand for travel, housing and effective land-use plans may lack a statement of intent and detailed programs of action. Following this definition, university student mobility unmentioned in the policy sphere, there are no programs of action to realise manageable travel demand and liveable land uses. Public policy is also defined as: 'a relatively stable, purposive course of action followed by an actor or set of actors in dealing with a problem or matter of concern' (Anderson 2006:6). Following this definition, the lack of a university students' policy framework purports that there is a gap in terms of specifying the responsible decision makers who take action on an issue such as mobility in the local area, because there is no policy base. To the author's knowledge, there is no policy framework that is equivalent or included LTP that reflects university student mobility needs.

The most recent national household travel survey (NHTS) conducted in 2013 provides an aggregated view of the education mobility market when analysed (*n* = 12 880). For the basic education segment, main modes are private cars (37%) and metered taxis (32%), and walking accounts for 18% of learners' mobility needs. For the adult basic education and training, further education and training/technical vocational education and training and other college segments, metered taxis dominate the mode choices by 47% – 56%, according to Figure 3. Higher education mode choice is dominated by private car preference (42%) and metered taxis (35%), and the remaining 13% use buses to get around. Only 4% of the student respondents to the NHTS used minibus taxis – which are the dominant mode of public transport for the general population, accounting for 64%, but only account for about 47% of the total motorised transport market. It is not unusual to find that students have unique mode choices than the general population, and a number of studies reveal this issue (Danaf, Abou-Zeid & Kaysi 2014; Khattak et al. 2011). Therefore, it becomes important to further disaggregate an analysis.

When observed across provinces, metered taxis do not continue to dominate the student mobility market. Limpopo (*n* = 48) and Mpumalanga (*n* = 40) present high bus use representing 40% and 31% of the modal split. In the Western Cape (*n* = 128), 51% of students reported to use private cars and 24% used buses. In Gauteng (*n* = 462), private cars dominate and they are followed by metered taxis. At the University of Johannesburg the modal split varies between campuses, some are dominated by walking, private car and minibuses, whilst bus and rail usage is higher in others (Mbara & Celliers 2013). The NHTS education data are dominated by school trips and variations across provinces and university precincts are muted by their sample size. It is plausible that this national view of student mobility

aggregates the travel demand at university precincts, whereas travel demand and supply interventions are unique to each university. A focus on the LTP represents the sheer scale of learner mobility needs, and universities precincts could be left to the market given the relatively fewer number of students there. On the contrary, lessons from the university student mobility market may become useful policy inputs with outcomes that reach learners in an integrated transport market.

However, this level of integration is limited by the long-standing argument that transport policy-making in SA is performed through silos – disintegrated across modes and services (Walters 2008). Especially given the various stakeholders involved in the political process of policy-making, the limitations for effective policy are accentuated by how each public sector function is endowed, orientated, and the administrative boundaries between departments (Hull 2008). Whilst Mitchell and Walters (2011) allude to a bias towards policies related to roads, over public transport because of the non-linear nature of public transport policy, a more specific market like learner transport may have limited incentives to intervene.

The LTP is currently shared between the National Department of Transport and the Department of Basic Education, adding a layer of policy-making limits may emerge from the Department of Higher Education. Policy implementation requires movement of policy information, and the limitations described by Hull (2008), earlier, are burdensome to the effective exchanges related to formulating and implementing policies.

However, according to Dunn (2017), an integrated approach to policy analysis involves an understanding of how a policy performs with respect to a problem it is tasked to redress, and then determining the future needs related to the evolution of the problem. This informs the selection of policies used to intervene with respect to expected and observed policy outcomes. One of the key limitations found from an extensive literature review of studies in transport policy is that they are dislocated from the policy-making processes related to their findings (Marsden & Reardon 2017). From a transport policy-making perspective, it appears reasonable to argue that setting, or at least contributing to, an agenda for university student mobility in the context of SA is an appropriate point of departure. This combined with a systematic process to learn from international evidence related to managing university mobility could enable the appropriate selection of effective policies that are implementable.

