AI-supported Skills Elicitation, Guidance, and Personalized Matching

Jasmin Baier, with Christian Meyer
University of Oxford and Tabiya

Implementing Partners

Funding Partners

Building Evidence While Building Solutions:
Our Ongoing Research in AI-Supported Employment Systems

- Today we are sharing **ongoing research** that is **embedded directly into Tabiya's implementation work** with partners in South Africa and Kenya
  - We're inviting feedback while our studies can still adapt—shifting from post-hoc evaluation to collaborative learning
- We develop theoretically grounded **graph-based matching** based on skills elicitation from unstructured text (conversations with AI & semi-formal job descriptions)
- **Two RCTs** examining different applications:
  - How AI can enhance skills-elicitation matching and correct labor market beliefs (South Africa, Harambee Youth Employment Accelerator / SAYouth.mobi)
  - The quality and effectiveness of AI-powered vs. human career guidance (Kenya, Swahilipot Hub Foundation)

About Tabiya (⟶ tabiya.org)

Open-Source Solutions for Economic Opportunity in LMICs

- Tabiya is a non-profit spin out from the University of Oxford
  - *Mission:* Build and share open-source tools for labor market applications
- Interoperable, integrated data systems to link demand- and supply-side data:
  - Basis for all tools: Structured occupation and skills taxonomy (ESCO based) that captures informal and traditionally "unseen work" including care work
  - Skills elicitation, CV building, vacancy processing, and matching tools
  - Connectors with CRM systems and existing digital public infrastructure
  - *Today's focus:* **GenAI-supported conversational agents and matching**
- Everything open-source, freely available for governments, NGOs, and researchers to adapt and improve

Broader Policy Context and Literature
From Credential-Based to Skills-Based Hiring and Matching

Skills-Based Hiring: US employers (Google, IBM, Delta) and states removing degree requirements
- HICs: Promises more equitable access, addresses talent shortages
- LMICs: Opportunity for recognizing informal economy skills (60-90% of work)—street vending, domestic work, agriculture, care work

Evidence on Barriers
- **Information Asymmetry**: Key barrier is credible skills signaling. Verifiably demonstrating skills leads to employment and earnings gains (Carranza et al., 2022) – not realistic at scale
- **Pronouncement-Practice Gap**: Despite policy changes, hiring outcomes have not shifted. Degrees still proxy for unobserved attributes (Fuller, Langer & Nager, 2024) – what are alternatives?

Where AI Could Help (or Harm): Signal deteriorating but skill-leveling?
- AI compresses skill distributions (Brynjolfsson, Li & Raymond, 2023), but also reduces skill signal to noise ratio (Wiles & Horton, 2025).
- Training of recommender systems (esp. content-based & collaborative filtering) often encodes human biases (Zhang & Kuhn, 2022)
- Our taxonomy makes "unseen" informal competencies visible and matchable

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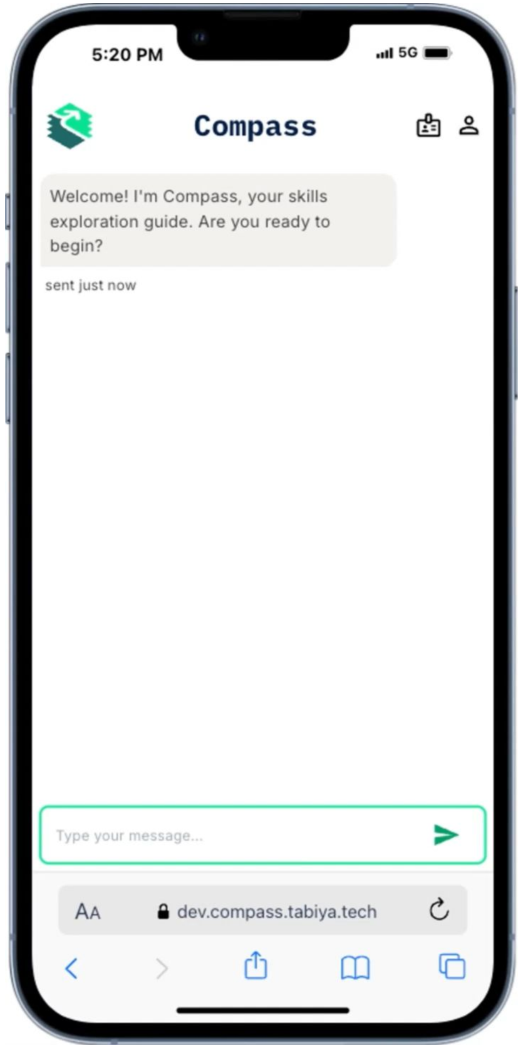
Skills Elicitation, Extraction, and Graph-Based Embeddings for Matching

Two-Sided AI-Taxonomy-Linkage

Labor supply

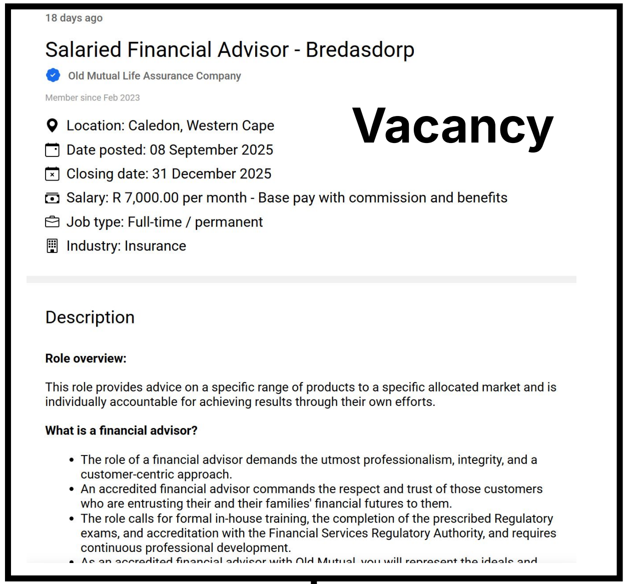


Taxonomy Bridge

Full Skills Entity

Skill	ESCO code	Skill Type	Occupation
		Knowledge	
		Competence	
		Language	
		Attitude	

Labor Demand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Salaried Financial Advisor - Bredasdorp

Old Mutual Life Assurance Company

Member since Feb 2023

Vacancy

Location: Caledon, Western Cape
Date posted: 08 September 2025
Closing date: 31 December 2025
Salary: R 7,000.00 per month - Base pay with commission and benefits
Job type: Full-time / permanent
Industry: Insurance

Description

Role overview:

This role provides advice on a specific range of products to a specific allocated market and is individually accountable for achieving results through their own efforts.

What is a financial advisor?

- The role of a financial advisor demands the utmost professionalism, integrity, and a customer-centric approach.
- An accredited financial advisor commands the respect and trust of those customers who are entrusting their and their families' financial futures to them.
- The role calls for formal in-house training, the completion of the prescribed Regulatory exams, and accreditation with the Financial Services Regulatory Authority, and requires continuous professional development.

Fine-tuned BERT classifier

NLP

LLM-reranker with full context

LLM

Technical Approach
Graph-Based Embeddings for Skills Matching (1/2)

Challenge: Keyword-based matching is inefficient – no accounting for skill transferability, hierarchies, distances between capabilities<>requirements

Objective: Develop data-driven measure of skill proximity for users

Methodology:

1. **Graph Representation:** Taxonomy as multi-relational graph (skills = nodes, relationships = edges)
2. **Learn Embeddings (Node2Vec):** Generate high-dimensional vectors via random walks; skill meaning revealed by network neighborhood/context, not just its label or definition
3. **Match Score Calculation (extending Bied et al., 2023):**
    - Cosine similarity of embeddings to calculate distances between jobseeker **`j`** & opportunity **`o`**
    - Calculate utility score **`U`** ("fit") using coverage across essential/optional skills and skill groups
    - Calculate vacancy side success proxy **`p`**
    - Get final job seeker ranking: `rankscore(u,j) = U(j,o) x p`

Delivery: 2-sided skills elicitation via Chatbot with agentic AI orchestrating (Google Gemini on GCP), BERT classifiers, and context-aware LLM re-rankers

Technical Approach

Graph-Based Embeddings for Skills Matching (2/2)

Formally, inspired by Bied et al. (2023), we define skills coverage (Cov) across essential skills (Ej), optional skills (Oj), and skillgroups, where κ represents proximity = cosine similarity of skill embeddings.