Mobility management at South African universities

In SA, however, university student travel behaviour is under-researched even though universities tend to explore ways to cope with their access and mobility needs. A number of universities in SA developed unique and similar approaches to managing mobility. To connect students, university facilities and relevant activity centres, in 2016, 5 of the 26 large public universities had official *shuttle* services exclusive for university students and staff. In 2019, there are seven universities that have introduced such services into the public domain, and these are presented in Table 1.

The University of Witwatersrand offers bus services that are integrated with a mobile app connecting campuses and amenities (WITS 2016). The UP and the University of KwaZulu-Natal offer services that facilitate intercampus and inter-residence mobility (UKZN 2016; UP 2016). The UCT offers a bus service that connects campuses, residences and surrounding areas for off-campus students across neighbourhoods (UCT 2016). More recently, these services were expanded in the form of bike-sharing pilot programme in the form of a *Jammie Bike* and carpooling in the form of *RideLink* (UCT 2019).

The University of Stellenbosch offers a campus shuttle service supplemented by parking restrictions, and it provides a service after-hours to residences and the surrounding areas

TABLE 1: Mobility interventions in selected universities in South Africa.

Type of intervention	University of Cape Town	University of the Witwatersrand	University of Pretoria	University of KwaZulu-Natal	University of Stellenbosch	Nelson Mandela University	North-West University
Inter-campus	X	X	X	X	X	X	-
Inter-residence	X	-	X	X	X	X	-
Neighbourhood access	X	-	-	-	-	X	-
Minibus shuttle	X	-	-	-	X	-	-
Bus shuttle	X	X	-	X	-	X	X
Bike sharing	Pilot	-	-	-	X	-	-
Carpooling	RideLink	-	-	-	-	-	-
Lift club	-	-	-	-	X	-	-
Code of conduct	-	-	X	-	X	-	-
Mobile App	No	Yes (WitsM)		-	-	-	-
BRT connection	-	-	Pilot	-	-	-	-
Parking management	-	-	-	-	X	-	-
Dedicated official	-	-	-	-	-	X	-
Mobility and access plan	v	-	-	-	X	-	-
Single website	X	X	X	X	-	X	-
Citation	UCT (2019)	WITS (2019)	UP (2019)	UKZN (2019)	SUN (2019)	NMU (2019)	No website

BRT, bus rapid transit; UCT, University of Cape Town; WITS, University of the Witwatersrand; UP, University of Pretoria; UKZN, University of KwaZulu-Natal; SUN, University of Stellenbosch; NMU, Nelson Mandela University.

(SUN 2016). This was expanded with bike-sharing and is underpinned by a mobility and access plan that is tailored to each campus (SUN 2019). Literature on student mobility in SA is growing to reflect the emerging importance of this segment of mobility. One study of university student mobility indicates that off-campus students in the metropolitan area of Johannesburg have limited access to the university because of a lack of efficient public transport – although the service appears abundant (Mbara & Celliers 2013). Policy provisions for transport in the education sector are limited to the National LTP, which is oriented towards learners in the basic education sector (ages 5–18) (Government Gazette 2014). The lack of evidence related to the university students' segment in SA is problematic because the level of service needs, mode preferences and travel demand dynamics of a growing travelling population remain unknown.

International student mobility research

University students' travel behaviour and mode choice research are gaining significant interest for service design, university development and policy-making. Student populations tend to be significantly different from the general population in terms of motorised transport mode preference, value of time and the use of public transport (Danaf et al. 2014; Khattak et al. 2011; Limanond, Butsingkorn & Chermkhunthod 2011). For instance in Beirut, students are a unique mobility segment with different valuations of time than the general population, and they have a preference towards jitney (paratransit) over scheduled bus (Danaf et al. 2014:149). Whilst in Los Angeles, students' mode choice with respect to commuting distance is different from university staff (Zhou 2016). This may be because of the factors related to lifestyle factors within which mobility and access take place such as university timetables, proximity to the university and the difference between student and employed persons' commitments in general (i.e. age, marriage, children, larger stable income, etc.). Exploring this particular sub-group of the population is quite pertinent to transport planning in general, but more specifically to access to education.

In developed and developing countries, the differences between university student travel are not so clear. University students may be highly car captive as drivers or passengers and only 20% chose to use a bus in a rural university in Suranaree, North-Eastern Thailand (Limanond et al. 2011:169). Universities located in rural areas such as Northern Ireland seem to influence car dependence mainly because of the lack of student accommodation that is close to the university (Davison et al. 2015). However, the intention to purchase a car across eight countries is highest in two developing countries (Beruit and China) than in developed countries partly because of the social pressures of the inner circle, but more so because of the lack of good quality public and non-motorised transport alternatives (Belgiawan et al. 2017). In Los Angeles, an extreme case for car dominance, Zhou (2016) revealed that age influences mode choice between public transport and car use, Davison et al. (2015)

argued that car use influences the choice of accommodation and Belgiawan et al. (2017) also showed that car purchasing intentions are influenced predominantly by parents. At some point these university students will leave their parents' nest with certain commuting preferences formed. However, living on- or off-campus and living with relatives also influence the commuting patterns of university students, such that students commute longer distances when living with relatives probably because of the proximity to the university (Zhou 2016), whilst those living on-campus have an evidently much lower carbon footprint (Davison et al. 2015). University students' travel behaviour is not well understood in SA, although it may be a considerable generator of local area travel demand.

Understanding, managing and adapting student travel demand is gaining significant interest in transport service design, university precinct development and related policy-making. It is commonly found that student populations are different from the general population in terms of the following three major recurring themes: (1) motorised transport mode preference, (2) value of time and (3) the use of public transport, amongst other characteristics (Danaf et al. 2014; Khattak et al. 2011; Zhou 2016). In Virginia, Khattak et al. (2011) argued that students are unique because of their socio-demographics, trip-purposes and living conditions (on- or off-campus), which induce more frequent daily trips than the general population. For example, comparing university staff with students in Los Angeles (a car dominant city), students drive alone 15% less on average in terms of commuting distance; their mode choices are responsive to their level of study (undergraduates are more likely to use non-motorised transport); and the availability of a transit pass (Zhou 2016). However, these are cases in which students have access to private cars, and it is not necessarily the case in developing countries, like SA, which are confronted with *paratransit* services in addition to scheduled public transport. This does make one wonder if such an undertaking is relevant, as paratransit services follow commuter demand and thus may render the need to intervene as a negligible issue. However, given the evidence of universities in SA making efforts (Table 1), and international literature documenting some evidence, there is merit to explore the policy gap in SA.

Process of integrated policy analysis

Universities in SA have found ways to interact with the TDM needs, even without any specific policy basis as comprehensive as the LTP. Dunn (2017) argued that there is a difference between 'logic-in-use' and 'reconstructed logic'. University interventions in Table 1 are 'logic-in-use' because they flow from practices, whilst reconstructed logic is an abstract representation of the collective logic-in-use. The PIPA presented in Figure 4 is aimed at reconstructing the logic used in analysing public policy decisions. This analysis can occur prospectively or retrospectively and may
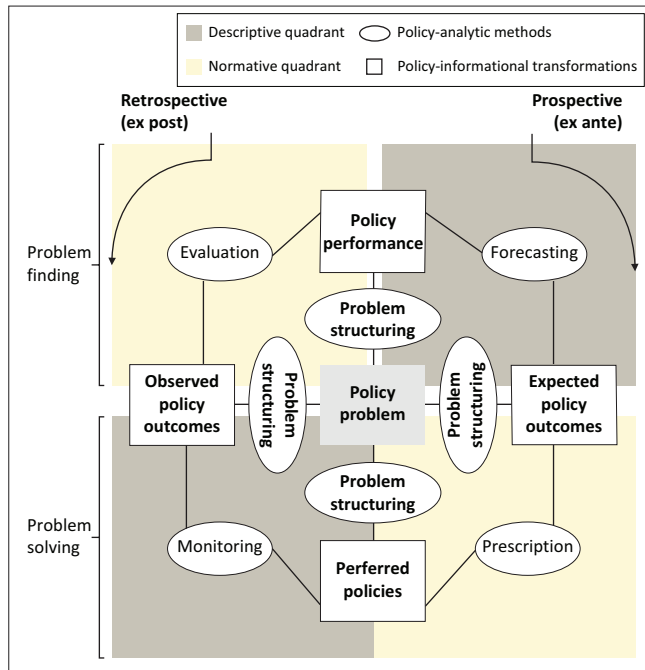
Source: Dunn, W., 2017, *Public policy analysis: An introduction*, Routledge, New York, NY.