$$\mathrm{Cov}_{\mathrm{ess}} = \frac{1}{|E_o|} \sum_{s \in E_o} \kappa_{j,s}, \qquad \mathrm{Cov}_{\mathrm{opt}} = \frac{1}{|O_o|} \sum_{s \in O_o} \kappa_{j,s}. \tag{1}$$

$$U(j,o) = \theta_{\mathrm{ess}}\, \mathrm{Cov}_{\mathrm{ess}} + \theta_{\mathrm{opt}}\, \mathrm{Cov}_{\mathrm{opt}} + \theta_{\mathrm{grp}}\, \mathrm{SkillGroupRecall}, \tag{2}$$

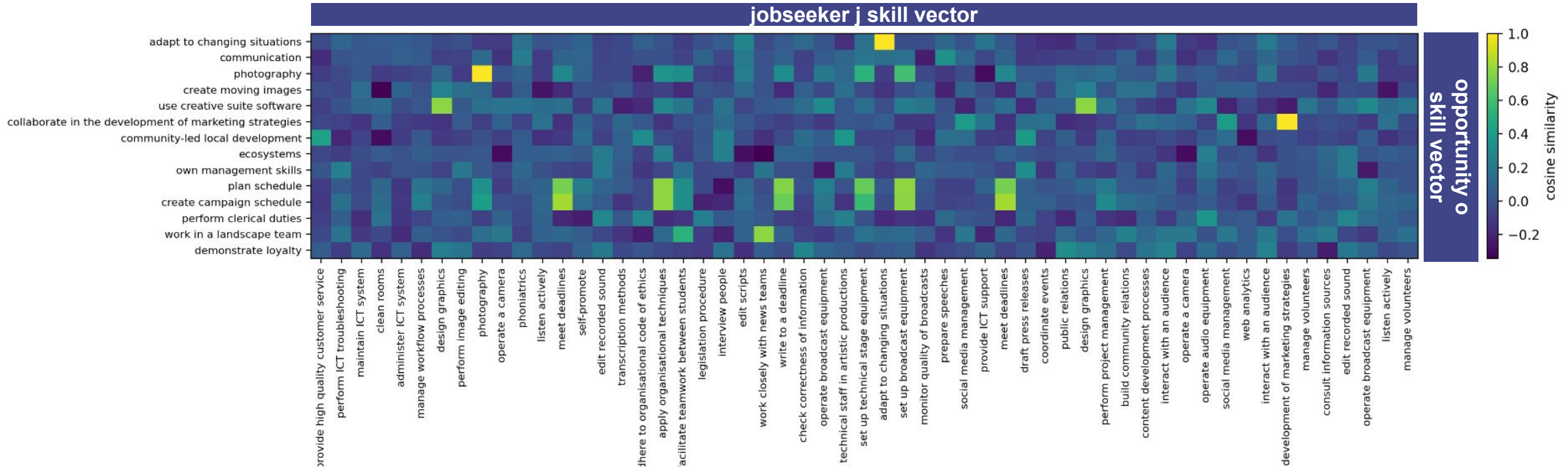
where SkillGroupRecall (0–1, rewards breadth across competency areas) = share of required skill-groups with any skill member at d≤1 i.e., an exact match (d=0) or a one-hop hierarchy neighbor (d=1).

$$\hat{p}_o = \mathrm{OSI}_{o,\ell} \times s_o. \tag{3}$$

where OSI is an opportunity supply index at a given location, and so represents opportunity staleness.

$$\mathrm{rank\_score}(j,o) = U(j,o) \times \hat{p}_o. \tag{4}$$

Matching: Example



Jobseeker	“Communications and Marketing Intern”	Opportunity	κ
photography		photography	1.0
collaborate in the development of marketing strategies		collaborate in the development of marketing strategies	1.0
meet deadlines	manage time	plan schedule	0.82
set up broadcast equipment	set up equipment in a timely manner ↔ manage time	create campaign schedule	0.71
design graphics	graphics editor software	use creative suite software	0.77
work closely with news teams	work in teams	work in a marketing team	0.77
adapt to changing situations		adapt to changing situations	1.0
⋮		⋮	

Two Empirical Applications

Two Implementation Contexts, Two Matching Challenges

Labor supply

Labor demand

South Africa (national)

AI-facilitated **skills elicitation** and its signalling effects

Skills-based matching & aggregate competitiveness information

Repository of ~4,000 entry level jobs (from SAYouth.mobi API) mapped to taxonomy

Kenya (Mombasa)

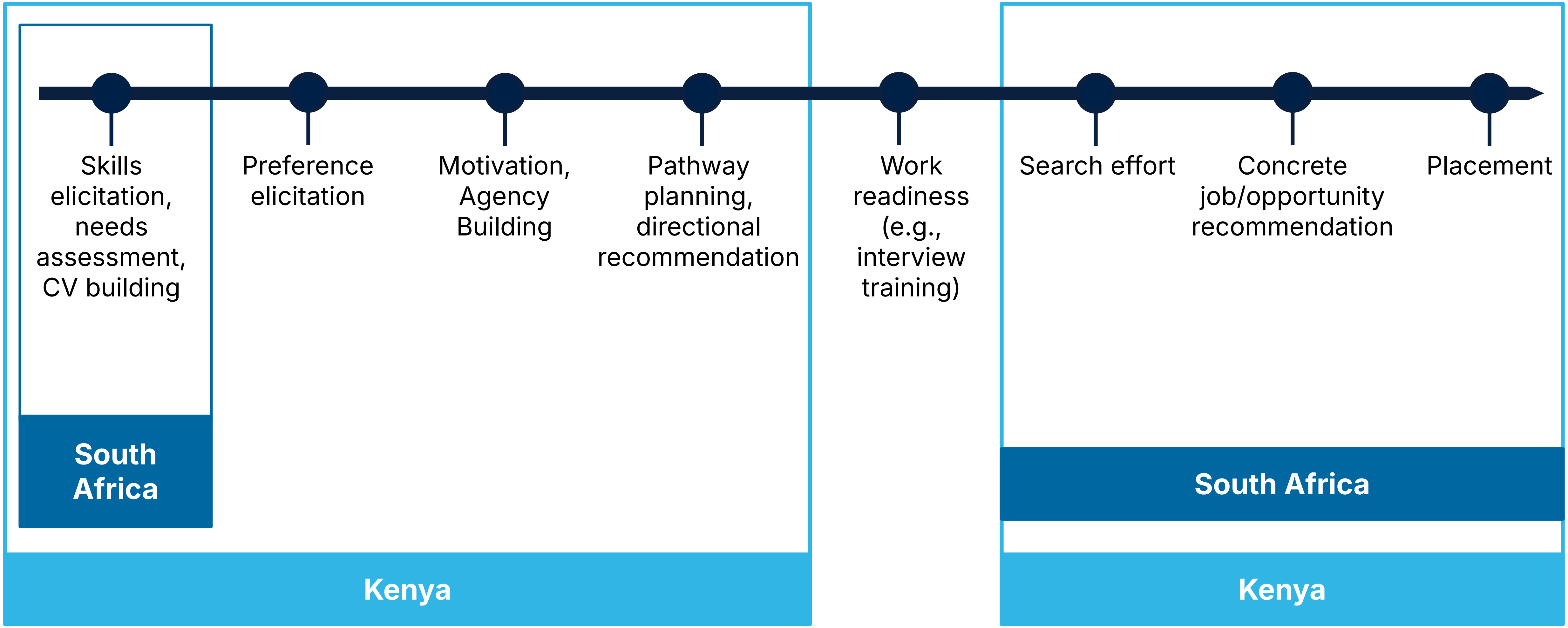
AI-facilitated career guidance, agency building & **recommendation,** compared/complemented with human advice

Human counselors

Recommendation and quality of advice

Semi-formalized collection of training opportunities, pathways, and concrete jobs