FIGURE 4: The process of integrated policy analysis.

TABLE 2: Informational components and transformations for university student mobility.

Multidisciplinary knowledge for the PIPA	Description
Policy-informational transformations	
Policy problem	Managing university student mobility travel demand and a lack of policy framework
Preferred policies	Expansion of the LTP; or the formulation of a new policy; or policy inaction
Observed policy outcomes	Lack of policy action/programmes implemented in other countries
Policy performance	Impacts of interventions in other countries
Expected policy outcomes	Improvements in transport-land-use planning for the education sector
Policy-analytic methods	
Problem structuring	Approaches to university student mobility research
Monitoring	Research methodologies applied
Evaluation	Policy interventions
Forecasting	Expected impacts of policy interventions
Prescription	Policy recommendations and prescriptions

LTP, learner transport policy; PIPA, process of integrated policy analysis.

be used to find and solve problems through systematically structuring policy problems, determining the policy analytical methods applied to transform this structure into policy information.

The PIPA outlines five types of policy-informational components that contain specific information about the policy such as how it is structured, expected policy outcomes to redress the problem, preferred policies that should achieve the outcomes and the observed outcomes assessed in terms of how well the policy performs (Dunn 2017). Between each policy-informational component are the policy-analytic methods that transform the information from one component to feed into the next one.

When structuring a new policy problem, the policy-informational components transform how the preceding policy performed into expected policy outcomes by structuring the problem in a manner that enables previous performance to forecast future performance. From the forecasts, expected policy outcomes are prioritised by the structure of the problem, and courses of action are prescribed. Preferred policies are crafted based on the prescriptions and they need to be monitored to measure the observed outcomes of a policy decision. These outcomes are then evaluated to transform the observation into an assessment of the policy's performance. This cycle is ongoing, but it is dependent on policy-related information transformed by the policy-analytic methods based on the structure of the problem. Given the policy gap in the student mobility context, observing international evidence may serve as an informational input to this analytical process. The informational components, their transformation and

policy-analytic methods for university student mobility are described in Table 2.

Recall that this study aims to contribute to the agenda-setting process by highlighting the policy needs in the university student mobility context. Kingdon's Agenda-Setting Model postulates that government agenda is a result of three streams through which a policy window would result in a policy being preferred and adopted (Anderson 2006). The streams interact as stakeholders want certain problems to be considered (problem stream); various solutions are proposed, assessed and debated (policy stream); and 'election results, changes in presidential administrations, swings in public moods and pressure-groups campaigns' (politics stream) (Anderson 2006:90). The lack of an explicit account of university student mobility whilst growing demand is central to the problem stream. As the LTP only focuses on learners, there are various categories of post-school education facilities that may each offer unique travel needs; this is a policy gap. Finally, given the upsurge of public unrest associated with university student needs from accommodation to lower fees, the political realm is influential.