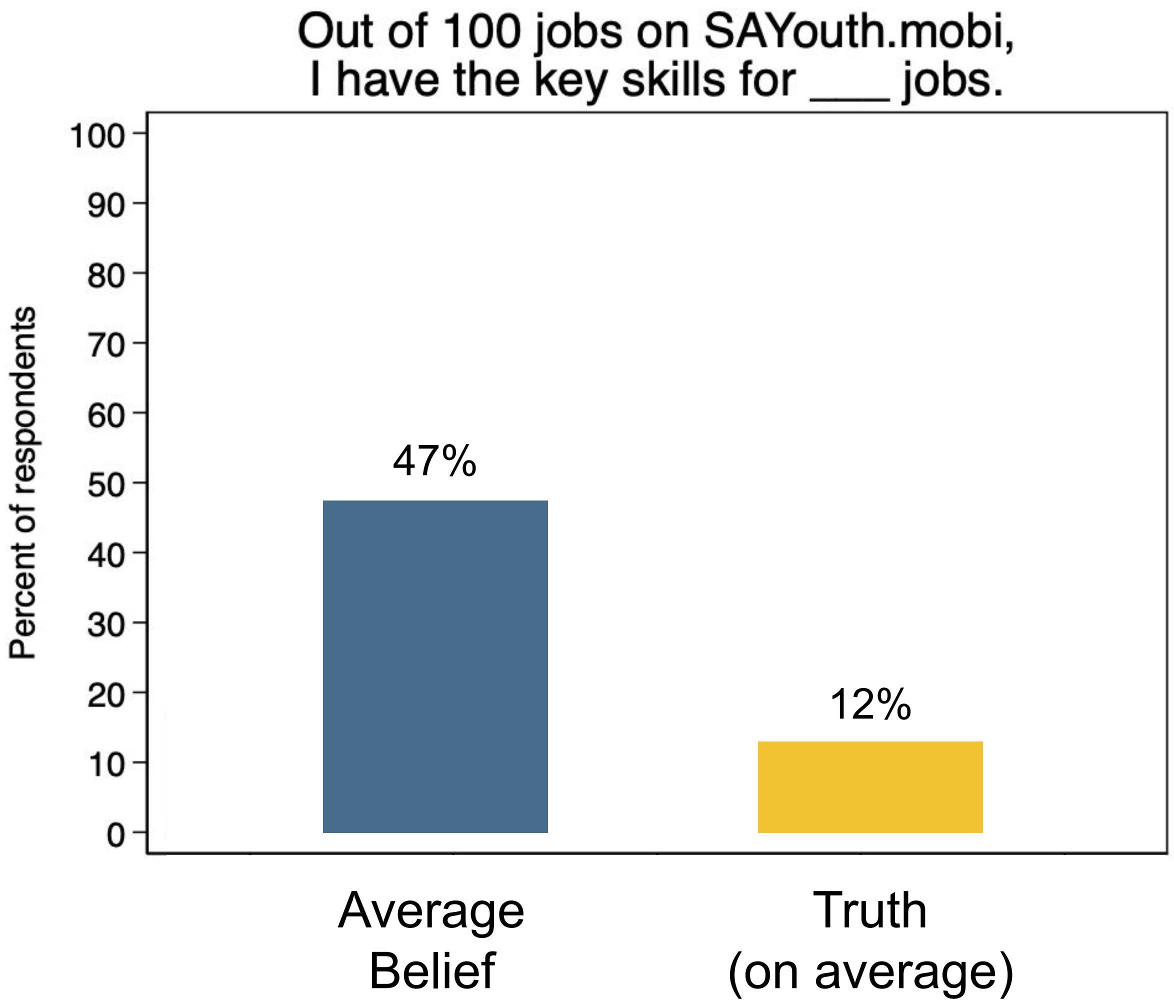
We Intervene at Different Moments of the Jobseeker Journey



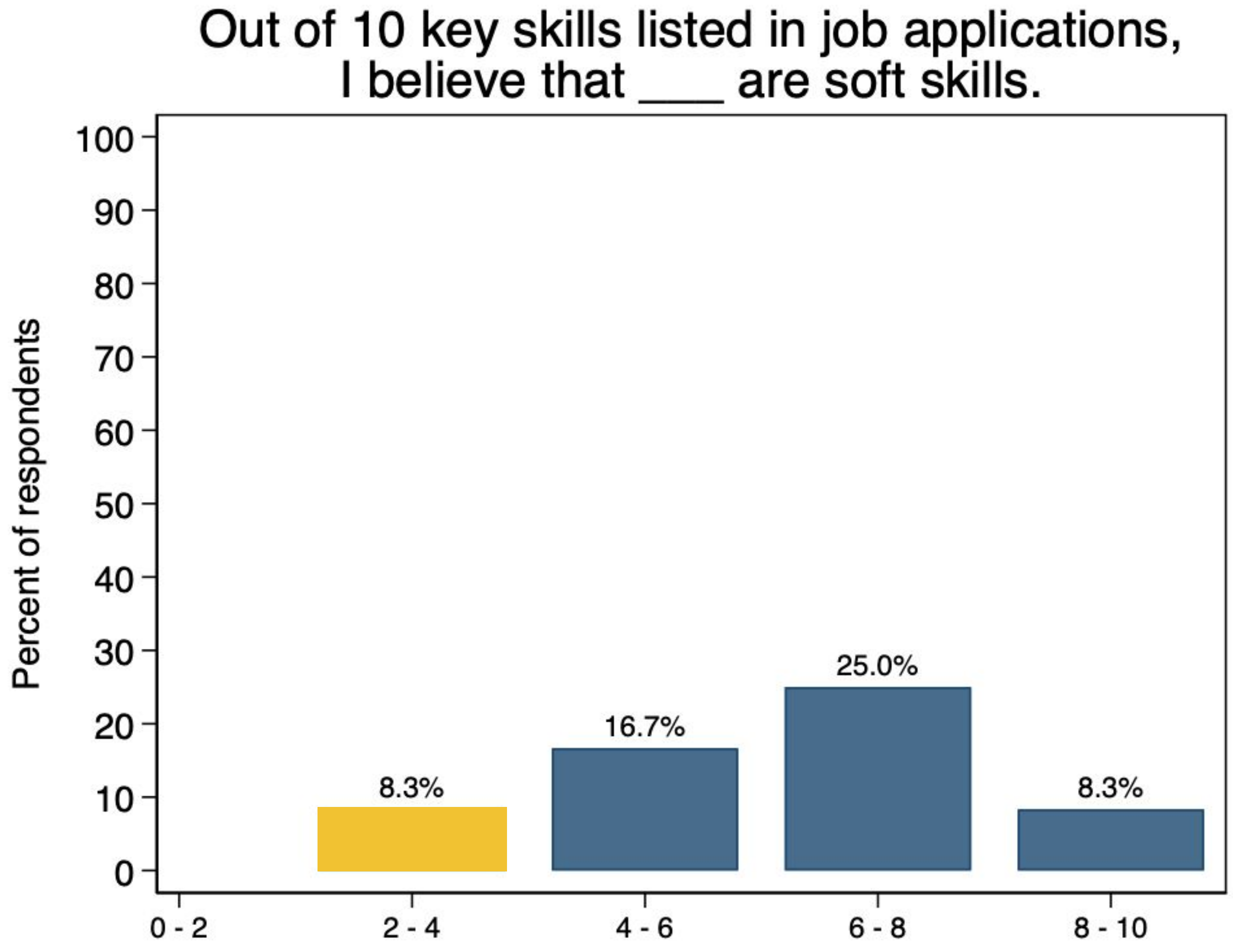
Intervention: Agentic AI system

Outcome Measurement

South Africa: Pilot Data on Beliefs and Preferences