In a review of transport policy studies, empirical evidence without locating it within the policy-making process of the country or region in question is common practice (Marsden & Reardon 2017). To avoid this pitfall, the PIPA is applied to analyse university student mobility research with regard to policy recommendations, proposed interventions, approaches to monitoring and actual programmes implemented to manage travel demand. International evidence is then used to inform local policy recommendations. In doing so, a suitable policy agenda may set, and further research, interventions and policy reforms could be identified.

As a conceptual point of departure, this study focuses on the findings from monitoring and evaluation-related evidence in academic literature because the preferred (current) policy is

TABLE 3: Literature reviewed by focus area and methods.

Focus area	Source	Method applied
Mode choice	Nguyen-Phuoc et al. (2018)	Conditional logit model
	Danaf et al. (2014)	Multinomial logit model
	Daisy et al. (2018)	Count data modelling
	Davison et al. (2015)	Statistical analysis (cross-tabulation, chi-squared tests, *t*-tests and ANOVA)
	Zhan et al. (2016)	Hierarchical tree-based regression (chi-squared automatic interaction detection)
	Limanond et al. (2011)	Travel diary
Travel demand management policies and strategies for universities	Boyd et al. (2003)	Descriptive statistics, trip conversion rates, modal split analysis
	Aoun et al. (2013)	Literature review
	Barla et al. (2012)	Discrete choice modelling
	Rotaris and Danielis (2014)	Mixed logit model
	Rotaris and Danielis (2015)	Cost–benefit analysis and social costs
	Shannon et al. (2006)	Bi-variate and multi-variate analyses
	Gurrutxaga et al. (2017)	Likert scale survey
	Longo et al. (2015)	Analytic hierarchy process
	Brown et al. (2001)	Systems analysis
	Zhou (2016)	Multinomial logit model
	Molina-García, Castillo and Sallis (2010)	Structural equation modelling
Travel behaviour modification	Kerr, Lennon and Watson (2010)	Hierarchical multiple regression analysis, MANOVA
	Zhou et al. (2018)	Multinomial logit model, nested logit model
	Van and Fujii (2011)	Principle component analysis with varimax rotation
	Bamberg, Hunecke and Blöbaum (2007)	Structural equation modelling
	Belgiawan et al. (2017)	Ordered hybrid discrete choice model on Python BIOGEME
	Muromachi (2017)	Ordered Probit model

the LTP, and an observable outcome is that university mobility is not catered for. Inaction on an issue by suppressing, ignoring or not knowing its existence is in policy terms a *non-decision* (Anderson 2006). Following the PIPA, a systematic literature review is conducted to formulate policy frameworks that enable effective agenda-setting and implementation mechanisms that underpin the PIPA. The non-decision in the case of university student mobility in SA may have a place in the policy agenda; however, inaction may be explained by the relatively small size of the market, especially when compared with basic education mobility needs. Based on this argument, the informational components and transformations shown in Table 2 are used to systematically review the literature presented in Table 3 and are used to guide the discussion of results.

Ethical consideration

The authors confirm that ethical clearance was not required for this study.

Results

In Table 3, the 22 studies related to university mobility were reviewed. Although more recent evidence exists, some studies were chosen because of their seminal nature in the student mobility research environment (Boyd et al. 2003;

Brown, Hess & Shoup 2001; Shannon et al. 2006). The results are discussed through the PIPA framework based on the *informational transformations* given that this study is a systematic literature review.

Problem structuring, monitoring and forecasting

It is found that interrelationship between problem structuring, monitoring and forecasting is evident in the studies reviewed. Approaches adopted by the studies reviewed are varied, and each one informs the methods adopted to explore the problem. Firstly, the methods applied are quantitative because of the underlying premise that travel demand models should primarily enable statistical forecasts because they change the performance of market actors. Secondly, they influence conjectures with similar assumptions because of their empirical nature, and thirdly with longer term practices judgemental forecasts where the contexts are similar may be possible (Anderson 2006; Dunn 2017). Problems were structured around mode choice, and studies that focused on this phenomenon specifically form the basis for monitoring and forecasting.

Mode choice

Studies on mode choice were categorised based on their focal point being on mode choice. Mode choice research outlines the various factors that influence how students make travel choices through understanding their preferences, and they find that the value-of-time of university students is different from the general public (Danaf et al. 2014:149; Limanond et al. 2011). In addition to expanding area-wide public transport networks, improvements in public transport ranging from the interior, to service quality and reliability, and the modal network interfaces between NMT and PT, and accounting for differences in gender, enhance the preference towards student mobility (Davison et al. 2015; Nguyen-Phuoc et al. 2018). Trip generation rates need to be included for university students, staff and faculty. This will enable 'practical and strategic planning solutions to promote walking and biking-friendly environment near and on campus and enhance management of on-campus demand' (Daisy et al. 2018), particularly because trip generation influences travel frequency and this is dependent on spatial, income and modal determinants that enable analysis and forecasting for various mode choice interventions (Zhan et al. 2016). Mode choice analysis in the university setting requires context-specific survey design to suit the university student and staff community – which may deviate from the general public.

Travel demand management

Studies on TDM were categorised based on their interest in shifting and testing shifts towards other transport modes and introducing various interventions to do so. Unlimited Access is an approach to inducing travel demand for public transport through a university student and staff 'discount', but it creates a lock-in effect for the public transport operations in general because of the Mohring effect (Brown et al. 2001). On

the contrary, the effect of free or subsidised university transport is most effective to students who are within the routes it affects, and thus introducing services appropriately has a significant impact on shifting students' travel behaviour (Barla et al. 2012; Boyd et al. 2003). On either end of the extremes, TDM measures seem most effective when they are used in unison with others (Limanond et al. 2011; Rotaris & Danielis 2014). Shannon et al. (2006) proposed integrated interventions that blend transit subsidies, additional routes, integrated pedestrian and cycling networks, a clear information platform and an unlimited access transport service in addition to increased student housing.

There are cases where fully subsidising public transport may not be feasible. Rotaris and Danielis (2015) proposed that assessing combined effect of TDM alternatives should be accompanied by determining their level of acceptability and feasibility. For instance, improving the provision of safe non-motorised transport infrastructure, educational programmes and reducing car use through parking fees combined may encourage active mobility (Molina-García et al. 2010). Barla et al. (2012) found that improvements in trip characteristics, such as travel time, ticket and parking costs, are much more effective in managing travel demand. According to Aoun et al. (2013), managing parking and formulating the appropriate approach to public transport pricing are important trade-offs. They also found that shift towards low-occupancy modes may be more effective for high-income earning university students who are exposed to a significant car culture (Aoun et al. 2013). This places emphasis on studies which find that group- or segment-specific interventions should also be understood (i.e. the impact on gender on student travel behaviour (Zhou 2016)). From a spatial planning perspective, the same principle applies to context specificity in network design for different transport modes, and it should be responsive to its proximity to the university's location (Zhan et al. 2016). In terms of student housing, increasing the affordability of housing near public transport networks and stops can increase transit use (Zhou 2016). From the literature, interventions vary depending on context, land-use, modal split and the nature of the public transport system. From the above literature, TDM measures to improve the level of service quality and service characteristics in conjunction with other interventions yields results that could be forecasted and monitored against the expected policy outcome.

Behaviour modification

Behaviour modification studies are those that focus on attitudinal or psychological variables in structuring the transport problem they measure and intervene upon. This theme is an extension of mode choice and TDM that includes psychological variables. One study finds that reducing the social acceptability of students using cars or increasing normative pressure to use other methods to commute could be used to inform psychological and physical barriers that cause students to reassess their mode choices (Kerr et al. 2010). In line with the preceding section for TDM, bundling