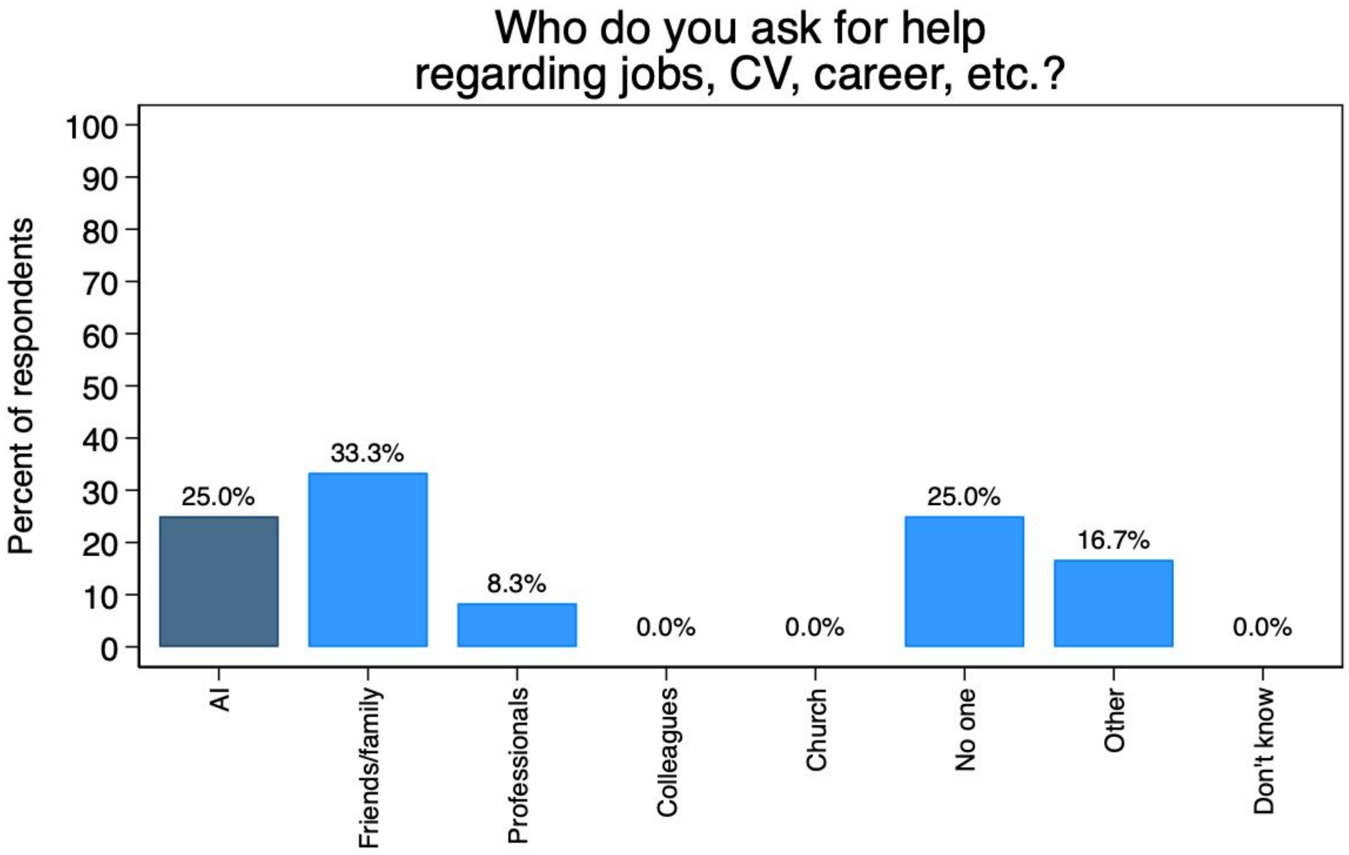


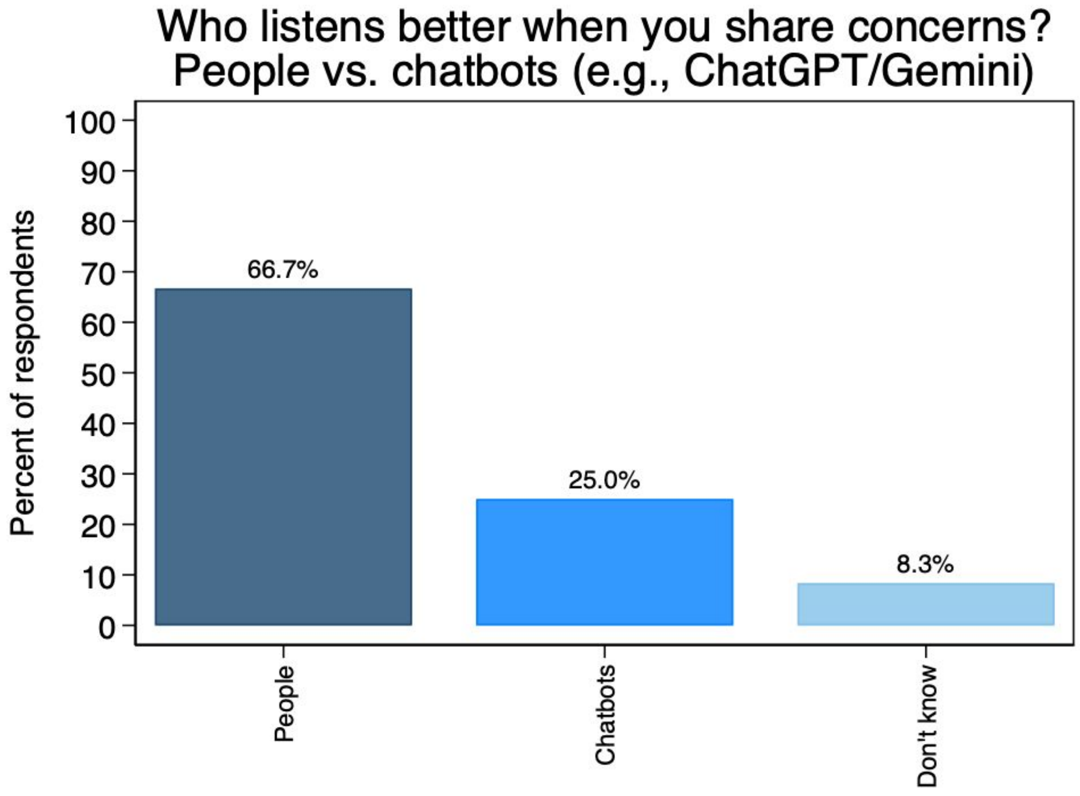
South Africa: Pilot Data on Beliefs and Preferences