behavioural interventions is a key mechanism for inducing sustainable mobility. Interventions should combine the influence of peers, proximity to campus and quality public transport modes, whilst balancing supply and demand in such a way that the unmet needs which induce car use are curbed (Zhou et al. 2018). Van and Fujii (2011) found that public transport promotion in a student setting that targets symbolic, affective and instrumental attributes of public transport may contribute to lowering the trend for strong passions towards cars in developing countries through behavioural interventions that are suitable for each country's characteristics. By using social norm variables and psychological indicators to modify behaviour, Bamberg et al. (2007) recommended that campaigns to promote behaviour change should be informed by the psychological constructs. Belgiawan et al. (2017) extended this by highlighting the need to decouple student travel from car use in developing countries, but 'one cannot change social norms unless the public transport system has a sufficient quality'. To extend the effect of mode choice modelling and TDM interventions, complementing student mobility management interventions with behavioural variables reinforce the effort towards a policy priority. This harnesses a multi-dimensional approach to structuring the policy problem and identifying how the effects of policy outputs are forecasted and monitored over time, possibly creating a more complex process of analysis because of the multidisciplinary nature of the evaluation process.

Problem structuring, evaluation and prescription

Although problem structuring is a key theme, it is a product of the process of transforming information throughout the policy-making process. The previous subsection focused on evidence in the literature related to how the problem is structured (mode choice, TDM or behaviour change) and the outcomes that can be measured and forecasted. This section focuses specifically on the outputs, as in the specific TDM measures implemented and their outcomes. Whilst voluntary and non-voluntary interventions are found, it is also found that they are implemented through coordinated efforts. The review finds that mobility management is an important part of coordinating the local authority, transport and travel needs in and around the university precinct. It is the role of the mobility management structure to generate policy recommendations that produce the desired outputs and outcomes for all stakeholders involved. The effects of these interventions are what drive their evaluation, and the coordination of multiple stakeholders is what informs the policy recommendations and priorities for student mobility and access.

Voluntary interventions

Boyd et al. (2003) reported on the BruinGo programme, which is a one-tap transit service for staff and students and has yielded significant ridership effects, and remains active to-date. This is part of U-Pass presented by Shannon et al. (2006) and has spread across universities in the United

States and Canada. These Unlimited Access schemes effectively create a reinforcing loop in favour of public and non-motorised transport use because the additional patronage resulting from the U-Pass, SuperTicket or ClassPass mechanisms induces higher load factors and greater economies of scale (Brown et al. 2001). They are not independent of local public transport services because of the interdependence in welfare gains as a result of the high-load factors when these schemes are part of the local operations. More recent cases can be complemented by carpooling services such as Zimride (Zhou 2016). In their most extreme permutation, the public transport provided is fare free and is largely subject to the frequency, network design and route structure (Barla et al. 2012; Limanond et al. 2011). Unlimited Access schemes are voluntary TDM measures, attracting users through an interplay of service offerings that reinforce each other.

Non-voluntary interventions

There is, however, evidence of hard TDM measures that push users towards sustainable mobility alternatives. The interplay between pricing parking for students and staff whilst providing affordable and frequent integrated public and non-motorised transport alternatives is highlighted in the literature. Some argue that charging parking fees and providing a shuttle-service are suitable (Danaf et al. 2014), whilst another proposes that supplementing this intervention with a digital platform can induce an efficient shift (Aoun et al. 2013). Other studies reveal that university property could also be enclosed and car use restricted (Van & Fujii 2011), thus, creating a controlled environment for mobility and access. The non-voluntary TDM measures demarcate travel behaviour, but can provide alternatives within a certain threshold, and provide an option for those willing to pay to make travel choices outside of the demarcated behaviour. Implementing these measures requires coordination within higher education institutions and external partnerships.

Mobility management at universities

Partnerships between the transport authorities and university management place impetus on a mobility management team within higher education institutions. One example of a multi-dimensional team is Cyride public transport system in Ames, Iowa. It is a partnership between the City of Ames, University of Iowa, and the student governing body of the university (Zhou et al. 2018). According to the literature designing, developing and implementing transport interventions require a dedicated Mobility Manager or a Mobility Management Team (Gurrutxaga et al. 2017; Longo et al. 2015; Rotaris & Danielis 2014, 2015). Through appropriate mode choice methods, TDM measures and their effects can be estimated in advance to inform policy priorities and decisions of mobility managers (Rotaris & Danielis 2014). These assessments can be used to inform and develop a comprehensive Mobility Management Plan, which should guide the planning priorities within and beyond the

university precinct (Gurrutxaga et al. 2017:243). Multi-criteria decision-making approaches may enable the mobility manager to balance the interests of experts, users and decision makers when selecting appropriate solutions and cultivating mutual understanding (Longo et al. 2015). It is apparent that the mobility manager's primary role is not only to administer the operations of public transport, but instead to manage multimodal travel demand within the context of the local transport authority's plans and potentially enhance the mobility and access gains through land-use decisions as well.

Conclusion

This article describes the transport policy environment for student travel behaviour through the PIPA, with the primary aim of outlining the major directions of student mobility management from peer-reviewed literature.

Research gaps in South Africa

Through the PIPA process, three major gaps are identified. Firstly, the transport policy environment for university student mobility in SA seems to lag behind the interventions that universities have embarked upon. Secondly, international evidence reveals that multiple directions for managing travel demand around university precincts are plausible, and each of these has the potential to inform the policy design for student mobility management in SA. Thirdly, the heterogeneity of contexts and techniques to specify mobility and access problems and redress them enhance the quality of policy design, evaluation and implementation. However, with the policy scene described in this article, further research should explore the mobility managers' responsibilities, the impact of mobility planning and student travel behaviour in response to university interventions. By observing the research area through a selected cluster of studies, this study's conclusions are limited to the South African policy context.

Integrated policy analysis

Policy problems in transport are identified through the process of integrated transport planning. In SA, this is guided by the *Minimum Requirements for Integrated Transport Plans* published in 2016. Monitoring and forecasting of university student mobility travel demand purport unique dynamics associated with mode choice, responsiveness to TDM measures and propensity to respond to behaviour modification. University students offer a unique opportunity to reform travel habits of future car owners through exposure to sustainable mobility options. However, this requires a concerted effort to focus on the university mobility market as part of integrated transport planning. One approach could be to increase the sample of university based commuters, over their aggregation into the general population.

Evaluating policy decisions and formulating recommendations take shape through the assessment of voluntary and non-

voluntary interventions. Studies provided a number of unique interventions, but in the literature review, a mobility management plan that is coordinated by a mobility management team was highlighted. The mobility manager is responsible for evaluating and formulating the recommendations based on the appraisal of interventions. As a result, new interventions or changes to existing efforts could be a product of the coordinated efforts between the university, student council, transport authorities, transport operators in the area, land-use development, law enforcement and other stakeholders. However, the literature suggests that the mobility manager is led by both the needs of the Integrated Transport Plan (ITP), service efficiency, and student mobility and access needs. The execution of transport plans is subject to procurement activities which lead to the development and implementation of such plans.

Recommendations

Changes in integrated transport planning practices are necessary, particularly for cities and towns with universities in their jurisdiction. This requires appropriate output specifications for transport operators, authorities and universities to be coordinated and aligned. Managing travel demand for university precincts can be performed in numerous ways, but the role of the mobility management plan and mobility manager in coordinating the function appears to be a prerequisite for policy effectiveness.

In essence, there is also a gap in the direct legislative prescripts that describe university student mobility. The literature describes approaches that are embedded in local operations, such as Unlimited Access, but seldom describes services that are exclusive to university students (other than evening services). Further research is necessary to explore the scope of the operations in various scenarios and to identify the responsible entity for designing, financing and administering the contract associated with the operations – particularly in a multimodal network. Finally, exploring the potential impact of e-learning and online offerings for post-school education may enable further analysis of telecommuting and its impact on travel demand, particularly for university students.

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Authors' contributions

O.H.M. conducted the research, and M.Z. supervised the study.

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