In our current database of entry level jobs posted on Harambee's SAYouth.mobi, on average ~8% of key demanded skills are soft skills.

South Africa: Pilot Data on Beliefs and Preferences for AI-based guidance





Kenya: Recommendation Focus, Test Against Humans

Motivation: Mentorship addresses search costs, information asymmetries, and uncertainty in human capital investment decisions – but quality mentors don't scale

Conceptual Frame: Real option theory, learning under uncertainty, preference discovery vs. eval

- Under uncertainty → invest in transferable skills (theoretical basis for recommendations)
- θ = latent preferences/constraints; S = option set; $u(\theta,x)$ = utility
  - **Discovery:** Improve identification of θ, expand S (youth often only see narrow paths)
  - **Evaluation:** Better predict (θ,x) → outcomes and rank options

Core Questions:

1. Do AI recommendations complement or substitute human mentors?
2. Who better surfaces preferences – and with what biases?
3. What type of guidance increases agency under low self-efficacy?

Design: Cross-randomize feedback to humans/AI; compare Human vs AI vs Hybrid arms

- Outcomes: Search breadth, skill investments, placement, retention, earnings
- Mechanisms: Belief updates, agency, confidence, advice uptake, perceived constraints

Kenya: Qualitative Insights on AI for Career Counseling

Perceived Risks

- **Signal inflation**: AI CV-polish leads to documents looking the same → Employer shift to referrals → Exclusion risk
- **Cultural misfit**: Models may feel “not Kenyan,” can’t reference local anchors (e.g., chief)

Perceived Opportunities

- **AI as infrastructure**: Data plumbing + mentor co-pilot increases mentor throughput and interview rates, even without changing youth skills
- **AI as for work readiness:** Coaching for language, behavior, dresscode & interview skills
- **Pathway discovery**: Map transferable skills to adjacent roles; aggregate local opportunities.

Perceived Limitations

- **AI as mentors:** Mentors themselves **do not** believe that AI can replace them; they mention that personal relatability and authentic shared experience is key
- **Lacking Accountability**: If reminders and feeling accountable to a person drives effort → AI may not succeed
- **Referral economy**: Employers prefer intros over platforms; “mindset” often trumps formal skills

Summary of Approach and Next Steps

- We develop open-source **graph-based skills matching** via conversational AI
  - Moves from heuristic to **learned, quantitative skill distance** based on taxonomy
  - Uncovers non-obvious matches via vector-space proximity of transferable skills
  - Fully interpretable – decomposes matches to show exact skill substitutions
  - Theoretically grounded (Bied et al, 2023) and informed by both sides of the market
- We implement and evaluate in **two contexts for improved matching & recommendation**
  - In South Africa, we support jobseekers with AI-facilitated skills elicitation and CV building, preparing them for more targeted search and signalling.
  - In Kenya, Youth faces limited information and symptoms of learned helplessness – requiring personalized mentorship. With humans being the bottleneck, AI-facilitated pathways planning may relieve constraints more effectively than simple signalling.
- Expect **first results in late January 2026**

Thank you

We'd love your feedback and welcome collaboration opportunities.

Get in touch:

jasmin.baier@bsg.ox.ac.uk
christian.meyer@tabiya.org | www.tabiya.org